# Connacht GAA
# Energy Master Plan
# Nov 2022

Supported by

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| DRAFT | --/--/2022 | | |

# Executive Summary

Connacht GAA joined the SEAI Sustainable Energy Community (SEC) network in 2019 to continue our commitment to supporting a sustainable future both within our organisation and among our members. Connacht GAA completed this Energy Master Plan (EMP) which includes a sustainable energy roadmap for the Centre of Excellence and an action plan for Connacht GAA clubs

## Current energy use – Connacht GAA Centre of Excellence

The current energy use of the Centre is outlined below:

| **Energy Baseline (from 2020 data)** | | | | |
|---|---|---|---|---|
| **Energy source** | **Quantity [kWh]** | **Cost (excl. VAT)** | **Cost (incl. VAT)** | **CO2 Emissions [t]** |
| Electricity Imported | 334,800 | €50,220 | €56,999 | 99.03 |
| LPG | 359,971 | €18,000 | €20,430 | 82.54 |
| Diesel for Generator to power Floodlights | 198,218 | €15,000 | €17,025 | 52.31 |
| **Total** | **892,989** | **€83,220** | **€94,454** | **233.89** |

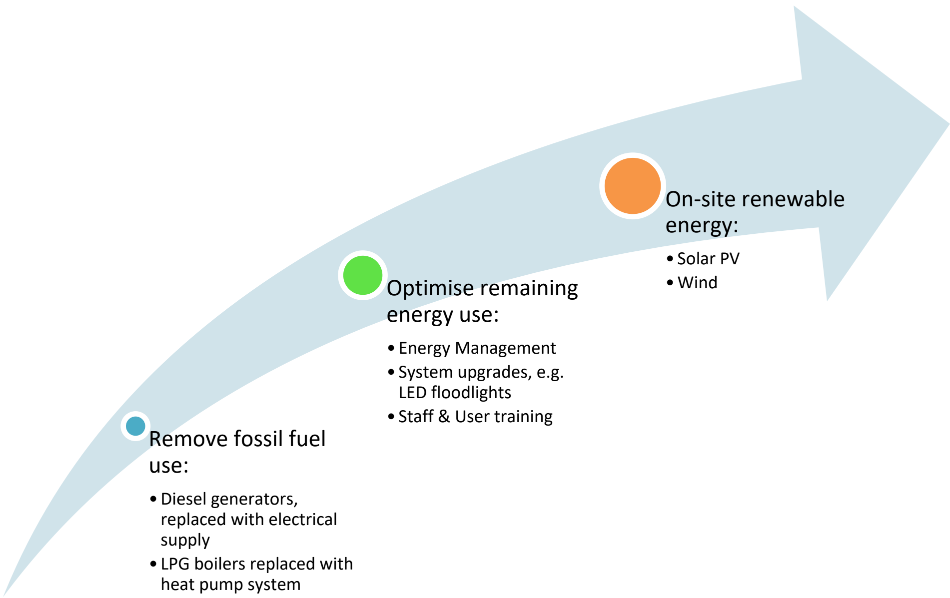
## Current energy use – Connacht GAA Clubs

Working with clubs across the province and with Mayo GAA County Board, an online survey of over 50 GAA clubs was conducted to establish to categorise regional clubs based on annual energy costs. Taking these clubs as a representative baseline gives a broad indication of an energy baseline cost for the regional clubs, as set out below. It is noted that due to increased energy costs since the survey, many clubs will have moved to higher cost categories.

| **Regional club energy costs** | | | | |
|---|---|---|---|---|
| **Annual energy cost** | <€2,500 | €2,500 - €5,000 | €5,000 - €10,000 | >€10,000 |
| **Cost category** | Very low | Low | Medium | High |
| **% of responses** | 39% | 49% | 5% | 7% |

## Recommendations for carbon reduction at the Centre of Excellence

This roadmap illustrates the key route to carbon neutrality in energy use at the Centre.



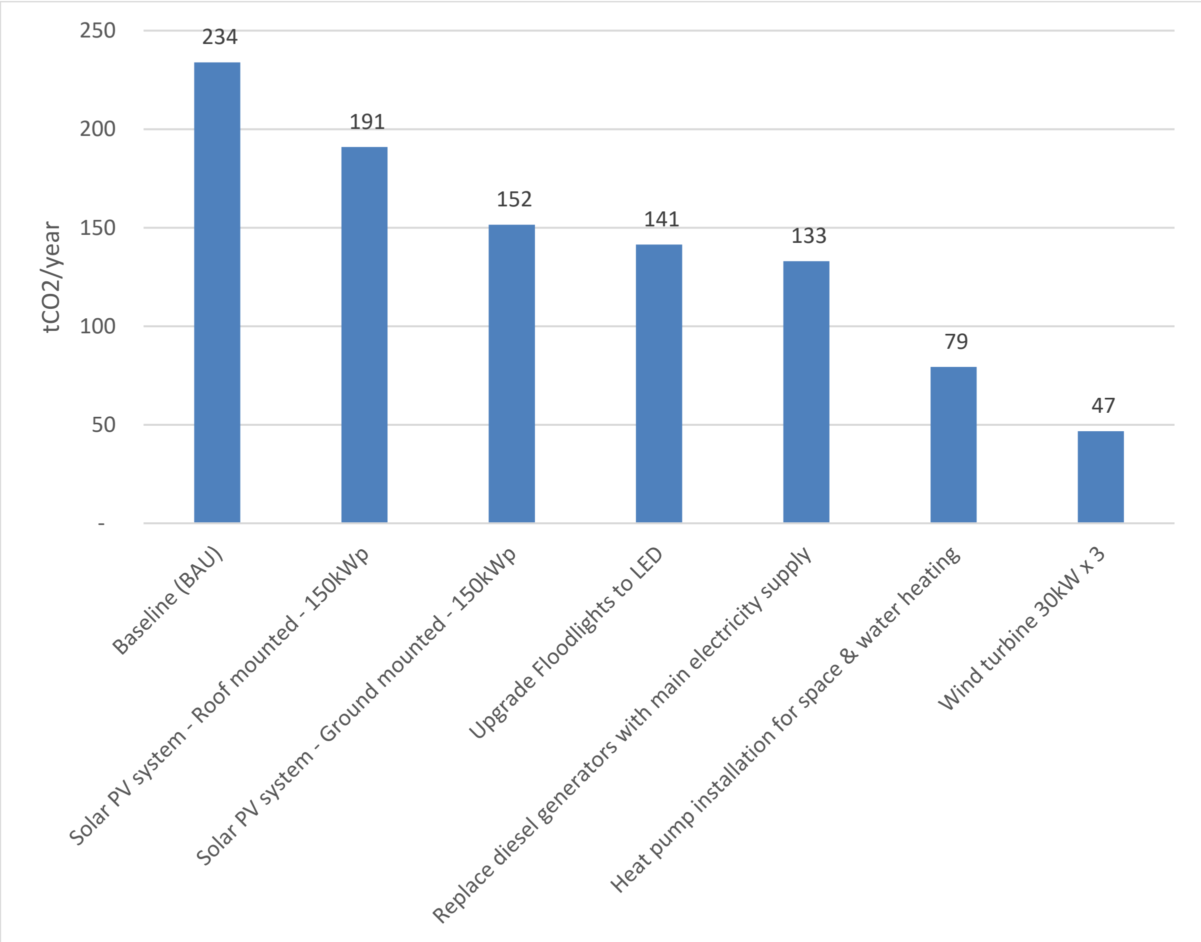

**Route to Carbon Neutrality**

The table below provides a high-level outline of options to carbon neutrality against the 2020 baseline and the opportunities discussed in this study.

| **Project pathway to carbon reduction** | | | | | | |
|---|---|---|---|---|---|---|
| **Project order** | **Step / project** | **Initial investment cost** | **Simple payback** | **Year 1 energy saving (€)** | **Annual emissions reduction ($tCO_2$)** | **Baseline emissions after project** |
| 0 | Baseline | | | €0 | | 234 |
| 1 | Solar PV system - Roof mounted - 150kWp | €81,500 | In Year 3 | €29,198 | 43 | 191 |
| 2 | Solar PV system - Ground mounted - 150kWp | €135,000 | In Year 5 | €26,781 | 39 | 152 |
| 3 | Upgrade Floodlights to LED | €220,000 | In Year 7 | €10,212 | 10 | 141 |
| 4 | Replace diesel generators with main electricity supply | €3,000 | In Year 9 | €311 | 8 | 133 |
| 5 | Heat pump installation for space & water heating | €75,000 | In Year 4 | €13,885 | 54 | 79 |
| 6 | Wind turbine 30kW x 3 | €150,000 | In Year 8 | €20,971 | 33 | 47 |

**Potential savings of €2.5m over the life span of equipment.

The options shown on the previous table are taken as sequential. The reductions in CO2 are illustrated below.




**Pathway to emissions reduction**

The proposed projects represent in 80% reduction in GHG emissions for the centre. The remaining $tCO_2$/year are associated with the reduced reliance on electricity supplied from the national grid.

