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Shannon Technology and Energy Park (STEP) Power Plant

Environmental Impact Assessment Report - Volume 2

Chapter 03 Need and Consideration of Alternatives

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Delivering a better world

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3. Need and Consideration of Alternatives

3.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) sets out the need and reasonable alternatives, and the design progression that has been considered during the evolution of the Proposed Development.

Schedule 6 to the Planning and Development Regulations 2001, as substituted by Article 97 of the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018) (the 'EIA Regulations'), states that the EIAR should contain '*A description of the reasonable alternatives studied by the person or persons who prepared the EIAR, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the proposed development on the environment'.* This chapter recognises and fulfils this requirement in respect of the Proposed Development.

This does not impose a general requirement to assess potential alternatives, only to describe those "reasonable alternatives" that have been "studied by the person or persons who prepared the EIAR".

In relation to alternatives the '*Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment' (August 2018)* states (Section 4.2) that the information provided must include *'A description of the reasonable alternatives studied by the developer*' and '*an indication of the main reasons for the option chosen ...*'. Reasonable alternatives as defined in the Government guidance ('*Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment'* refer to Sections 4.12 and 4.13) '*may relate to matters such as project design, technology, location, size and scale*' however there is no requirement for each of these alternatives to be assessed in detail and the guidance states that a broad description of each main (and reasonable) alternative studied and the key environmental issues associated with each is sufficient.

In addition, the Environmental Protection Agency (EPA's) '*Guidelines on the Information to be contained in Environmental Impact Assessment Repor*ts' (2022) states (Section 3.4.1), that *'the objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option'. It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account in deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required.'*[1]

In this context, the consideration of reasonable alternatives and design evolution has been undertaken with the aim of avoiding and / or reducing adverse environmental effects (following the mitigation hierarchy of avoid, reduce and, if possible, remedy), while maintaining operational efficiency and cost-effectiveness, and considering other relevant matters such as available land and planning policy.

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[1] *North East Pylon Pressure Campaign Ltd v An Bord Pleanála*[1] [2017] IEHC 338 Barret J. held that nowhere in the EIA Directive is there any language which requires or suggests that the rigors of an EIA have to take place with regard to alternatives that are discounted. Barret J. also stated that the information on alternatives is not required to comprise a statement of the likely significant effects of the alternatives that are studied and discounted but rather an indication of the main reasons for the preferred option.

This is outlined in the following sections of this chapter:

- Do nothing scenario (**Section 3.2**).
- Need for the Proposed Development (**Section 3.3**).
- Alternatives to the Proposed Development (**Section 3.4**).
- Alternative Locations (**Section 3.5**).
- Alternative Layouts (**Section 3.6**).
- Alternative Processes / Technologies (**Section 3.7**).

Full details on the Proposed Development are provided in **Chapter 02** (Description of the Proposed Development) of this EIAR.

3.2 'Do Nothing' Scenario

A 'Do Nothing' scenario in which the Proposed Development does not proceed is the baseline against which the impacts of the Proposed Development will be compared within the assessment.

For the purposes of this assessment, the 'Do Nothing' scenario assumes no development of the Proposed Development at Tarbert, Co. Kerry.

The 'Do Nothing' scenario would not enable the Applicant to create additional electricity generating capacity, thus would exacerbate security of supply concerns for Ireland resulting in significant adverse effects on population.

Chapters 05 to **17** of this EIAR describe the environmental effects of the 'Do Nothing' scenario.

3.3 Need for the Proposed Development

This section outlines the need for the Proposed Development due to:

1. A generation capacity shortfall.
2. Support intermittent renewable generation.
3. A target for 2 GW of Flexible Gas Fired Generation under the Climate Action Plan 2024.

The Proposed Development will support Ireland's intermittent renewable generation, help to resolve a predicted generation capacity shortfall and meaningfully contribute towards Ireland's Climate Action Plan Target.

The need for the Proposed Development is recognised at national, regional, and local level as detailed in **Chapter 04** (Energy and Planning Policy) which also provides a summary of relevant action plans and policy documents.

3.3.1 Shortfall in Power Generation Capacity

In the absence of new additional power generation, and with the closure of coal, peat and oil-fired power plants, a generation capacity shortfall is forecast by 2026. If realised, this shortfall will mean that electricity demand exceeds supply, and the system operator(s) will be required to reduce demand on the system (known as load shedding). The Proposed Development can counteract this issue and provide sufficient system capacity to prevent a shortfall from occurring. This is further explained in the following three sub-sections.

3.3.1.1 The Ten-Year Generation Capacity Statement 2023 to 2032

The Generation Capacity Statement (GCS) is an annual report from EirGrid and the System Operator of Northern Ireland (SONI). It follows a methodology set out by the energy regulator the Commission for the Regulation of Utilities (CRU) in Ireland. The GCS examines the balance between electricity demand and supply in Ireland for the following 10 years.

The GCS is published annually. This allows for the identification of changing scenarios and allows time for developers, policy makers and regulators to respond. The ten-year outlook reflects the time required by the wider energy eco-system to build the necessary infrastructure that can address identified problems.

