Pathfinder Case Study

Dún Laoghaire-Rathdown County Council
Ballyogan Operations Centre Decarbonisation Project

Date (July 2025)

Sustainable Energy Authority of Ireland
SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

SEAI is funded by the Government of Ireland through the Department of Communications, Climate Action and Environment.

Dún Laoghaire-Rathdown County Council – Climate Objectives

Dún Laoghaire-Rathdown County Council's Climate Action Plan 2024–2029 outlines objectives towards achieving a 51% reduction in greenhouse gas emissions and a 50% improvement in energy efficiency by 2030, as mandated by the Climate Action and Low Carbon Development Act.

Dún Laoghaire-Rathdown County Council Strategy – Corporate Buildings

As part of the Council's broader strategy to meet its climate and energy performance targets, the Corporate Services Facilities Management team is tasked with developing decarbonisation projects for key, high-energy-use corporate buildings.

The DLRCoCo Corporate Plan 2025–2029 clearly affirms the importance of integrating sustainability improvements across the organisation's activities. This commitment is reflected in the management of the corporate estate. For example, traditional building services contracts—such as outsourced Facilities Management—have been structured with a heightened focus on enhancing sustainability outcomes.

In parallel, the development of a dedicated procurement framework targeting feasibility and design services for building projects will enable a complementary, scalable approach to designing, building, monitoring, and maintaining energy and carbon reduction solutions—without compromising quality or standards.

An integrated approach to workforce planning has supported the expansion of the Corporate Services FM team and the development of in-house expertise. This combination of a complementary procurement strategy and strengthened internal capacity is proving to be an effective model for delivering key action plans and driving meaningful progress.

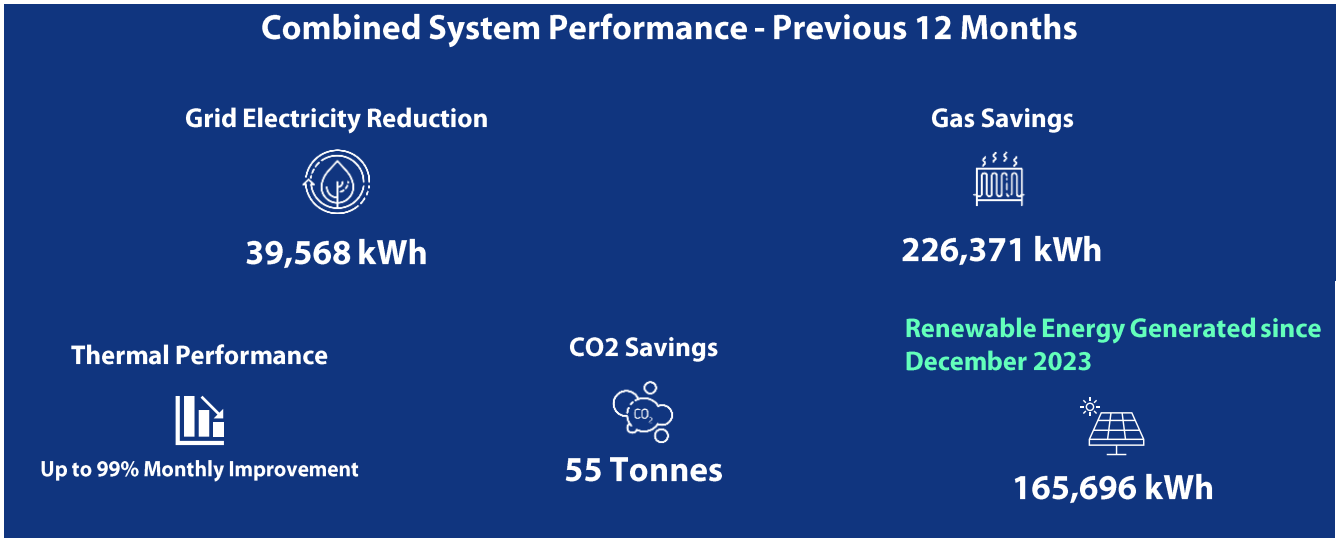
The above is underpinned by strong corporate governance and oversight, ensuring a holistic approach to evaluating, prioritising, and pursuing key opportunities. This process is further strengthened through effective partnerships with agencies such as CODEMA, who assist the Council with implementation of the organisation's Energy Management System, and SEAI who provide valuable guidance and supports, such as the SEAI Pathfinder Programme.