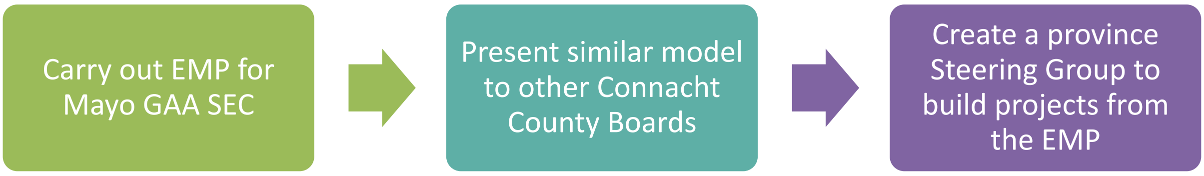
The Government has set a policy goal of an 80% reduction in GHG emissions from the energy system. Studies have projected a carbon intensity for grid electricity in 2050 of 38 $gCO_2$/kWh.

Further options for carbon neutrality for the Centre could include:

- Increased use of site generated renewable electricity:
    - Battery storage
    - Diversion to hot water
- Increased export of clean energy (offsetting):
    - More wind or solar PV projects
    - Supply of site material to AD biogas plants
- Creating larger long term carbon sinks e.g. increased tree planting

## Action plan for Connacht GAA clubs

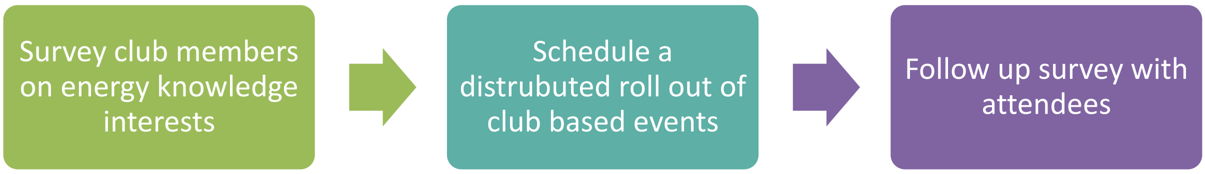
The plan for Connacht GAA clubs includes actions for the clubs at each county level and also an engagement plan for club member. The main action plan for the clubs is illustrated below:




**Action Plan for Community-based clubs**

The EMP design for the County scale GAA SECs will be based on the energy cost categories, as detailed previously, and will leverage the GAA Green Clubs toolkits.

The proposed action plan for club members is illustrated below:




**Action Plan for club members**

This action plan will seek support from the SEC mentor team and other SEAI resources.

# 1. Introduction

## 1.1. Connacht GAA

The Sustainable Energy Authority of Ireland (**SEAI**) has established a dedicated Sustainable Energy Communities (SEC) Network. The **SEC Network** is a support framework designed to enable a better understanding of how communities use energy and to save energy across all sectors. The Network's core purpose is to catalyse and support a national movement of SECs operating in every part of the country.

Connacht GAA joined the Sustainable Energy Community (SEC) network in 2019 to continue our commitment to supporting a sustainable future both within our organisation and among our members. We are also on the National Steering Committee for the Green Club project, which is a partnership between the GAA, LGFA and Camogie Association and local authorities across Ireland. The Green Club project is an all-island programme, structured around five main thematic areas:

- Energy
- Water
- Waste
- Biodiversity
- Travel & Transport

Connacht GAA are now entering into a Partnership Agreement with SEAI to access technical supports and develop an **Energy Master Plan (EMP)**.

## 1.2. Connacht GAA Energy Master Plan

This EMP provides a roadmap for the transition of the Connacht GAA Centre of Excellence towards becoming more energy efficient and harnessing renewable energy opportunities. The objective is to achieve Carbon Neutrality for Connacht GAA Centre of Excellence as a demonstrator to other centres, regional clubs and other partners. The EMP also examines energy use in GAA community-based clubs and explore common solutions at different club scales. The objective will be to disseminate the solutions and technologies being implemented in the Centre of Excellence and engage with clubs and members across the region to work collaboratively toward sustainable energy use.

The EMP Will also illustrate how energy could be supplied locally in a low carbon manner, in the future. The document will then be used within the local planning process to help determine development within the Connacht GAA SEC Area, and to ensure that it meets the community's priorities and wishes and that it will enable Connacht GAA to become a Carbon Neutral organisation.

This Energy Master Plan is supported by SEAI and contributors to the technical and qualitative analyses include Global Green and the Atlantic Technological University (ATU).

**Fig 1. EMP contributors**

## 1.3. Policy Context

The Irish Government has approved a new climate action bill that will put the country on the path to net-zero greenhouse gas emissions by 2050.

The Climate Action and Low Carbon Development Bill contains a National Climate Objective and commits Ireland to "pursue and achieve" carbon neutral status by the end of 2050.

The policy seeks to achieve a 51% reduction in Ireland's emissions by the end of the decade and would enable the transition to a climate-resilient, biodiversity-rich, environmentally-sustainable, and climate-neutral economy by 2050. Among the key energy policy target for 2030, the following are of particular relevance to Connacht GAA:

- Develop and enhance initiatives to educate and enable organisations to contribute to our national energy and emissions targets
- Phasing out fossil fuel heat throughout all buildings
- Increase the proportion of renewable electricity to up to 80%, including an expected 260MW from microgeneration

## 2. Community-based club engagement

The network of GAA community clubs, across the island or Ireland, is an extensive pathway to local engagement. The location of all GAA pitches is available at the GAA Pitch Finder[1], as illustrated below.

**Fig 2. Connacht GAA pitches[1]**

The community clubs present a valuable opportunity to communicate sustainable energy information, both for the clubs themselves and their members' homes and businesses. Many smaller GAA clubs may not have significant energy use or costs, but can still provide a local venue or focal point for energy awareness raising.

[1] https://www.gaapitchfinder.com/

## 2.1. GAA Clubs survey

### 2.1.1. Energy costs

Working with clubs across the province and with Mayo GAA County Board, an online survey of over 50 GAA clubs was conducted to establish to categorise regional clubs based on annual energy costs. A total of 41 responses were received. Taking these clubs as a representative baseline gives a broad indication of an energy baseline cost for the regional clubs, as set out below.

**Table 1. Regional club energy costs**

| Annual energy cost | <€2,500 | €2,500 - €5,000 | €5,000 - €10,000 | >€10,000 |
|---|---|---|---|---|
| **Cost category** | Very low | Low | Medium | High |
| **% of responses** | 39% | 49% | 5% | 7% |

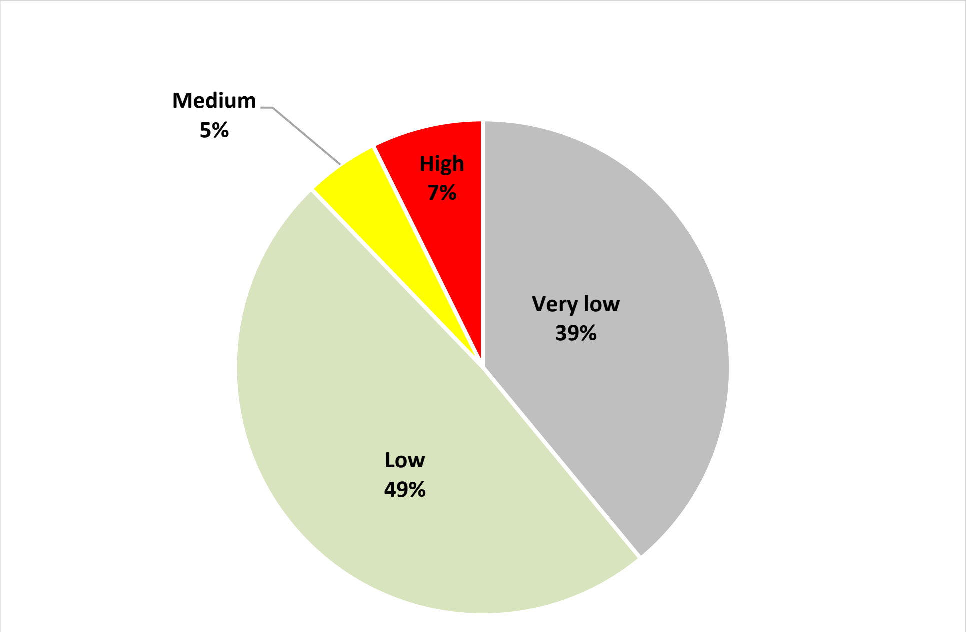



**Fig 3. Breakdown of energy cost categories from county wide club survey**

As the survey shows the majority of regional clubs are in the very low and low energy use categories, as would be expected. It is also observed that many of the lower energy use clubs have floodlights on their pitches. While floodlights will have a high-power demand when in use, it is the total hours of operation that impacts on the overall energy costs.

The clubs in the medium and high energy use categories tend to be larger clubs with indoor spaces and that are used regularly. From the survey, the key factors that appear to influence higher energy use are set out in the table below.

| **Table 2.** | **Factors influencing energy use** |
|---|---|
| **Factor** | **Notes** |
| Regular use | Higher energy use is expected the more the club is used i.e. more days per week and used all year round. |
| Indoor facilities | Clubs with indoor sports halls, gyms and function rooms that are used regularly by the community tend to have higher energy use. |
| Multipurpose sites | Clubs that serve as a local community resource centre are generally used more often e.g. for community and local committee meetings, or as a school sports facility. |
| Commercial activities | Clubs with bars, commercial gyms, rented space. |

These factors indicate that maximising club utilisation is in itself a key pathway to optimising energy use. Investing in energy upgrades will have a greater impact for a club that is in use for more time. This must be taken into account when considering the significant energy users detailed in the following sections.