Key extracts from the latest GCS published in January 2024 that support the urgent need for additional natural gas power plants are:

> ***Section 1.1 Why do we have a GCS?***
>
> *For Ireland, since 2016, EirGrid has warned via the GCS of an increasing tightness between supply and demand. There is no question that the current outlook, based on the best information available, is serious. It is likely that in the coming years we will experience system alerts and will need to work proactively to mitigate the risk of more serious impacts.*
>
> ***1.2 Overview of GCS 2023–2032: stating the challenge***
>
> *This year's GCS predicts a challenging outlook for Ireland with capacity deficits identified during the 10 years to 2032. The deficits will increase up to 2025 due to the deteriorating availability of power plants, resulting in their unavailability ahead of intended retirement dates as well as increasing electricity demand. In later years, the deficits are expected to reduce as new capacity comes forward through the SEM capacity auctions. Our analysis for Ireland shows that further new electricity generation will be required to secure the transition to high levels of renewable electricity over the coming decades. A balanced portfolio of new capacity is required and this includes the need for new cleaner gas fired generation plant which are renewable gas ready, especially at times when the wind and solar generation is low. This balanced portfolio is also crucial to ensuring Ireland meets its carbon budgets between now and 2030 for the electricity sector, which positions the electricity sector to achieve the zero net carbon target by 2050. Furthermore, by 2030 there will be significant new additional load from the heat and transport sectors as they are electrified, in line with government targets set out in the Climate Action Plan 2023.*

3.3.1.2 New Power Plants are Not Being Built

To encourage new generation capacity onto the grid, the Single Electricity Market Operator (SEMO) holds periodic auctions for new and existing capacity for delivery up to four years in the future (SEM Committee, 2021). A number of new build gas power station projects which had successfully cleared the auctions in recent years and were awarded ten-year CRM contracts have withdrawn / terminated their contracts due to their inability to deliver in the required timeframe (EirGrid and Soni, 2021).

Since last year's Ten-Year Generation Capacity Statement, 455 MW of previously awarded capacity has been withdrawn and the developers have paid termination charges. This is in addition to the previous 630 MW which was terminated. This means that most new predictable capacity that was expected to come online over the coming years has now withdrawn. EirGrid in their Generation Capacity Statement 2022 to 2023 noted:

> ***1.3 Recent developments impacting forecasts***
>
> *Recent developments will affect the security of electricity supply over the coming years in Ireland.*
>
> ***Availability***
>
> *Generator performance continues to be poor, and this is reflected in our analysis. There was a slight improvement in forced outages, that is where there are unforeseen outages, between 2022 and 2021. While the slight improvement in 2022 was welcome, availability of conventional generation remains a cause for concern. This low availability negatively impacts the long-term adequacy position. Since last year's GCS, 455 MW of previously awarded capacity has been withdrawn and the developers have paid termination charges. This is in addition to the previous 630 MW which was terminated. This means that most new predictable capacity that was expected to come online over the coming years has now withdrawn.*

Put simply, the Capacity Market is not delivering new power plants, and in the context of increasing power demand, the result will be increasing amounts of costly emergency measures and potentially load shedding events. The resulting capacity constraints have forced EirGrid and CRU to intervene directly in the market by procuring almost 700 megawatts (MW) of temporary emergency generation, which will cost the state more than €1 billion euros[2].

This failure to attract new modern, efficient, baseload generation may lead to a sub-optimal future electricity system where aging, inefficient, unreliable peaking power stations, that run on coal and oil, may remain on the system (Nord Pool, 2021).

Many of the plants that currently run on the margins of the electricity system in times of peak demand are oil and coal fired that are increasingly unreliable with multiple faults reported in recent time.

3.3.1.1 Testimony of EirGrid CEO (30th January 2024)

EirGrid Chief Executive Officer (CEO) Mark Foley was before the Joint Committee on Environment and Climate Action debate on 30th January 2024, highlighting the issues with the Capacity Market and capacity shortfall:

> *"it is a matter of record that the capacity remuneration mechanism overseen by the single electricity market committee, SEMC, has failed to deliver gas generation capacity to backstop the system. That is known. The most recent and frightening manifestation of that occurred in the autumn just passed, where the most recent auction had the very exciting high-level number of 3.3 GW for which developers were qualified to bid. Most of them made a decision not to bid, which is the ultimate statement of the market saying it has no confidence in that market mechanism."*

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[2] Available at: https://www.businesspost.ie/news-focus/power-down-state-cap-on-data-centres-puts-billions-of-euro-at-risk/

Furthermore, Mark Foley discussed the real and present risk of not getting new gas generation to the market:

> *"We cannot seem to get new gas generation from the capacity market. I think the answers are pretty straight forward, but we need the CRU to deliver on that. That will relieve this sort of, call it crisis, around generation capacity, which we have mitigated through the temporary emergency generation and keeping Moneypoint open. That needs to be fixed whatever happens because it threatens our reputation as a country. It also threatens the energy transition if we cannot backstop renewables. There is a risk that the new renewables coming on the system will happen more slowly than we would like. Much of that is to do with challenges in the planning system. Offshore is untested and a recent statistic I heard about onshore, and the number of projects gone into judicial review was somewhat alarming."*

> *"We must make the electricity grid stronger and more flexible because it will need to carry more power from distributed renewable sources. It is also essential that we invest in the correct technologies to ensure that we have a balanced portfolio in meeting Government targets around carbon emissions. This includes: renewable generation; gas-fired generation, which is renewable gas ready; electricity storage; low-carbon technologies, which provide essential services for a secure power system; and, of course, demand-side flexibility on the demand or consumer side."*

> *"Our analysis for Ireland shows that further new electricity generation such as those powered by cleaner gas, which is renewable-fuel ready, will be required to secure the transition to high levels of renewable energy over the coming decades. There is no inconsistency by saying we need gas generation to backstop the renewables revolution. We need both working in tandem."*

3.3.1.2 System Alerts

System Alerts are issued by the SEMO during periods when there is an elevated risk of not being able to meet electricity system demand. Alerts occur where the buffer between electricity supply and demand is tighter than is prudent to maintain a secure system. On 14th December 2022, a then record all-island peak demand figure of 7031 MW was measured on the transmission system. Ireland had a record peak demand of 5544 MW on 14th December 2022. Therefore, increased flexible capacity is required to meet peak demand.