The Corporate Services team has identified a pipeline of decarbonisation and energy retrofit projects across key high-energy use buildings, including:

- County Hall
- LexIcon Library & Cultural Centre
- Harbour Square Office Block
- Harbour Master's Lodge
- Ballyogan Operations Centre
- Library Branches

This case study will examine the decarbonisation project for the Ballyogan Operations Centre.

Ballyogan Operations Centre – Decarbonisation Project



Background

Opened in 2012, Ballyogan Operations Centre serves as a fully integrated hub for outdoor operations at Dún Laoghaire-Rathdown County Council. The facility comprises of two operations buildings and a 2.4 hectare services yard. Historically, the Operations Centre has accounted for approximately 3% of total energy consumed by the Council.

The Utility Building is a hybrid structure combining in-situ concrete and timber. It houses staff welfare facilities, storage areas, mechanical garages, workshops, and a salt barn. The Administration Building comprises three floors of modern, open-plan office space. Constructed using mass timber with larch glue-laminated columns and beams, the building is passively designed and naturally ventilated.

The energy centre was originally equipped with a 250kW biomass pellet boiler, supported by a natural gas boiler. Circa 2016, the gas boiler was upgraded to a cascade of more efficient condensing boilers. The original design also included a 120-tube evacuated solar thermal array and a comprehensive Building Management System.

By winter 2022, thermal demand at the facility was predominantly met by natural gas, due to the degradation and declining reliability of the biomass system. The biomass boiler ultimately reached end-of-life in September 2022 following water damage

A Building Energy Rating (BER) assessment was carried out in early 2023, with both the Administration and Utility buildings receiving a C1 rating.

Administration Building at Ballyogan Operations Centre

Project Description

The project brief focused on integrating renewable energy technologies that would complement the buildings' energy-efficient design and combine to create a system with strong synergies. Measures were selected based on clearly defined criteria prioritising decarbonisation, energy performance improvement, cost effectiveness, Building Energy Rating (BER) improvement, and restoring continuity of building services.

The approved project plan included for installation of roof-mounted solar P/V on both buildings, optimisation of the existing solar thermal array and an overhaul of the energy centre, inclusive of the integration of Heat Pump technology.

Project Targets

- Achieving up to a 95% reduction in natural gas usage
- Reducing carbon emissions from the heating system by over 40,000 kg per year
- Generating more than 160,000 kWh of clean, renewable electricity annually
- Realise the potential to export surplus renewable electricity back to the national grid
- Reduce ongoing operational expenditure

Delivery Model

The project delivery model leveraged the existing outsourced Facilities Management (FM) contract to design, build, commission, and maintain the new systems. In practice, this model enabled the engagement of pre vetted specialist engineers across both solar and mechanical disciplines, supported by essential project supervision from the FM service provider

The project plan consisted of six key stages commencing in April 2023.

- Feasibility Screening
- Technical Assessment
- Preliminary Design

- Detailed Design
- Installation and Commissioning
- Measurement and Verification