### 2.1.2. Significant Energy Users

The club survey indicates that clubs tend to have common Significant Energy Users (SEU, i.e. a system which consumes a high proportion of overall energy over time). It is worth restating that an energy system with a high-power demand will only be an SEU if it is used on a regular basis. The common SEUs are outlined in the table below.

| **Table 3.** | **GAA club Significant Energy Users** | |
|---|---|---|
| **System** | **What makes this a Significant Energy User?** | **Potential measures to reduce energy and CO2** |
| Pitch Floodlights | Non-LED systems will have significant high power demand (Wattage).<br><br>This will be an SEU if the lights are used for most months of the year and on more evenings per week.<br><br>Many floodlight systems are run on diesel generators rather than the club electricity. This increases the CO2 emissions impact. | If an SEU:<br>• Consider upgrading the electricity connection to remove the need for diesel generators<br>• Upgrade to LED fittings |
| Hot water for showers | Clubs with regular shower use for training, matches and gym, e.g., multiple times per week. | If an SEU:<br>• Reduce heat loss from hot water system by lagging pipework, valves and tanks.<br>• Ensure proper heating controls to only heat the water when it is required<br>• Consider heat pump systems |

| Table 3. GAA club Significant Energy Users | | |
|---|---|---|
| **System** | **What makes this a Significant Energy User?** | **Potential measures to reduce energy and CO2** |
| Space heating | Clubs with sports/function halls used for community events e.g., weekly bingo, meetings, groups | If an SEU:<br>• Reduce heat loss by increasing/improving insulation and airtightness.<br>• Ensure proper heating controls to avoid heating areas that are not in use.<br>• Consider heat pump systems. |

### 2.1.3. Diesel generators & floodlights

The use of diesel generators is common in clubs of all sizes that use floodlight systems. The reason for this is as follows:

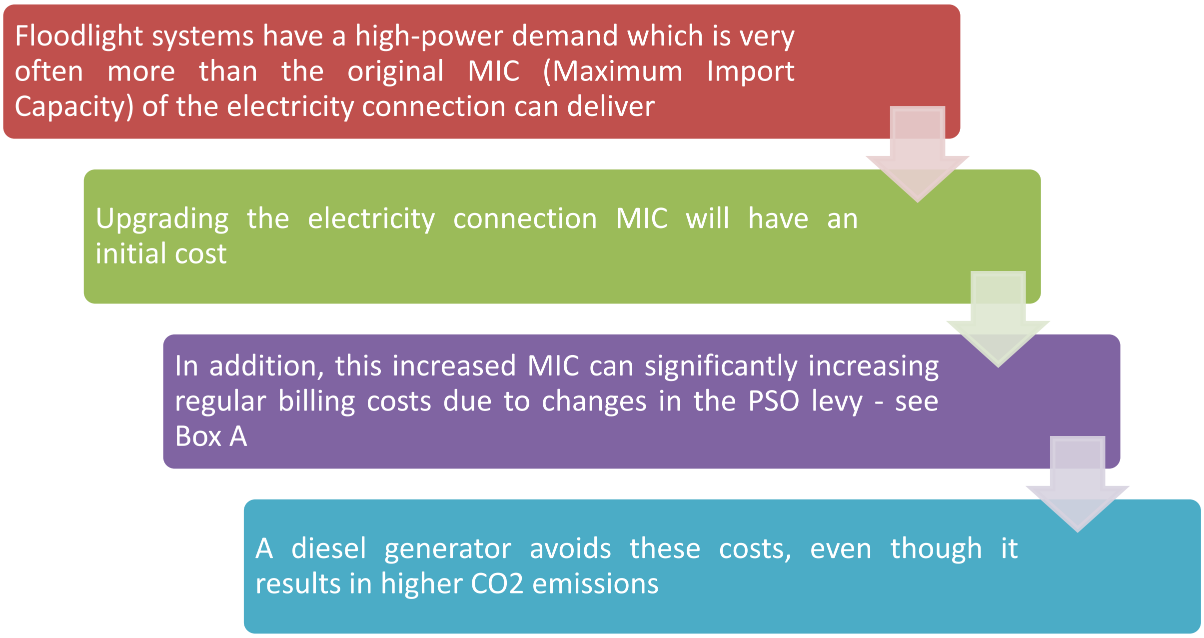



**Fig 4. Rational for use of diesel generators**

**Box A**

**MIC and your PSO Levy:**

The PSO levy is **variable** and set by the Commission for Regulation of Utilities on an annual basis from 1st October to 30th September.

The PSO levy rates for businesses from 1st October 2020 to 30th September 2021 were:

- PSO where MIC < 30kVA = €21.41 per month
- PSO where MIC => 30kVA = €2.78 per kVA per month

The current PSO levy rates for businesses from 1st October 2021 to 30th September 2022 are:

- PSO where MIC < 30kVA = €13.63 per month
- PSO where MIC => 30kVA = €1.63 per kVA per month

The CO2 impact is compounded by the use of agricultural ('green') diesel in the generators. Discussion with the regional clubs has shown that an economic case for moving away from diesel is very challenging, as the cost for LED upgrades and the increased electricity costs generally result in very long payback periods. The key factor for this, as referred to previously, is the amount of time the floodlights are used.

A more in depth 'sensitivity' analysis has been carried out to examine the economic case using operating hours as the key variable. This analysis considers the following Floodlight system options:

**Table 4. Analysis for floodlighting options**

| Option | Option 1: Existing floodlights on electricity | Option 2: Upgrade floodlights on electricity | Option 3: Existing floodlights on diesel generator |
|---|---|---|---|
| **Floodlighting system** | Existing system with 40No. 2.2kW lights | Upgrade to 40No. 1kW LED lights | Existing system with 40No. 2.2kW lights |
| **Energy source** | **Main electricity connection** | **Main electricity connection** | **Diesel generator** |
| **Description** | Increase the MIC (Maximum Import Capacity) to 95kVA and run the existing floodlights at full capacity from the electric connection | Upgrade the floodlights to LED and run from the existing 49kVA MIC electricity connection | Purchase a diesel generator to run the existing floodlights |
| **Notes** | Will require a new MIC agreement with ESBN which may have initial costs. Will increase PSO costs which are linked to MIC. | Significant investment that will reduce running costs. The more the lights are used the greater the savings. | Will require initial cost of new generator. |
| **Capital investment (if applicable)** | €3,000 | €70,000 | €15,000 |
| **Grant funding (if applicable)** | €0 | €30,000 | €0 |
| **Net Capital investment** | €3,000 | €40,000 | €15,000 |

Initial investment costs have been based on recent project research for all options. As shown, Option 2 assumes grant support of C.40% for the LED lighting upgrade.

Running costs are based on total system power demand, costs of electricity and agricultural diesel, with operating hours as the key variable. The graphs below show the cumulative cost for 15 years for the following operating hours:

- **Low use model:** 1.5 hours, 3 nights per week, 22 weeks per year = **99 hours**
- **High use model:** 2 hours, 4 nights per week, 30 weeks per year = **240 hours**

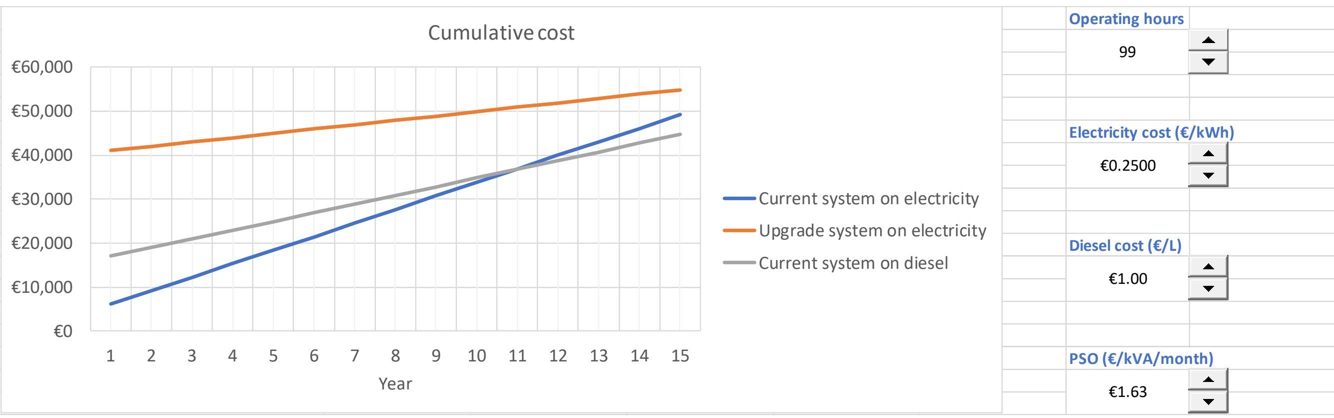



**Fig 5. Low use model (99 hours per year)**

The analysis of the Low use model indicates that the optimal economic case over 15 years is to maintain the existing floodlights and install a diesel generator to serve this demand. The main factors which will influence this are:

- Cost of electricity
- Cost of diesel
- Changes in the PSO levy (reviewed by the Regulator annually)
- Costs for light replacement over time

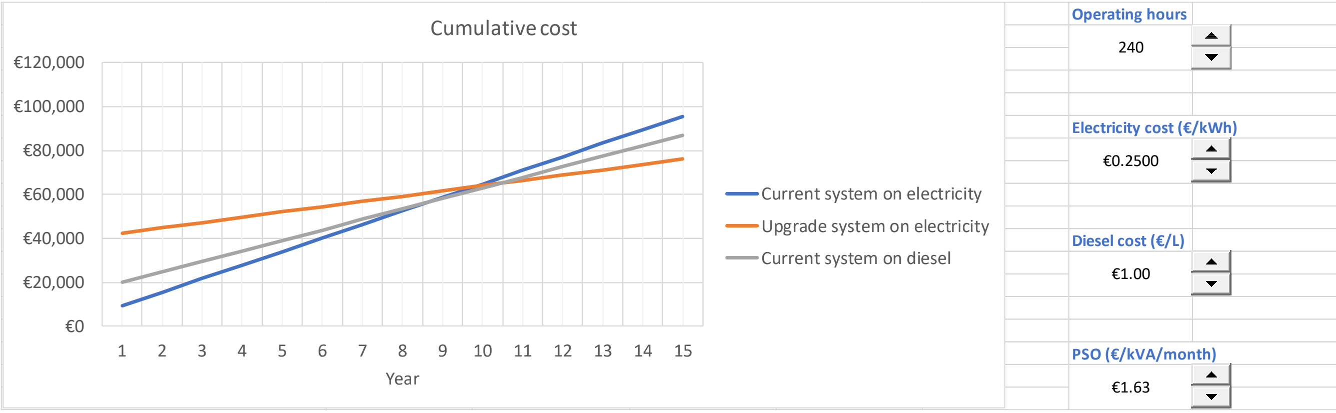



**Fig 6. High use model (240 hours per year)**

The analysis of the High use model indicates that the optimal economic case over 15 years is to upgrade to LED floodlights and maintain the existing electrical connection to serve this demand. The main factors which will influence this are:

- Cost of electricity
- Cost of diesel

LED lights will generally have a design life in excess of 50,000 hours. Even in this High use model, this far exceeds the 15 year timeframe examined here.

Increased use of floodlight systems will improve the economic case for moving away from diesel generators. However, in discussion with clubs it is clear that this has other implications to consider:

- Floodlights are generally installed first on main pitches used for matches
- Using the main pitch for training increases pitch maintenance requirements

## 3. Community club audits

Energy audits of the clubs listed below were carried out with the cooperation of club members. Each club has received an energy audit report with guidance on their current energy use and a register of opportunities to take forward. These audits provided the clubs with clarity on investment choices such as LED flood lighting and Solar PV.

- Glavey's GAA
- Ballintubber GAA
- Moygownagh GAA
- Dunmore McHales Galway
- Páirc Seán Mac Diarmada

# 4. Connacht GAA Centre of Excellence

The Connacht GAA Centre of Excellence began its biodiversity and sustainability journey back in 2008 with the plantation of 5 acres of ash in conjunction with the construction of our first 5 pitches. Since its initial inception various other Sustainability and Biodiversity programs have been undertaken. During 2010-11 the fairy fort on site was fenced and secured, as part of this upgrade project new walkways were constructed around the site boundary covering just under 2km. This project in particular has been of huge benefit to our local community, indeed through the recent pandemic it has been an extremely beneficial facility for our local community to have and use.

By 2012 the addition of our administration building seen the installation of a 72,000ltr rainwater harvesting tank. Through 2013-14 this harvested rain water was connected to all our toilets onsite and by 2015 this water was better managed by the installation of solenoid valves and motion sensors throughout our sanitary system. The construction of the building also included a building management platform to assist in managing key elements of our energy needs.

In 2019 with assistance from our local Community Organisation CLÁR we upgraded all our lighting on site to LED, at this point all our lighting is LED bar our pitch lighting which we hope to upgrade as part of our sustainability road map. In early 2020 we installed movement sensors and photocells to control our public lighting. All our dressing rooms, public lighting and communal areas are now automated. 2020 also seen the introduction of our first Biodiversity and Sustainability section to our weekly staff meeting, this has given us a platform to begin to engage our staff on all sustainability and biodiversity elements. It allows us to begin education and culture change around the various thematic areas. A big part of this weekly meeting is driven by data, data which we gather through metering all our energy sources, Diesel, Electricity, Water and Gas. These meters were installed as part of a building management system upgrade in 2021, the data collected allows us to measure performance around energy efficiency from a human view point and introduce key performance indicators within our team. This leads us to best practice across the various Thematic areas.

Q1 of 2021 also seen us hit a major milestone with the formation of the Connacht GAA Sustainability and Biodiversity Committee. The committee includes experts from various fields such as Technology, Engineering, Local Government, Energy Agencies, Biodiversity and Sustainability, these experts volunteer their time. The committee compromises of Kurt Reinhardt, Brian Mangan, Attracta Hunt of Connacht GAA, Brendan Heaney of Tobin Engineering, David Mellett the North West Regional Climate Action Co-ordinator, Liam Scott of Mayo County Council, Margie Phillips of Teagasc. I'd like to take the opportunity to thank them for the time volunteered to our efforts at the center. I'd also like to thank Mel Gavin of ATU for his advice and guidance. We believe the actions and output from this expert group will stand to Connacht GAA and the local community for generations to come.

Also, in 2021 we began our first Biodiversity Community project with our local community. We engaged the TY classes in the locality to become involve and indeed drive a plantation project of wild flowers and native trees, this was successfully completed and has now become a program we will build on year on year with the 3 schools involved, St Colmans College, Swinford and Charlestown.

2021 saw our second Biodiversity Community Project with the construction of our first "Bug Hotels". The TY classes of 2021 spent a day a week on site designing, collecting materials and constructing these hotels. They have been a huge success.

The efforts in biodiversity have lead us to plant 7,000 trees and hedgerows at the centre to help with wind break and shelter belts for our pitches. These trees will also enhance the environment through carbon extraction and indeed wildlife habitat.

We became a Sustainable Energy Community (SEC) in 2021 and are now about to publish this Energy Master Plan in Q3 2022 which we have developed. It will lead Connacht GAA Centre of Excellence on a 3 phased change program to renewables over the next 5 years. This program will include completion of 1,000 solar panels, 3 wind turbines and air to water heat pumps, details of the various projects are explained in this document. The excess power produced is currently spilled onto the ESB at no charge BUT we will be a formal exporter of Electricity to the ESB from October.

Q2 2021 also saw the start of our third Biodiversity project in conjunction with our local Bee Club. The month of March has seen the introduction of 4 beehives to our Centre, currently we have approx. 40,000 bees which will expand. These bees continue to positively impact our local environment.

There are four further programmes which we completed in 2021. A software measurement & Management System which monitors and measures our Electricity, Pitch lights, Dome and main building, Solar harvesting, Diesel usage, our gas usage and water usage. This system gives us a live view to running costs and performance in these areas leading us to better decision making, better cost management, behaviour change and implementation of new policies.

The software installed also connects directly to our waste suppliers where live data such as weights are collected. This data will drive our waste and recycling policies and change programs into the future.

We have also repainted the building at the centre with an Eco-friendly lime based paint, this has a 7 times longer life span to normal paint and allows the building to breath essentially stopping paint from peeling in bad weather conditions. The building now extracts the same amount of carbon from the atmosphere as 5 fully grown tree. Graphestone the supplier donated 5 Oak Tress representing each county in our province, these trees have been planted on our walkways and will be clearly marked in 2023 with seating and signage of each of our 5 counties.

2022 will also see the expansion of our walkways with a further kilometre being added and 2023 will hopefully see delivery of our own well onsite which will drive various future projects through water and waste. With our water projects we also intend to install a reed bed off our sewerage percolation.

Our future roadmap will see us strive for Carbon neutrality with addition of various programs in Quality, Education, Open days in our new Air Dome with our partners and community partners, it will see further technology enhancement around wind and Air to water technology and will see extension of our existing walkways. We have begun formal process to achieve Carbon Neutrality in 2023/24 through an international certification process.

Beyond 2021/22 we look forward to being involved with the national Green Clubs program and playing our part with communities in the region. As part of this program the Center of Excellence is the regional technology center for the program, for our clubs and county grounds to see and learn best practice in various areas. We are currently mentoring various county grounds and county boards nationally. Our efforts as part of this program hope to deliver free car charging to every club, where the money earned from the charging of cars will remain within clubs as new potential revenue stream for the club, a Co-Op type system. I would also hope that these efforts will see county boards qualify as SEC`s (Sustainable Energy Communities), this will allow collective energy grant applications on behalf of clubs and county grounds maximising grant availability and educational programs. It is envisaged that these County Board SEC will sit and be controlled and managed by each county boards development committee.

Sustainability and Biodiversity is a important part of the world that we now live in, Connacht GAA are now leaders within our organisation and nationally in this area at the Centre of Excellence. The programs we are running potential savings with new revenue streams and these earnings should enhance the funding of our games and education programs in the future.