Since December 2020, EirGrid have issued over a dozen (amber) system alerts on the electricity grid due to a risk that conventional generation might not meet demand at the time of the Alert. All of these alerts were issued during a period of low wind generation. In the EirGrid and Soni Ten Year Capacity Statement 2023 – 2032, they have stated that *"over the coming years, we will experience system alerts and the electricity grid will struggle to meet demand due to the deteriorating availability of power plants, resulting in their unavailability ahead of intended retirement dates as well as increasing electricity demand."*

The recent increased frequency of Alerts coupled with the failure of the capacity auction is a leading indicator of a very major problem in the years ahead. The Capacity Market is not delivering new power plants, and in the context of increasing power demand, the result will be increasing amounts of costly emergency measures and potentially load shedding events.

3.3.1.3 Testimony of EirGrid CEO Change (22nd of March 2022)

EirGrid also appeared before the Oireachtas Joint Committee on Environment and Climate Change on 22nd March 2022[3]. EirGrid CEO, Mark Foley, noted:

> *"I remind the committee of EirGrid's position on gas and dispatchable gas generation. Gas is essential to see us through this transition. I cannot overemphasise this. We are all committed to achieving the Government's climate action target of 80% renewables, but gas is our backstop. This is what ensures that we can deliver this transition and get out the other end, and hopefully with hydrogen replacing gas in due course in the next decade. Based on EirGrid's analysis, we need some 2,000 MW of dispatchable gas generation. We need it preferably by the end of 2026. This will do two things. It will backstop the system and ensure that we have security of supply, and it will help us to see off the old fossil-intensive plants, be they at Moneypoint, Tarbert or elsewhere, in the system. We should not apologise for it. It is necessary and it will get us to our goal. We are very focused on that and we have made very strong representations to the regulator in that regard."*

3.3.2 Intermittency of Renewable Generation

Renewable generation is weather dependent, and its output fluctuates considerably. For this reason, conventional power plants are required to fill the fluctuating gap between electricity demand and renewable generation. Natural gas is the only major energy source currently available to back-up renewable generation and thereby maintain a resilient electricity supply to the country while supporting the transition to 80% renewable generation by 2030.

At their appearance before the Oireachtas Joint Committee on Environment and Climate Change on 29th March 2022[4], the CRU Chairperson, Ms. Aoife McEvilly emphasised that despite over 5 GWh of installed renewable generation, there was only 19 MW being delivered on the morning of 27th March 2022 and reiterated numerous times that Ireland is moving towards a 'Renewable and gas power system'. Furthermore, the suggestion that renewables, batteries and interconnectors are sufficiently reliable for Ireland's energy security was challenged by the CRU, *"even with all the proposed infrastructure operating, they will deliver only circa 2 GW, and this would be insufficient in a 7 GW peak scenario".*

As an example, the wind generation profile on 6th December 2020 provides an insight into the vulnerability of wind power to weather conditions (EirGrid, 2021c). On this day, there was installed wind generation capacity of over 4,000 MW. However, at 2:45 PM wind produced only 1 MW of power with the system requiring over 5,000 MW of power at that time. Most of the power generation at that moment was delivered by gas fired power generation. The low level of wind generation continued to the next day, 7th December 2020, when Ireland experienced a system record peak day electrical demand, refer to **Figure 3.1**).

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[3] Available at: https://www.oireachtas.ie/en/debates/debate/joint_committee_on_environment_and_climate_action/2022-03-22/2/
[4] Available at: https://www.oireachtas.ie/en/debates/debate/joint_committee_on_environment_and_climate_action/2022-03-29/2/