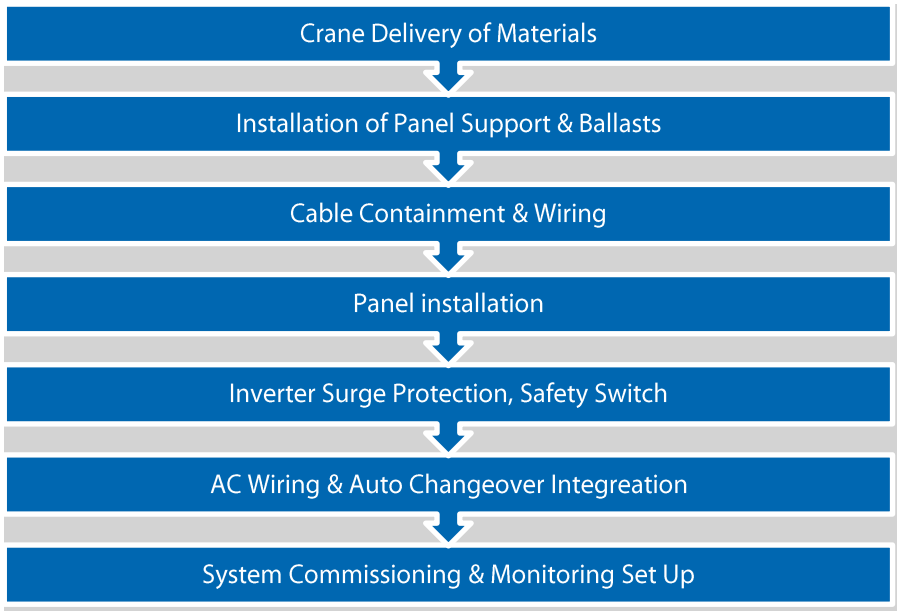
Phase I Solar PV Installation

Phase I of the solar photovoltaic (PV) system installation involved the deployment of a 62.04 kWp system comprising 132 solar panels on the administration building. The system will generate approximately 59,102 kWh per annum, the equivalent of 18% of the sites 2022 electricity consumption and will save an estimated 27.767 tonnes of CO_2 emissions per annum.

Preliminary works necessitated an assessment of the roof structure by a structural engineer and consultation with a roofing specialist. The installation process commenced on 20th November 2023 and lasted two weeks. Installation required a crane-lifting all panels, ballasts, and fixings onto the roof to preassigned areas that were well supported by in-situ glulam timber support beams. Cable trays were installed from the PV arrays to the plant room, with panels mounted on rubber feet to avoid any damage on the roof membrane. Inverters were mounted on internal plant room walls, and containment routes were installed for cabling. Surge and lightning protection systems and a firefighter safety switch were also installed. The AC side of the system was connected to the building's sub-board, with a brief power shutdown to complete the integration.

Technological Challenges and Innovative Solutions

One of the primary challenges was installing the PV system on a green roof without compromising its waterproof membrane. This was overcome by using rubber mounts instead of mechanical fixings, leaving the roof intact. Another challenge was managing the interface between the solar PV system and the existing emergency power generator. In order to prevent both systems from operating simultaneously, an innovative solution was implemented: a 2-core cable was run from the auto changeover switch to the inverter. This ensures that in the event of a power outage, the solar system shuts down and the generator takes over, and the reverse happens when the power returns. This integration enables seamless and safe energy source switching.



Phase I: Stages of Installation

Phase II Solar PV Installation

Phase II involved the installation of a 160-panel a75.2kWp array on the roof of the utility building and integration into G10 relay and panels. The system was commissioned in July 2024.

The modelled performance of combined production of phases I & II is equivalent to approximately 40% of electricity consumption of the Ballyogan Operations Centre. The combined CO_2 emissions avoided per year is expected to be 61.318 tonnes, marking a substantial environmental benefit.

Technological Challenges and Innovative Solutions

A key innovation in Phase II was the integration of real-time performance monitoring across both phases. Data from Phase I demonstrated that actual generation was tracking well against modelled performance. This data led approach provided valuable insight on dynamic energy trends, peak usage, potential for electricity export; as well validation of system performance, which informed optimisation of the Phase II final design. The installation was executed with minimal disruption to operations and was scheduled to ensure seamless integration with the existing system

Phase III Solar PV Installation

Phase III of Ballyogan Operations Centre Solar PV project realised the installation of a 64-panel photovoltaic array with a peak capacity of 37.44 kWp.

The simulated annual energy production from Phase III is approximately 35,199 kWh. This brings the total estimated production from all three phases to 165,696 kWh annually, or 51% of the site's total electricity consumption in the baseline year 2023. The overall CO_2 benefits from all three phases is estimated at 77.85 tonnes annually.

Phase III was commissioned in April 2025 and will realise further improvements above and beyond the performance metrics captured at the time of this report.

Phase	Panels	Capacity(kWp)	Annual Output(kWh)	CO_2 Avoided(tonnes)	Year Implemented
Phase I	132	62.04	59,102	27.767	2023
Phase II	160	75.20	71,395	33.551	2024
Phase III	64	37.44	35,199	16.532	2025

Summary of PV installation at Ballyogan Operations Centre

The Council has successfully attained an NC8 export licence for the array. Export to the grid commenced in spring 2025 and will be monitored as part of ongoing M&V. The P/V solar array has been sized to take into account planned expansion of the Operations Centre.