The Centre has always been Centre of Excellence and ground breaker from a sporting perspective, our vision is for the Centre to be a leader in the community and indeed a Centre of Excellence in Biodiversity and Sustainability.

## 4.1. Energy Baseline

The table and charts below outline the energy consumption and associated CO2 emissions from the Connacht GAA Centre of Excellence for 2020.

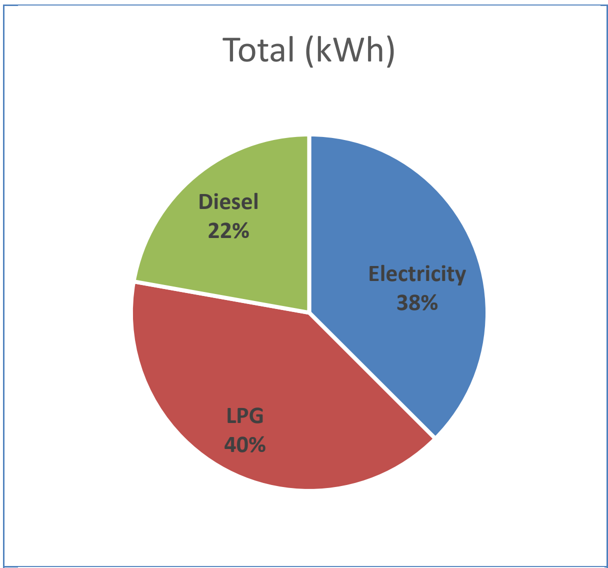
**Table 5. Energy Baseline (from 2020 data)**

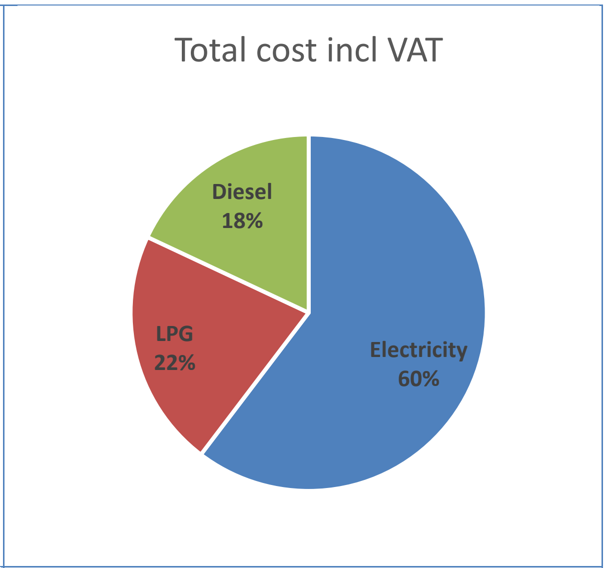
| Energy source | Quantity [kWh] | Cost (excl. VAT) | Cost (incl. VAT) | CO2 Emissions [t] |
|---|---|---|---|---|
| Electricity Imported | 334,800 | €50,220 | €56,999 | 99.03 |
| LPG | 359,971 | €18,000 | €20,430 | 82.54 |
| Diesel for Generator to power Floodlights | 198,218 | €15,000 | €17,025 | 52.31 |
| **Total** | **892,989** | **€83,220** | **€94,454** | **233.89** |

**Notes on the Energy Baseline:**

- CO2 emissions and costs are based on 2020 figures provided by SEAI[2].
- The Energy Baseline presented here includes imported (grid supplied) electricity, LPG for space and water heating and diesel used in generators for floodlights.
- CO2 emission of grid electricity in Ireland is projected to reduce significantly by 2030 due to the target for 80% of all electricity from renewable sources.
- Diesel generators are approx. 40% efficient, i.e. 60% of the total diesel energy is lost from the system as waste heat. **This makes the diesel generators the most intensive CO2 emitters in terms of useful kWh/tCO2.**

[2] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/



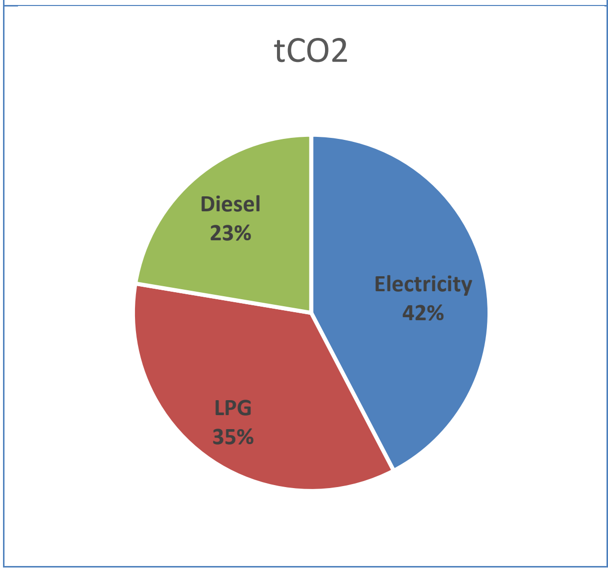




**Fig 7. Charts showing the distribution of energy impacts from the various sources**

## 4.2. Significant energy users & opportunities

The following sections consider the systems and areas that have significant energy use and also takes into account the associated emissions.

### 4.2.1. Electricity and diesel use

Grid electricity accounts for 38% of energy consumed at the Centre. In 2020 this represented 60% of energy costs and 42% of CO2 emissions. It should be noted that the CO2 emission of grid electricity in Ireland is projected to reduce significantly by 2030 due to the target for 80% of all electricity from renewable sources.

The diesel use on site is also used to generate electricity for the external floodlights. It is worth noting that the diesel generators are approx. 40% efficient, i.e. 60% of the total diesel energy is lost from the system as waste heat. **This makes the diesel generators the most intensive CO2 emitters in terms of useful kWh/tCO2.**

The Significant Energy Users (SEUs) and opportunities for electricity and diesel use are outlined below.

**Table 6. SEUs Electricity and diesel**

| SEU | Notes & Opportunities |
|---|---|
| **Air Dome** | The Air Dome is modern State of the Art facility. The key opportunities to maintain high efficiency are:<br>○ Scheduled maintenance and servicing of systems including inflation fans, air handing etc.<br>○ Regular review of energy use and BEMS to monitor for changes<br>○ Staff and user training |
| **Floodlight and site lighting systems** | Some of the external floodlights are currently powered by diesel generators. This is a significant CO2 emitter for the site and also results in local air and noise pollution. The key opportunities are:<br>○ Conversion of all existing floodlights to LED<br>○ Removal of diesel generators<br>○ Occupancy/use-based controls for site lighting e.g. walking tracks |
| **General electricity use** | The key opportunities to maintain high efficiency in electricity use are:<br>○ Staff and user training<br>○ Regular review of energy use and BEMS to monitor for changes<br>The site has significant opportunities for on-site renewable electricity which are explored in the following sections, including:<br>○ Solar PV<br>○ Wind |
| **Renewable electricity generation (for export)** | As noted above the site has significant opportunities for on-site renewable electricity generation. The emerging Small-Scale Generation (SSG) support scheme invites a further opportunity for generation of renewable electricity for export, as a revenue stream for Connacht GAA. At the time of writing the SSG scheme is at public consultation[3], with targets to be launched in 2023. |

[3] https://www.gov.ie/en/consultation/353f2-consultation-on-a-small-scale-generation-support-scheme-ssg-in-ireland/#:~:text=Small%2DScale%20Generation%20is%20defined,consumers%20for%20installations%20below%2050kW.

#### 4.2.1.1. *LED lighting upgrades and removal of diesel generators*

The Centre of Excellence is continuing to progress the upgrade of all site lighting to energy efficient LED. In conjunction with this the Centre will examine the option to use the main electricity supply in lieu of diesel generators. The factors to be considered as identical to those referred to for the community clubs, and include:

- Cost of electricity
- Cost of diesel
- MIC requirements and associated cost

Taking the LED lighting upgrades in isolation, there are significant benefits, as illustrated below:

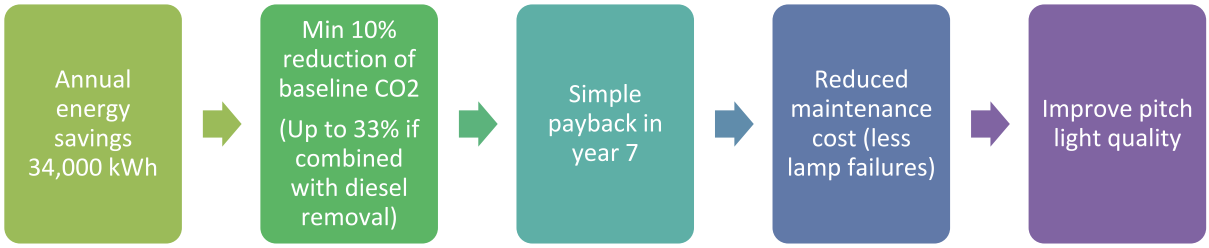



**Fig 8. Proposed LED lighting benefits**

If the further measure is taken to supply the lighting demand with electricity only, removing the operation of the diesel generators, then the following benefits will also be achieved:

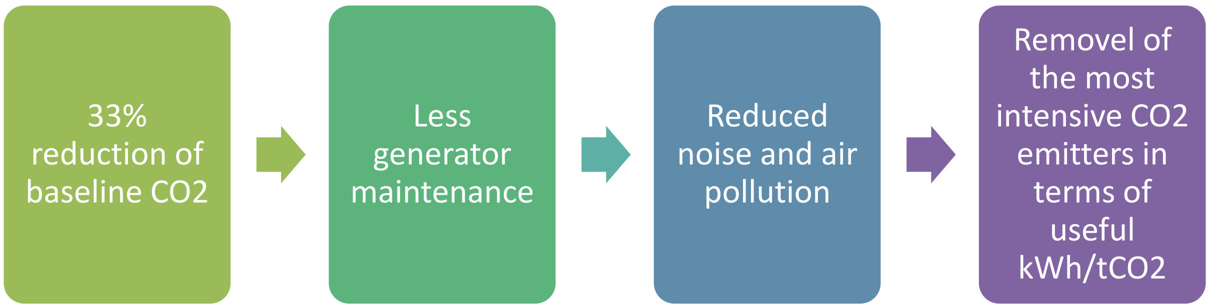



**Fig 9. Proposed removal of diesel generator benefits**

### 4.2.2. Space and Water Heating

The Centre of Excellence Building is up to current building standards in terms of insulation, windows doors and building services. Therefore, no further major fabric upgrades are recommended at this time. Building maintenance and energy management are also performed well on-site.