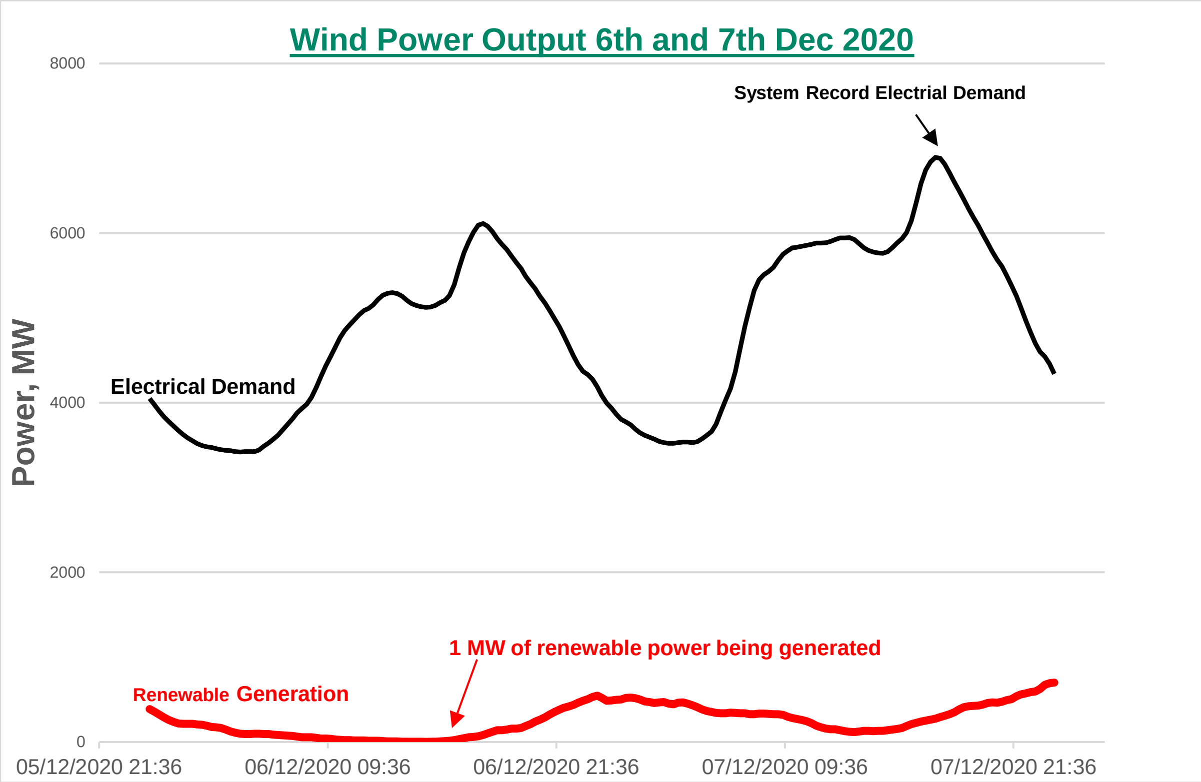

Figure 3.1: Wind Power Output and Electrical Demand on 6th and 7th December 2020

The Irish Academy of Engineering (2021) notes the following:

> ‘*Like other climatic phenomena annual mean wind speeds are subject to significant variations from year to year. The winter of 2010 was characterised by an exceptionally cold spell over Western Europe. Such weather patterns are unusual over Western Europe but when they do occur, they are accompanied by exceptionally low wind speeds and the patterns survive for prolonged periods. During the five-week period from mid-November 2010 to the final week in December, wind output, at peak demand period, was less than 10% of installed wind generation capacity. There was a 10-day period in this very cold spell where wind output was close to zero.*
>
> *In these conditions it is questionable as to whether a significant infeed could be obtained through interconnectors with [Great Britain] GB and France. Scotland, which has much of GB's wind generation capacity, was even more affected by the same climatic conditions and France has a high dependence on electric heating, which was promoted to complement its nuclear programme and thus has high domestic electricity requirements when temperatures are extremely low. The key to understanding the challenges posed by such weather patterns is to acknowledge their extent –not just Ireland or GB, but most of Western Europe.*
>
> *It has been suggested that storage technologies might be used to manage such multi week periods of low renewable generation and high demand. While such technologies could indeed contribute to solving daily intermittency problems, the cost of implementing such solutions (pumped hydro, or battery storage for example) to provide power over many days makes them entirely unfeasible for the foreseeable future.*’

3.3.3 Climate Action Plan Target

The Climate Action Plan 2024 (December 2023) commits Ireland to becoming a carbon-neutral economy by no later than 2050. A key component of meeting this reduction target is the decarbonisation of electricity generation in Ireland. To drive this change, Ireland has set a target to generate 80% of grid electricity from renewable sources by 2030, largely from wind. To allow this uptake of renewable energy to happen it is necessary to have in place back up sources of energy generation that can be efficiently dispatched when the wind is not blowing. This is discussed in more detail in **Chapter 04** (Energy and Planning Policy).

Flexible gas-powered generation is a critical part of that strategy, given the highly variable nature of wind energy generation.

Current policy as stated in the Climate Action Plan 2024 is that an additional 2 GW of conventional generating capacity is likely to be required by 2030 to support the transition to a net zero carbon electricity system. Natural gas-fired generating capacity, using combined cycle gas turbines, is currently the most efficient and lowest carbon dispatchable power source available to fill this gap.

3.4 Alternatives to the Proposed Development

As discussed in **Chapters 02** (Description of the Proposed Development and **15** (Climate), Volume 2 the fast acting, flexible Combined Cycle Gas Turbine (CCGT) in combination with the Battery Energy Storage System (BESS) are exactly the type of new generation units that are required to facilitate increased intermittent renewables on the system. The low minimum stable generation levels offered by the multi-shaft units will allow for reduced curtailment of intermittent wind generation while providing the mechanical inertia needed to maintain system stability. A review of the minimum stable generation of existing plant and in development power stations shows that the proposed units will be amongst the lowest stable minimum generation while maintaining a high relative level of efficiency. The BESS will provide the rapid response necessary to support the DS3 services[5] in the timeframe of seconds to minutes as well as providing energy to the system while the CCGT units are ramping up.

The Proposed Development supports the resilient transition of Ireland's electricity system to renewables, will provide additional and flexible power generation capacity to support intermittent renewable generation and resolve a predicted generation capacity shortfall, in line with national policy goals.