Energy Centre Upgrade

The Energy Centre upgrade addressed several critical technical and operational challenges. The original biomass boiler was oversized relative to site demand, resulting in limited utilisation. Consequently, the gas boiler system operated more efficiently and met a greater share of the heating load. From an operational and maintenance perspective, the biomass system proved onerous—particularly in terms of reliability and the safe procurement and storage of high-quality pellets. The gas boiler system also presented reliability concerns due to high load and component failure.

Innovative Solution

A data-led design process allowed for a true understanding of the inefficiencies of the existing system relative to real world demands and provided key insight towards optimising a new design.

The upgrade entailed a complete replacement of the original gas-heating system. A cascade of four 35 kW air source heat pumps (ASHPs) was installed to meet 95% of the building's heating demand, while one of the original

gas boilers was retained for peak load management. An 80 kW water source heat pump (WSHP) was also integrated into the LTHW feed which feeds into a high temperature header supplying 100% of the building's domestic hot water (DHW), and supply to air handling and fan coil units. Oversized thermal storage tanks were replaced: the LTHW buffer tank was reduced from 3000 litres to 500 litres, and the DHW calorifier was reduced from 2000 litres to 500 litres, with a capacity to deliver 1500 litres of hot water per hour. The new DHW tank features a 6m^2 coil that can produce the required volume of water per hour up to a temperature of 50˚C. An electric immersion was also incorporated into the tank to cope with fluctuating demand and meet legionella control requirements.

A new MCC panel and dedicated power supply were installed, and the entire system was integrated with the building management system (BMS) for real-time monitoring.

Advanced energy monitoring was installed using electrical submeter clamps and heat meters, with data being incorporated into the BMS and online energy monitoring system. This arrangement supports real-time monitoring of the energy input and output, enabling accurate verification of seasonal coefficient of performance (SCOP) and constant optimisation of system performance.

The Heat Pump and mechanical aspects of the project required a duration of approximately 15 months from concept to completion from the period July 2023 to September 2024.

Finished Installation: Heat Pump and Solar P/V Array, Ballyogan Operations Centre

Performance Measurement & Verification

Thermal Performance Indicators

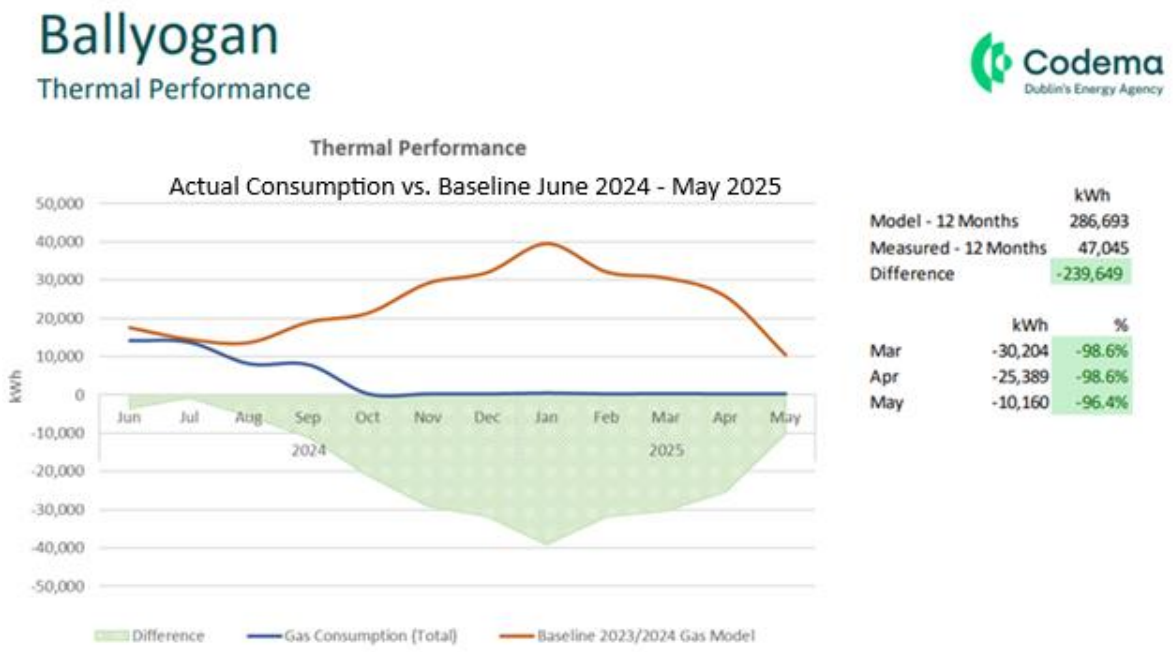
A two-stage Measurement & Verification process has been identified. The first phase has focused on monitoring performance improvement via facility Energy Performance Indicators. The second phase will incorporate live metering to facilitate analysis of the seasonal efficiency of the plant. This data will be incorporated into the Council's energy management platform.