Space and water heating systems are currently served by LPG boilers, installed in 2012. In 2020 LPG use accounted for 38% of all $CO_2$ emissions for the centre. As the $CO_2$ intensity of grid reduces as we approach 2030, the significance of the LPG associated $CO_2$ will increase. This is also the case as any renewable electricity systems are installed on site, which is currently underway.

The Significant Energy Users (SEUs) and opportunities for heating systems are outlined below.

<table>
<tr><th colspan="2">Table 7. SEUs Heating</th></tr>
<tr><th>SEU</th><th>Notes & Opportunities</th></tr>
<tr><td>Space heating</td><td>Currently provided by 2 No. Ferrol Energy W80 (17kW – 75kW) Condensing LPG boilers.


If the centre chooses to retain these boilers for the remainder of their design life, then maintaining a high unit efficiency will be the priority for that timeframe:<br>
○ Scheduled maintenance and servicing of systems including inflation fans, air handing etc.<br>
○ Staff and user training<br><br>
At some point the LPG boilers will require replacement. From a sustainability perspective there are 2 key options to consider:<br><br>
1) Heat Pump systems:<br>
○ Air or ground source options<br>
○ Heat distribution system may require modification e.g. larger radiators<br><br>
2) Biomass systems:<br>
○ Will require more technical skills on-site<br>
○ Will require biomass fuel store and large buffer tank<br>
○ Air quality must be considered in design of the system</td></tr>
</table>

| Table 7. SEUs Heating | |
|---|---|
| **SEU** | **Notes & Opportunities** |
| **Water heating** | Currently provided by 1No. floor standing Heatmaster 85TC Condensing LPG boiler.  **Same opportunities as above apply** |

### *4.2.2.1. Heat pump system to replace LPG use*

LPG use represents the largest energy cost and second largest CO2 emissions for the baseline year. As the main fossil fuel used on site, LPG is a key target for the decarbonisation of the centre. There is a significant opportunity to avoid all LPG carbon emissions by installing a heat pump system.

A brief specification to replace the LPG boilers with a heat pump system was prepared to seek outline proposals from suitable suppliers – see Annex 2. The specification included details of the existing boilers and data from the BEMS showing LPG and water consumption. Further to the outline proposal received from the supplier, a financial analysis is also provided in Annex 2. The benefits of this option are illustrated below:

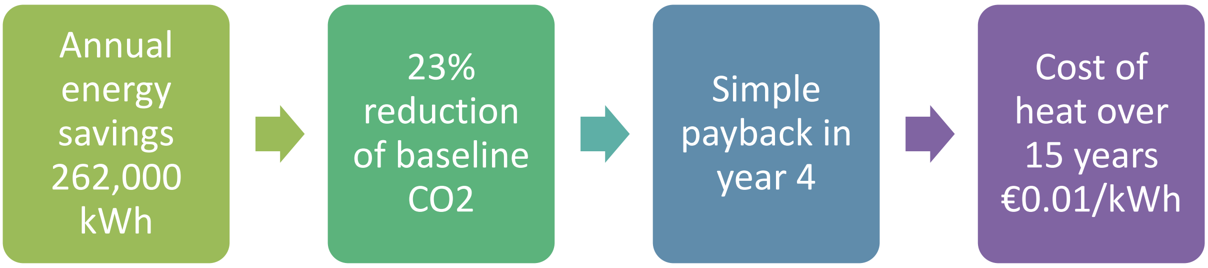



**Fig 10. Proposed Heat Pump system benefits**

### 4.2.3.

### 4.2.3. Renewable electricity opportunities

The Centre is well suited to on-site renewable electricity generation due to its location and scale. The key options examined here are wind and solar energy. These energy resources tend to be variable, but somewhat predictable, as shown below.


**Fig 11. Site layout with proposed Renewable Energy locations**

#### *4.2.3.1. Planning requirements*

For planning requirements, proximity to designated areas such as Special Areas of Conservation (SACs) must be considered. While some relaxation of Solar PV planning has been announced in October 2022, the size of the systems proposed in this report will still require planning permission.

A planning application for a wind energy project is likely to raise some concern in the local community. It is recommended to consult with the local community prior to such an application, to clarify the scale of the development as appropriate to the site.

#### *4.2.3.2. Exporting excess electricity*

Payments for exported renewable electricity are now available for systems up to 50kW as part of the Microgeneration Support Scheme (MSS). The Small-Scale Generation (SSG) support scheme is still in design, and expected to be launched in late 2023. This scheme will provide export payment for systems larger than 50kW and up to 6MW.

An export connection must be agreed with ESB Networks prior to any export payment. An application must be made to ESB Networks, regardless of who your electricity supplier is. The type and cost of the grid connection will depend on your existing electricity connection and the proposed size of your renewable generator system, and some outline details are shown below:

| **Table 8. Export connection details** | | |
|---|---|---|
| **Microgeneration connection[4]:** | **Mini-generation connection[5]:** | **Small-scale generation** |
| ○ Up to 6kW for singe-phase electricity connection<br>○ Up to 11kW for 3-phase electricity connection<br>○ No connection fees<br>○ Simple 'inform and fit' process using form NC6 | ○ Up to 17kW for singe-phase electricity connection<br>○ Up to 50kW for 3-phase electricity connection<br>○ **Connection fees: €977.85 (inclusive of VAT at 23%)**<br>○ Form NC7 | Information on grid connections in this scale can be found at: https://www.esbnetworks.ie/new-connections/generator-connections-group/small-scale-generation |

### *4.2.3.3. Economic analyses*

The electricity from renewable energy systems is often mistakenly referred to as **"free electricity"**, but the system has been paid, so **it's not free**. The investment will provide the site with an annual generation of some electricity for 20 years or more, i.e. your investment is buying you this supply of electricity. What this electricity is actually costing you, is referred to as the **Levelised Cost of Electricity (LCOE)**, using the following formula:

$$\textbf{LCOE over 20 years} = \frac{\textbf{Total system life investment cost (€)}}{\textbf{Total generation over 20 years (kWh)}}$$

Most of the investment for wind and solar PV is upfront, but there may be some servicing and component replacement costs during lifetime which should be included in the calculation.

- **NOTE:** LCOE is not affected by how much you export**, but the value to you is**
- For every kWh you export, the value to you = Export payment minus the LCOE
- For every kWh you self-consume, the value to you = Cost of electricity from you supplier minus the LCOE
- **Self-consumption will provide greater value against your investment than exporting and reduce the payback period**

### *4.2.3.4. Wind energy*

The proposal explored in this report is for a number of small wind turbines located appropriately around the site. This study is based on 3No. 30kW turbines spaced appropriately on the site. A typical 30kW turbine setting is illustrated below.

---

[4] https://www.esbnetworks.ie/help-centre/generator-connections/connect-a-micro-generator

[5] https://www.esbnetworks.ie/new-connections/generator-connections-group/mini-generation


**Fig 12. Typical 30kW wind turbine**[6]

Detailed information on the Wind energy analysis is provided in the Annex 3 to this report. In summary the 3No. 30kW wind turbines would achieve the following impacts:

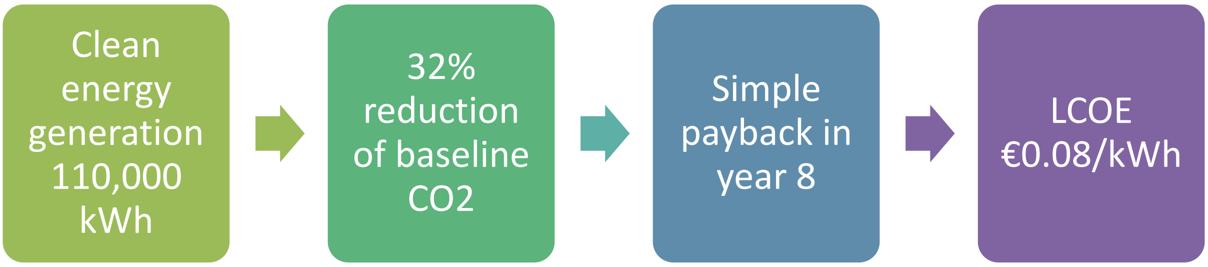



**Fig 13. Proposed wind energy benefits**

A Service contract should be considered for any wind turbine project to reduce risks associated with mechanical wear and component replacement.