The alternative of an integrated power plant with on-site gas supply was envisaged in the Shannon Technology and Energy Park (STEP) proposal but that proposal was refused permission on 13th September 2023 by An Bord Pleanála (ABP-311233-21) and is currently the subject of JR proceedings. Given the requirements of the current capacity contract from EirGrid, and the urgent need to deliver additional electricity generation capacity, the Proposed Development as envisaged is being progressed.

As the application was refused, it is not considered here to be a reasonable alternative as it cannot be developed pursuant to its refusal.

[5] https://www.eirgrid.ie/ds3-programme-delivering-secure-sustainable-electricity-system

3.5 Alternative Locations

The Ballylongford / Tarbert landbank is a suitable location to accommodate and safely operate the Proposed Development because the location offers the following:

- A large unoccupied landbank on the coast which is zoned for industrial purposes.
- Under the Kerry County Development Plan (CDP) 2022-2028, the Site of the Proposed Development is part of 430.6 hectares (ha) of land which are zoned as a Strategic Development Location (SDL). This SDL is recognised in the CDP for its potential as an Energy Hub and for industrial development at a regional and national level.
- The Site is located in one of nine strategic development locations identified in the Strategic Integrated Framework (SIFP): 'Strategic Development Location H: Tarbert-Ballylongford land bank, Ballylongford'.
- The Shannon Estuary Economic Taskforce recommendation that electricity generation would be a significant strategic investment in the North Kerry / West Limerick region.
- Access to high-capacity gas transmission network (*i.e.* the 26 km Shannon Natural Gas Pipeline has already been permitted).
- The ability to get a high voltage export grid connection offer within the generation capacity shortfall time window[6].
- Access to high-capacity electricity grid (220 kV or higher) that can export 600 MW without undue system constraint.

A Connection Agreement for a 600 MW Maximum Export Connection (MEC) was executed in April 2023 with EirGrid to connect the power plant with the electrical transmission system.

The previously consented 26 km Shannon Natural Gas Pipeline (Planning Reference: PL08.GA0003), once constructed, will facilitate transport of the natural gas to fuel the power plant from the national gas network at Foynes. Shannon LNG Limited obtained consent in February 2009 for Natural Gas Pipeline under Section 182C (1) of the Planning and Development (Strategic Infrastructure) Act 2006, as amended.

The fast acting, flexible CCGT in combination with the BESS are exactly the type of new generation units that are required to facilitate increased intermittent renewables on the system and will utilise both the 220 kV electrical infrastructure connection and the permitted 26 km Natural Gas Pipeline.

The technology chosen requires suitable available land of sufficient dimensions and also requires a main fuel supply and an electricity grid connection and therefore why an interest in the existing site. Non-environmental factors can have equal or overriding importance including the project economics, land availability, engineering feasibility or planning considerations.

3.6 Alternative Layouts

The Site layout for the Proposed Development has been condensed since the previous 2*012 CHP Plant EIS and 2007 LNG Terminal EIS* (Arup, 2007). The previously consented CHP Plant was located on Knockfinglas Point, refer to **Figure 3.2**.

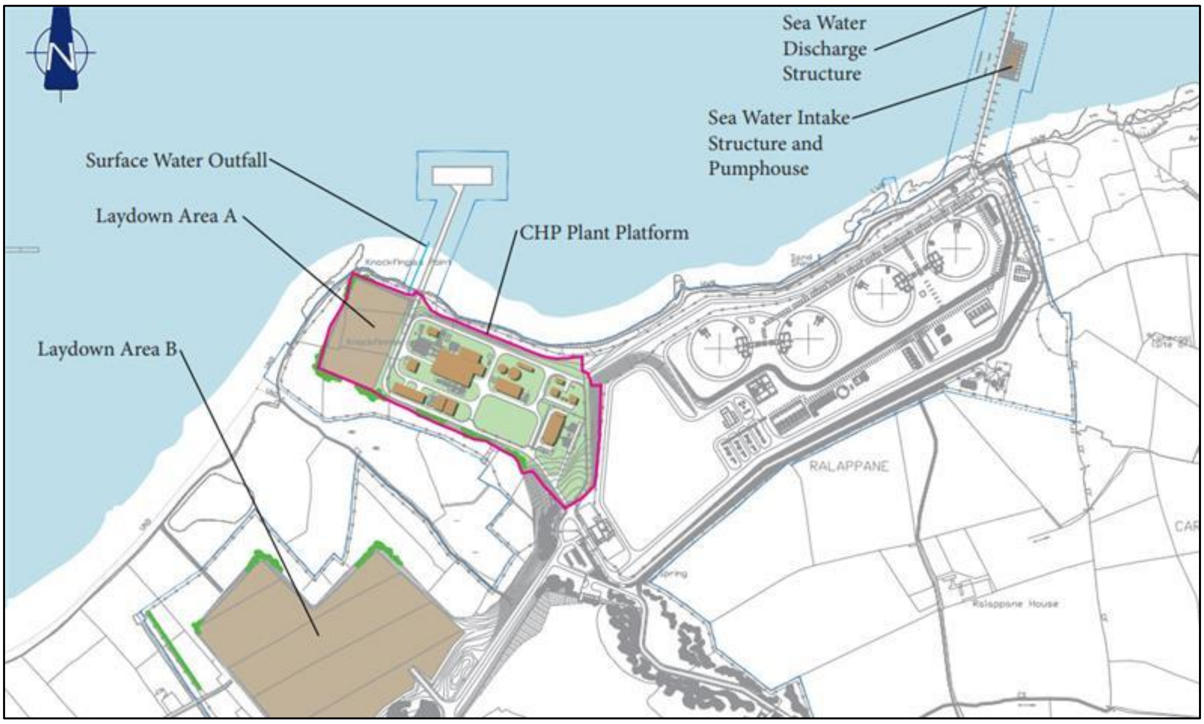

Figure 3.2: Location of Previously Consented CHP Plant

It is now located to the east of Knockfinglas Point. This layout is more efficient and minimises the total site footprint. The Site layout and the associated design minimises visual impacts by utilising natural screening and avoiding designated sites (Special Areas of Conservation (SAC), Special Protection Area (SPA), Natural Heritage Areas (NHAs)).