The performance measurement & verification process will be supported by DLRCoCo's ISO 50001 certified Energy Management System, ensuring that improvements in performance are measurable, consistent, and sustained over time.

Thermal Performance Indicators

Actual performance is compared to pre project baselines in a variety of ways to measure if improvement has been achieved.

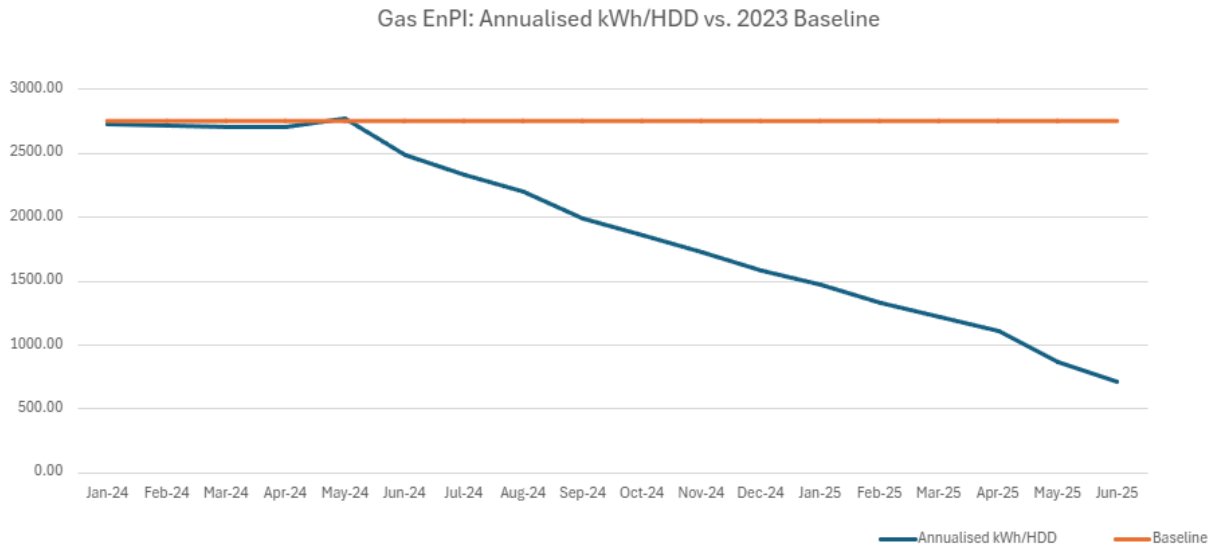
i. Absolute Consumption vs. Baseline Year



This analysis reveals that natural gas consumption is at near-zero levels since commissioning of the heat pumps. **Actual improvement is outperforming the project target of a 95%** decrease in gas. Absolute savings of 239,649 kWh have been achieved over the 12 months measured.

The remaining gas consumption on site is associated with catering operations. No gas has been used for the purposes of space heating since October 2024.

ii. **Annualised Natural Gas kWh/HDD vs. Baseline Year -** Rolling 12-month tally of Monthly Gas Consumption/Heating Degree Days (@15.5 degrees) vs. baseline.