### *4.2.3.5. Solar PV*

Currently there is a 150kW roof mounted solar array in place which has used up almost 100% of the roof space on the main building as illustrated below. This system is almost 12 months in operation and has provided positive performance data.

[6] https://en.wind-turbine-models.com/turbines/1612-zenia-energy-30kw


**Fig 14. Roof mounted 150kWp Solar PV in place at the Centre of Excellence**

An additional 150kW ground mounted is currently in progress for the site. Detailed information on the analysis for the ground mounted system is provided in the Annex 4 to this report. In summary the Solar PV system will achieve the following impacts:

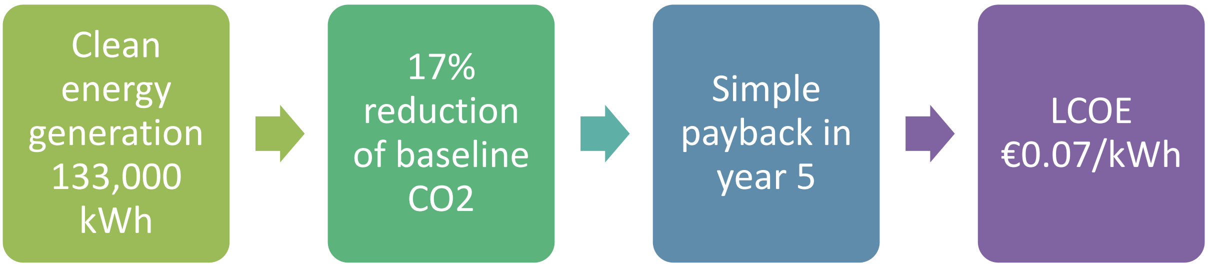



**Fig 15. Proposed ground mounted 150kWp Solar PV benefits**

# 5. Action Plan

## 5.1. Connacht GAA Centre of Excellence

### 5.1.1. Sustainable Energy Roadmap

The Centre of Excellence has set an objective to be carbon neutral. This roadmap illustrates the key route to carbon neutrality in energy use.

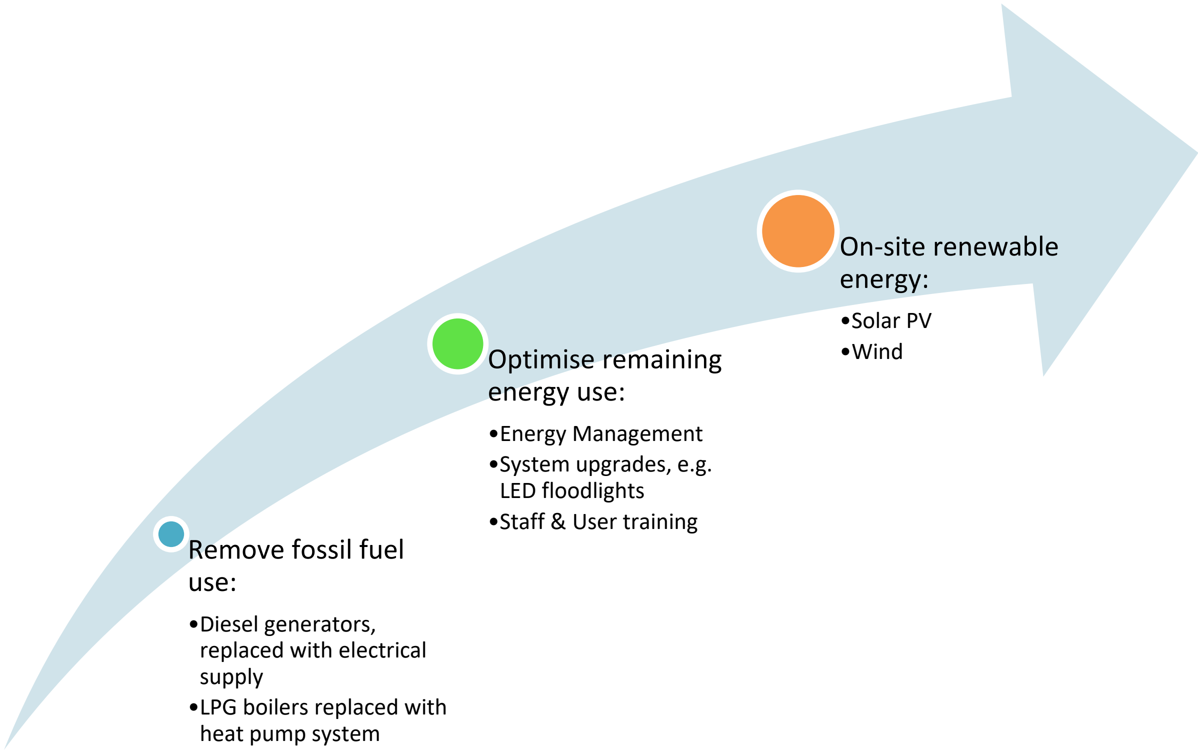



**Fig 16. Route to Carbon Neutrality**

The steps on the route should be viewed as a general order of priority rather than strictly sequential. Once the remaining fossil fuel systems are removed from the centre, the remaining energy demand should be minimised through technical and operational efficiency measures. Installation of on-site renewables is shown as the final step, however this can be acted on immediately if analyses indicate that most of the energy will be used on-site even after further efficiencies are achieved. In addition to this, on-site electricity use is likely to increase as fossil fuels are replaced with electrified systems.

Energy & Resource Management is already at a high standard at the Centre and will remain an ongoing continuous task. Each step on the route should be examined in detail to determine the case for investment. The existing management systems will support these examinations.

The table on the next page provides a high-level outline of options to carbon neutrality against the 2020 baseline and the opportunities discussed in this study.

| Table 9. Project pathway to carbon reduction | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Project order** | **Step / project** | **Initial investment cost** | **Simple payback** | **Year 1 energy saving (€)** | **Year 1 energy saving (kWh)** | **Baseline energy demand after project (kWh)** | **Annual emissions reduction (tCO2)** | **Baseline emissions after project** | **Project value by 20 years** | **Project value by 25 years** |
| 0 | Baseline | | | €0 | - | 892,989 | | 234 | | |
| 1 | Solar PV system - Roof mounted - 150kWp | €81,500 | In Year 3 | €29,198 | 145,262 | 747,727 | 43 | 191 | €544,252 | €722,545 |
| 2 | Solar PV system - Ground mounted - 150kWp | €135,000 | In Year 5 | €26,781 | 133,241 | 614,486 | 39 | 152 | €436,486 | €599,818 |
| 3 | Upgrade Floodlights to LED | €220,000 | In Year 7 | €10,212 | 34,040 | 580,446 | 10 | 141 | €250,862 | €363,819 |
| 4 | Replace diesel generators with main electricity supply | €3,000 | In Year 9 | €311 | 36,110 | 544,336 | 8 | 133 | €4,932 | €7,606 |
| 5 | Heat pump installation for space & water heating | €75,000 | In Year 4 | €13,885 | 262,265 | 282,071 | 54 | 79 | €282,177 | €396,767 |
| 6 | Wind turbine 30kW x 3 | €150,000 | In Year 8 | €20,971 | 110,376 | 171,695 | 33 | 47 | €323,568 | €461,170 |

The options shown on the previous table are taken as sequential.  The reduction in CO2 are illustrated below.