The location of the Power Plant was selected to minimise overall land take and to minimise environmental impact including:

- Reduced impacts on biodiversity by reducing the overall footprint.
- Reduced visual impact.
- Optimised platform level at 18m OD by balancing cut / fill requirements.
- Reduced impacts on Cultural Heritage assets.
- Reduction in carbon sequestration.

Detailed in **Table 3.1** are the key considerations on the layout of the Proposed Development.

Table 3.1: Layout Design – Key Considerations

Description Of Design Element	Summary Of Options Considered	Comparison Of Effects	Outcome
Sizing of the Proposed Development	The size of the Proposed Development is a commercial and technical consideration based on the market need, available electricity export, gas import and availability of suitable technology and equipment. All Technology options considered the same sized Site.	The condensed footprint associated with the Final Layout allows for more optionality on future use of lands.	The selection of three CCGT units each with capacity of 200 MW strikes a good balance in utilising the space available and the volume of associated infrastructure required for electrical and gas connections etc. There is availability of suitably sized technical solutions in the market that can meet the range of requirements at this output, including emissions, noise, and electrical grid requirements.
Open Cycle Gas Turbine (OCGT) Design	OCGT considered due to fast response to become operational to generate electricity. Less floor space required for an OCGT, but less efficient plant.	OCGT units require less space so more units could be developed however more space required to achieve same target output. Less efficient plant and lower achievable output with greater CO_2 emissions.	Discounted as the output and efficiencies are lower than the Proposed Development design which is being progressed.
CCGT Design	CCGT with a single shaft rather than a multi-shaft unit were considered.	Less visual intrusion. A typical OCGT has an efficiency of 40% whereas a typical CCGT has an efficiency of 55%. Therefore, CO2 emissions from our CCGT are at least 37% lower than the OCGTs.	Selected based on increased efficiency and reduced emissions when compared to OCGT.
Alternative fuel options	Different fuel types considered for a new power plant.		Discounted due to complexity of equipment and sourcing of fuel type.
Combined Heat and Power (CHP) Plant	The Applicant considered the option of combined heat and power (CHP).	CHP is the recovery of waste heat from the power plant to an associated useful heat demand. As there is no useful heat demand nearby this option was discounted. Layout and Size were also larger than CCGT. With the CCGT design, it reduces the total site footprint.	As there is no useful heat demand nearby this option was discounted and a larger site footprint when compared to CCGT design.

3.7 Alternative Processes / Technologies

3.7.1 Power Plant Technologies

Alternative Power Plant technologies were considered. Technology options considered against the proposed multi-shaft combined cycle configuration included:

- Combined heat and power (CHP).
- Open cycle gas turbines.
- Single-shaft CCGT.
- Multi-shaft CCGT.

In determining the optimum configuration, specialised studies and extensive consultation were carried out to identify the key functional requirements of the power generation capability to be developed:

1. Be capable of fast response to sudden instructions from the System Operator to support intermittent wind generation.
2. Enable low minimum stable generation to allow the System Operator to keep units on the system at a minimum level to ensure a sufficient level of system inertia is maintained.
3. Natural gas fuelled to meet with national Climate Change Policies and objectives.
4. Be able to accommodate faster or slower than forecast development of renewables power generation, and consequently be flexible in build out.
5. Support transitioning to deliver Ireland’s net zero carbon emission by 2050 ambition.

In summary, the proposed Power Plant is the most efficient, flexible and reliable option with the lowest CO_2 emissions profile of the alternatives considered.

3.7.1.1 Combined Heat and Power Plant

The Applicant considered the option of CHP. CHP is the recovery of waste heat from the power plant to an associated useful heat demand. As there is no useful heat demand nearby this option was discounted.

3.7.1.2 Open Cycle Gas Turbine

An OCGT plant is where a gas turbine generates power and the exhaust gases from the turbine are exhausted to air without heat recovery. An OCGT was proposed and was considered as an alternative design option. These facilities have relatively low capital costs and low thermal efficiencies: about 40%, compared to the Proposed Development with an efficiency of approximately 54%. Given their low efficiencies, electricity produced from OCGTs has a much higher CO_2 emission factor than electricity from CCGTs. Refer to **Chapter 15** (Climate) for a discussion and comparison on this.

With these performance characteristics, OCGT plants only dispatch in the electricity market during periods of peak demand or low wind. Given their low efficiencies and much higher CO_2 emission factors, OCGT were discounted.

3.7.1.3 Single-Shaft

As part of the Applicant's detailed electricity market modelling, the Applicant considered a larger single-shaft CCGT compared to the proposed multi-shaft unit. The larger single shaft unit was discounted because it was less flexible than the multi-shaft unit.