This performance indicator tracks the cumulative monthly reduction in natural gas intensity. As of June 2025, the rolling 12-month Energy Performance Indicator (EnPI) shows a 74% improvement compared to the pre-project baseline. Continued progress is anticipated as the system approaches its first full year of operation in September 2025.

iii. Actual vs. Modelled Performance – HDD Variable

Weather is a significant variable that influences thermal demand at Ballyogan Operations Centre. Heating Degree Day (HDD) regression analysis is used to analyse thermal performance.

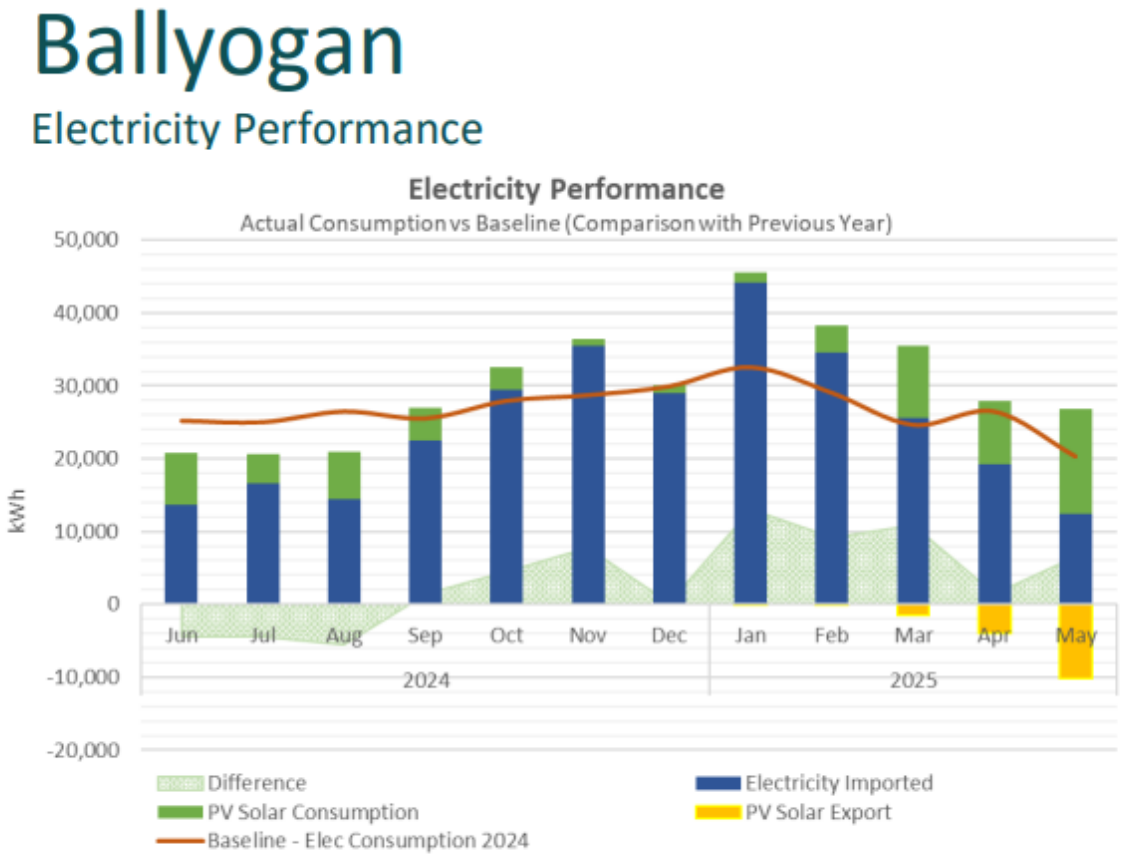
Month	HDD @15.5 Degrees	Actual Gas Consumed [kWh]	Predicted Gas Consumed (R^2 0.86)	Gas Avoided [kWh]	% Improvement
Sep-24	100	7912	20470	-12558	61.3%
Oct-24	127.9	294	22776	-22482	98.7%
Nov-24	218.9	296	30297	-30001	99.0%
Dec-24	251.9	334	33024	-32690	99.0%
Jan-25	339.5	548	40263	-39715	98.6%
Feb-25	253.1	350	33123	-32773	98.9%
Mar-25	234.7	400	31602	-31202	98.7%
Apr-25	177.7	356	26892	-26536	98.7%
May-25	121	384	22206	-21822	98.3%
Jun-25	51	424	16421	-15997	97.4%

This Energy Performance Indicator (EnPI) is derived from a linear regression model calibrated against Heating Degree Days (HDD), which characterizes baseline natural gas consumption under pre-intervention operating conditions. The model serves as a predictive baseline to quantify deviations attributable to energy efficiency measures.

This Performance Indicator demonstrates the effectiveness of intervention with improvement of up to **99%** recorded.

Electrical Performance Indicator

Consumption vs. Baseline Year EnPI



The electrical Energy Performance Indicator (EnPI) for the facility highlights changes in site-wide electrical demand characteristics over the past 12 months. During the heating season, demand exceeded baseline levels due to the increased intensity of heat pump operation. This seasonal trend reversed in spring and summer, with demand falling below baseline requirements.
Overall, grid electricity consumption has decreased by 13% compared to 2022 consumption. Further improvements are anticipated over the next 12 months, driven by the additional benefits from the commissioning of Solar PV Phase III in April 2025.
It is worth noting that the Ballyogan Operations Centre has seen a steady increase in the use of the site as well as the number of administrative staff based there over the last 3 years which has increased energy usage.

Project Insights

Preliminaries, and Design

- Planning and design proved to be the most intensive stage of project implementation. Considerable attention was paid to examining the historical profile of the facility to select the most appropriate technologies and build for efficiency. 3D IES modelling allowed for a room-by-room analysis to accurately calculate heat losses and determine the correct sizing of all heat emitters and central plant. Similarly for the solar panels, advanced modelling was carried out to refine the design and select for the most appropriate panels and orientation.

- BER Assessment and Energy Audits provided a good starting point.
- Technical Assessment – it was crucial to understand building fabric condition, heat loss, load profile & operating conditions
- A data & modelling led approach was key, but it was supported by practical measures and checks.
  e.g. the existing gas boilers were throttled back to observe how the building would respond to lower LPWH distribution temperatures, including comfort levels in the live environment.
  Storage tanks were metered to confirm that downsizing tanks would not cause operational issues. This included sourcing direct feedback from building users.

Securing Expertise via an Effective Delivery Model

- Contributions were required from a diverse array of disciplines to plan and execute the project including structural engineers, mechanical engineers, mechanical fitters, electrical engineers, solar engineers, electricians, building automation specialists, project managers and commercial managers, in addition to Council contract management engineering resources.

  - A "design to deliver" approach, co-ordinated within a central contract, provided for effective coordination between disciplines, allowing for informed decision-making at every stage, from feasibility through to commissioning. It ultimately contributed to a smoother delivery with strong budgetary and quality controls.
  - The process was underpinned by assignment of internal resources, particularly in the key areas of engineering and contract management.

Planning

- Implementing a phased approach to solar panel installation was a central component of project planning

  - Established momentum quickly
  - Helped build cachet and buy-in for the project
  - Allowed for data to be collected, which was used to realise incremental improvements to overall solar design and system optimisation
  - Smaller phased installations operated efficiently without export, allowing the array to operate while ESB applications and licencing progressed.

Organisation

- Project development and implementation was supported by a system of robust organisational and governance practices

  - Requirement for project approval by Project Governance Board ensures clarity on vision, intent and expectations
  - Projects are prioritised against key criteria – linked to organisational goals
  - Project development and implementation was supported by regular touch-point meetings with Director of Services
  - Emphasis on continual improvement means reflections & learnings drive incremental business process improvements and better outcomes
    e.g. performance monitoring of the Ballyogan project has steered the design team towards incorporating a dual coil calorifier in an upcoming project.

As detailed in the performance verification section of this report, the decarbonisation project at Ballyogan Operation Centre is on track to meet or exceed the established targets.

Dún Laoghaire-Rathdown County Council extends its sincere thanks to the Sustainable Energy Authority of Ireland for its invaluable support in bringing this project to fruition. We would like to express appreciation to the dedicated team behind the Pathfinder Programme, whose professionalism and commitment have been instrumental throughout.

The successful delivery of the decarbonisation project at Ballyogan Operations Centre stands as a significant achievement for all involved. It serves as a powerful example of what can be accomplished through collaboration and shared values, and it will undoubtedly inspire continued progress towards decarbonisation and enhanced energy performance across our corporate estate.

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