Specifically, as Ireland transitions to 80% renewables by 2030, the System Operator will require gas thermal units to be flexible. Units that have very low minimum stable generation will be kept running more than units with high minimum stable generations. A single shaft 600 MW would suffer from a minimum stable generation of about 176 MW compared to 41 MW for the multi- shaft unit. Given its high minimum stable generation, a single shaft unit was discounted.

3.7.1.4 Multi-Shaft

The Applicant has chosen a flexible modular Power Plant, which will comprise up to three blocks of CCGT, each block with a capacity of approximately 200 MW, for a total installed capacity of up to 600 MW. Each CCGT block will comprise two gas turbine generators, two heat recovery steam generators, a steam turbine generator, and an air-cooled condenser. This configuration enjoys higher efficiency, lower CO_2 emission factor, greater flexibility, and is more reliable than the alternatives considered above.

3.7.1.5 Future Grid Requirements

The Power Plant will not operate at 100% capacity all year round. The actual operation of the plant will be determined by many factors such as power demand itself, the amount of renewable generation on the system, its bid price into the market compared to other generators, and the rules of the grid to ensure priority is given to renewable generation. The grid also needs to remain stable and secure with increased levels of renewable generation.

EirGrid has advised the Applicant in pre-application consultations, to ensure grid stability with increased renewables, the future grid requires flexible gas fired power plants with high inertia[7], low minimum stable generation and fast response capability. Other stakeholder consultations and information support this advice.

The Applicant commissioned a detailed market analysis (*the Baringa Shannon Wholesale & Ancillary Revenue Report*) to consider these issues and model the future operation of the Power Plant from 2023 to 2050. Other power plant configurations were also modelled. The model assumes the Government's 80% renewable by 2030 target is met. It also considers the detailed requirements of the system operator (EirGrid) to keep the grid stable and secure.

As previously outlined, the design of the Power Plant and the BESS have been chosen for flexibility and efficiency. All future energy scenarios show gas power plant being required in the period to 2050 and beyond.

The operation of the Power Plant in the Single Electricity Market (SEM) is discussed in **Chapter 15** (Climate) (Section 15.4.4). In summary, the SEM takes into account the cost of emissions under the EU

[7] One of the challenges with increased renewable (wind) generation on the system is a potential for an increased rate at which the grid frequency falls. This is known as the rate of change of frequency (RoCoF). Events that result in high RoCoF levels can potentially lead to instability in the power system. All power systems, including the Irish power system, have inertia. Inertia is a resistance to change in motion. The inertia on the power system resists the RoCoF and helps maintain system stability.

ETS, which therefore dictates that the most efficient and least emitting plant will be dispatched first for energy generation and system stability. The efficiency of the Power Plant, combined with its ability to operate at a low minimum generation capacity, means that the Power Plant will be dispatched ahead of a less efficient OCGT power plant. It will provide lower direct emissions and also provide system inertia (and other system services) at a lower output, allowing for higher instantaneous renewable (non-synchronous) generation than would otherwise be the case if the Power Plant was not developed.

As discussed earlier, as the level of renewable generation on the system at any one-time increases, thermal power plant has their dispatch quantities decreased by EirGrid to facilitate the output of the renewable power plants. However, a certain number of dispatchable plants must remain on the system to provide the services mentioned above. 'Positioning' is when the grid operator keeps a power plant running so as to be on standby to provide these services to the grid operators in real time. This is a vital process for grid stability; however, with inflexible power plants it can lead to larger than necessary power plants being positioned. This causes increased emissions, increased curtailment of renewables (to make room for the positioned power plant) and increased costs.

The ability of the Power Plant to operate at a 50% blend of hydrogen by design offers the potential for the Power Plant emissions to become even more efficient over the period to 2050, as and when the required policies and supply chains for hydrogen are implemented.

The Power Plant is 'future-proofed' and has the ability to transition to hydrogen fuel once the technology and public policy are fully developed, thereby achieving a 'zero emission' facility. The location of the Site can, subject to separate planning approval at a future date, provide access to future offshore renewable projects, combined potentially with facilities for the production and landing of hydrogen. This would contribute to the decarbonisation of Ireland's energy system by providing long term hydrogen energy storage (produced onsite or into the national gas transmission network), renewable energy storage (through the BESS) and direct electricity generation at the Power Plant. The modular Power Plant offers flexibility to incorporate alternative fuels when the required policies and supply chains are implemented.in future.

Refer to New Fortress Energy Inc.'s 'A Step Towards a Zero Carbon Future' policy for further details in **Appendix A1.1**, Volume 4.

In conclusion, the flexibility of the Power Plant, including the BESS, is ideally aligned with a high renewable market from now to 2050. In particular, the Power Plant offers the market high inertia, very low minimum stable generation, and fast response capability with an ability to transition to hydrogen when the required policies and supply chains are implemented.

3.7.1.6 Best New Entrant

In March 2023, the Commission for Energy Regulation published the annual *'Best New Entrant'* decision paper[8]. EirGrid again stated that a power plant consistent with the proposed development was desirable:

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[8] Available from: https://www.semcommittee.com/publications/sem-23-016-best-new-entrant-decision-paper

The TSOs also argued that the CCGT used for BNE evaluation should be based on a multiple shaft CCGT with a by-pass stack, which would allow the CCGT to operate more flexibly in accordance with the needs of the system during the energy transition.

…

Looking into the longer-term projections, maximising flexibility of new CCGTs at the design stage will provide the system operators with a fit for purpose power system with enhanced system flexibility; this is particularly important as we are on a no regrets pathway to a high renewable electricity system.

….

Finally, the TSOs want to conclude by stating that a balanced portfolio of onshore and offshore renewables, new renewable gas ready flexible CCGTs and unrestricted OCGTs, long duration batteries, highly available demand side management, and interconnection complimented by low carbon inertia services are needed to enable the delivery of a secure transformation to an emissions target compliant power system that delivers at least 80% RES-E by 2030.

3.7.2 Cooling Processes

Alternative processes for cooling were considered as CCGT power generation produces waste heat. The methods considered of providing condenser cooling for the Power Plant are listed below.

- **Indirect Wet Cooling:** In an indirect wet cooling system, cooling water is circulated around a loop circuit with waste heat from the Power Plant being transferred into the water, raising its temperature. This hot water is then directed to a cooling tower where the water is in direct contact with the atmosphere. In the cooling tower a significant proportion of the cooling water evaporates and, as a result, must be replaced with 'make up' water so the water stream can be re-circulated to the proposed Power Plant and used to generate more electricity. For a power plant of the size and cooling system design proposed, large volumes of fresh water will be required for make-up. In addition, the cooling tower will be a large structure with a visible plume of water vapour emanating from it during some atmospheric and plant operating conditions.
- **Direct Wet Cooling:** In a direct wet cooling system, heat from the Electric Generation Facility is transferred into water. This requires large volumes of water to be drawn from a nearby water body. This warm water would be returned directly to the nearby water body at a higher temperature. Typically, the water intake structure and discharge structures in the water body are separated by some distance so that the warm water from the discharge structure does not circulate back to the inlet structure. Direct wet cooling is best suited to locations where there is a large body of cooling water available, such as a lake, river or estuary with strong tidal flows. It offers better condenser performance and cycle efficiency than Direct Air Cooling or Indirect Wet Cooling, and the lower condenser temperatures that can be achieved generally result in higher power Generation Efficiency.
- A seawater cooling system was identified as the preferred direct wet cooling method for the Power Plant. This would include separate water inlet and outlet structures in the Shannon

Estuary and associated pumps and piping to convey seawater between the water-cooled condenser, Power Plant and the estuary. However, this would also entail a significant seawater intake structure located within the Lower River Shannon SAC, hence it has been discounted.

- **Heat Extraction**: This option would have consisted of extracting heat from the atmosphere, which has been proven effective in hot climates. However, this option was discounted in the 2012 EIS (Arup, 2012) as the location of the project does not have the necessary air temperatures during the year to make this process efficient or feasible.
- **Air Cooled Condenser**: Steam exiting the steam turbine would enter the steam condenser and pass through air-cooled fin tubes. The steam would not be in direct contact with the air. The heat is transferred from the steam to the surrounding ambient air resulting in the steam being condensed. This produces a cooler condensed steam, *i.e.*, water condensate which is boiler quality feed water. The key advantage of air-cooled steam condensers is that large volumes of cooling water are not required. Another advantage is that the water intake and discharge structures are not required to be built in the estuary, minimising the impact on the SAC.

The Air Cooled option was selected.

3.7.3 Other Alternative Processes

3.7.3.1 Wastewater Treatment Discharge

The sanitary wastewater treatment plant, which will be used for the Power Plant, has been designed to discharge to sea via an outfall. The effluent waste stream will be monitored for compliance with the Industrial Emissions (IE) licence limits before being discharged.

The option of discharging the sanitary effluent from the Proposed Development to ground was considered in the context of the EPA (2011) *'Guidance on the Authorisation of Discharges to Groundwater'* and EPA (2014) '*Guidance on the Authorisation of Discharges to Groundwater'.* The 2014 guidance states that discharges to surface water should always be considered as a first option in the process, if technically and economically feasible. Furthermore, the Site is considered unsuitable for indirect or direct wastewater effluent disposal to ground / groundwater for the following reasons:

- The clay and silt dominated subsoils on the northern area of the Site are thin (<1m and Power Plant area) and characterised by poor drainage and low infiltration properties, with low subsoil permeability (typically <4 x 10-6 m/s in the upper 900 mm of soils (Upper Till) with the lower till being of lower permeability where present). Groundwater vulnerability beneath the Site is classified as 'High to Extreme' due to the limited subsoil thickness in areas of the Site.
- The underlying sandstone and shale bedrock aquifer of the Site is also of low permeability (from 1.05 x 10-5 to 1 x 10-6 m/s) and therefore does not have sufficient ability to 'accept' and move the effluent away from the Site.
- Both the subsoil and bedrock have a high-water table, with depth to groundwater in February 2020 typically being less than 1 m.

- The construction of the 18 m OD platform will involve removal of subsoils, extensive blasting and excavation of bedrock and use of excavated material (largely crushed rock) as engineering fill to construct the northern part of the platform. These activities will result in an operational site founded either on fractured rock or granular rock fill, resulting in little effluent attenuation capacity.

These soil and bedrock characteristics would result in inadequate attenuation of pollutants, making the Site unsuitable for onsite effluent discharge to ground, resulting in the design decision to use a packaged wastewater treatment plant for treatment of the effluent prior to discharge under licence via the combined surface water discharge.

3.8 References

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