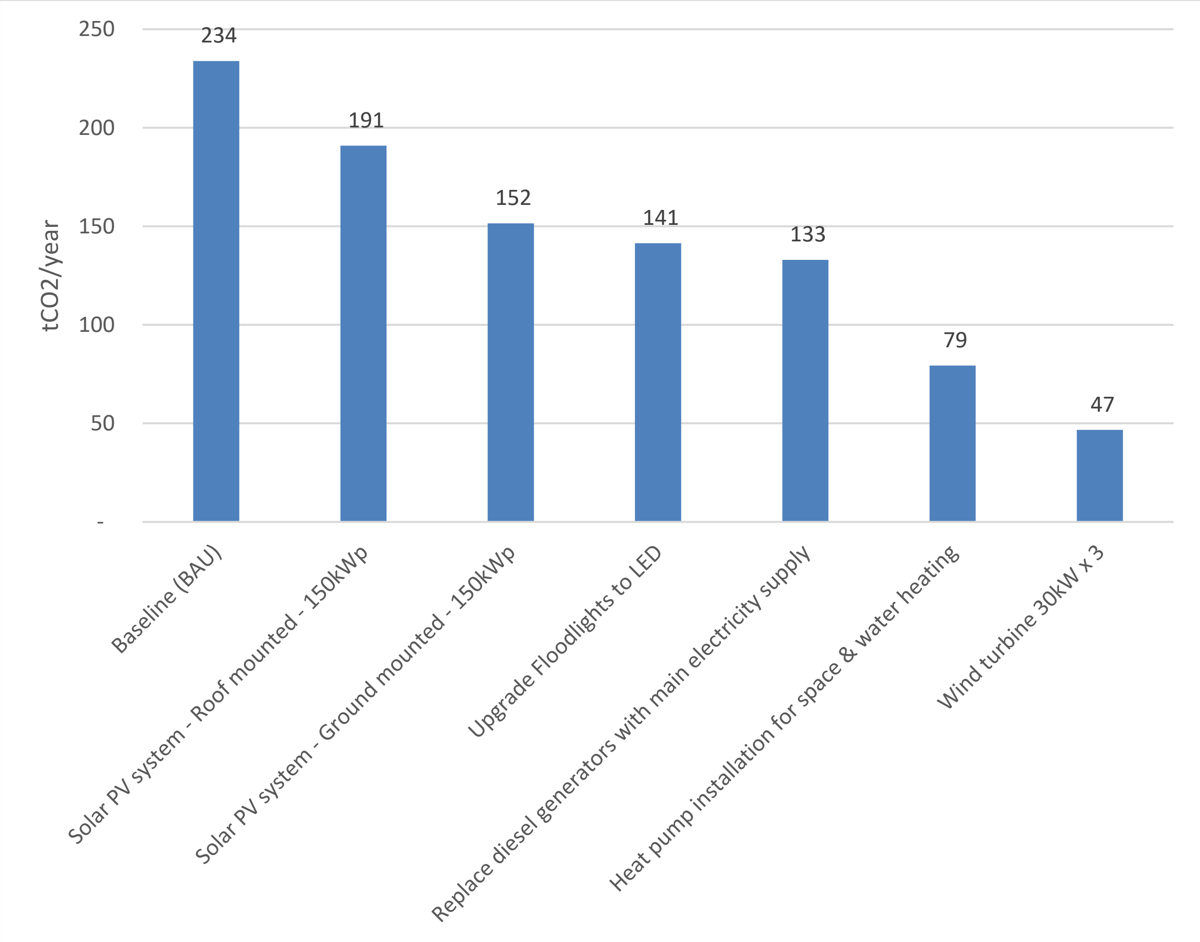



**Fig 17. Pathway to emissions reduction**

The proposed projects represent in 80% reduction in GHG emissions for the centre.  The remaining 47 tCO2/year are associated with the reduced reliance on electricity supplied from the national grid.

The Government has set a policy goal of an 80% reduction in GHG emissions from the energy system. Studies have projected a carbon intensity for grid electricity in 2050 of 38 gCO2/kWh.

Further options for carbon neutrality for the Centre could include:

- Increased use of site generated renewable electricity:
  - Battery storage
  - Diversion to hot water
- Increased export of clean energy (offsetting):
  - More wind or solar PV projects
  - Supply of site material to AD biogas plants
- Creating larger long term carbon sinks e.g. increased tree planting

## 5.2. Regional GAA Clubs

The initial club engagement has resulted in a developed strategy to support the clubs and club members on an ongoing basis. This strategy combines support from the SEC Programme and the GAA Green Clubs initiative as outlined in the table below. It should be noted that the GAA Green Clubs toolkits are to be launched in December 2022, and will be a significant resource for the proposals below:

**Table 10. Club engagement structure**

| | | | | |
|---|---|---|---|---|
| **Annual energy cost** | <€2,500 | €2,500 - €5,000 | €5,000 - €10,000 | >€10,000 |
| **Cost category** | Very low | Low | Medium | High |
| **Level** | 0 | 1 | 2 | 3 |
| **Engagement type** | Signpost to other Green Club theme e.g. Biodiversity | ○ Simple bills analysis<br>○ Switching energy supplier<br>○ SEAI Energy Academy Training | ○ All in Level 1 +<br>○ **Detailed bills analysis**<br>○ **Building checklist**<br>○ **Starter EMP** | ○ All in Level 2 +<br>○ Energy Audits |
| **GAA Resource** | | Club Manager, GAA Green Clubs | Club Manager, Caretaker, GAA Green Clubs | Club Manager, Caretaker, GAA Green Clubs, Service Providers e.g. electrician/plumber |
| **SEAI Resource** | N/A | SEC County Mentor | SEC County Mentor | SEC County Mentor |
| **County scale GAA SEC Energy Master Plan (EMP)** | | ○ Energy use included in baseline<br>○ Impacts of switching energy supplier and in-house training captured | ○ All in Level 1 +<br>○ Common opportunities captured<br>○ Case studies | ○ All in Level 2 +<br>○ Energy Audits |
| **Energy upgrade project options** | | ○ Subject to suitable payback<br>○ Partner with local SEC | ○ Small groups<br>○ Partner with local SEC<br>○ Partner with BEC Project Coordinators<br>○ GAA led projects | ○ Partner with local SEC<br>○ Partner with BEC Project Coordinators<br>○ Partner with Energy Supplier<br>○ GAA led projects |

This engagement process has already been initiated through the formation of a Mayo County GAA SEC, led by the Mayo GAA County Board. This process will continue through 2022 and will include the development of a GAA Green Club toolkit for clubs to examine sustainable energy options. Following the launch of the toolkit later this year this strategy can be expanded to the other counties in Connacht and beyond. Further details on the levels of engagement are outlined in the following sections.

The main action plan for the clubs is illustrated below:

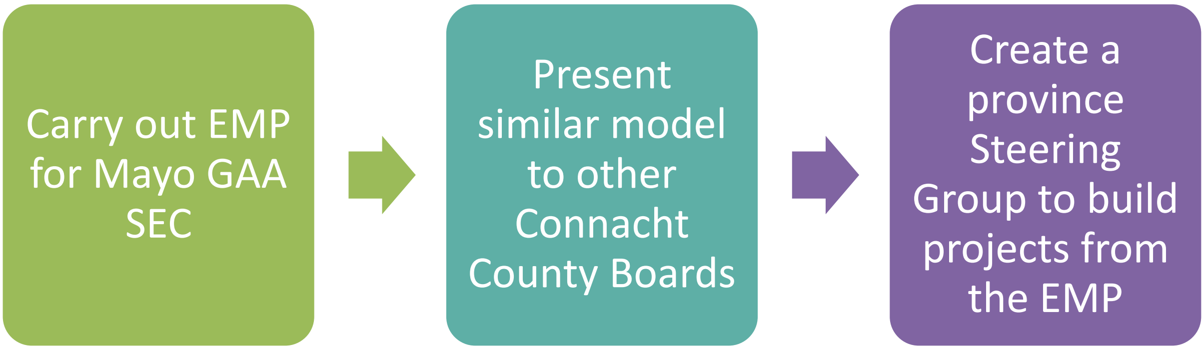



**Fig 18. Action Plan for Community-based clubs**

The EMP design will be based on the energy cost categories, as detailed previously. Further details are provided in the following sections.

#### *5.2.1.1. Very low cost clubs*

Clubs with very low energy costs are not likely to invest in energy upgrades at this time. These clubs can focus on one of the other Green Club themes but may also be interested in raising energy awareness for members' homes in their communities.

#### *5.2.1.2. Low cost clubs*

Clubs in the low-cost category will be taken through the process illustrated below, starting with a simple energy bills analysis. Switching electricity supplier can be a simple way to reduce energy costs and SEAI have several short training modules which are easy to follow and can help club managers to enhance their understanding of energy use.

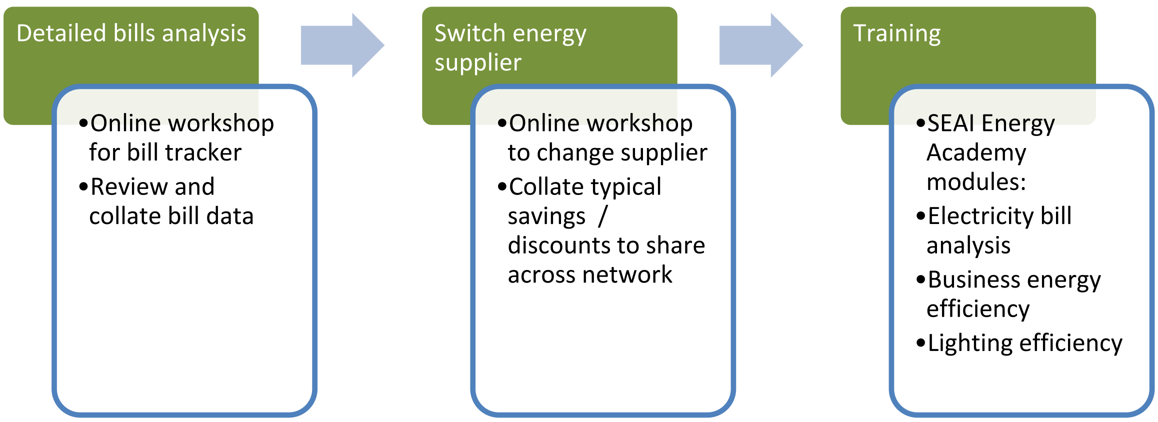



**Fig 19. Low-cost club strategy**

#### *5.2.1.3. Medium cost clubs*

Clubs in the medium cost category will be offered the same supports as the Low-cost clubs and also taken through the process illustrated below, starting with a detailed energy bills analysis. A starter EMP will also be produced for these clubs.

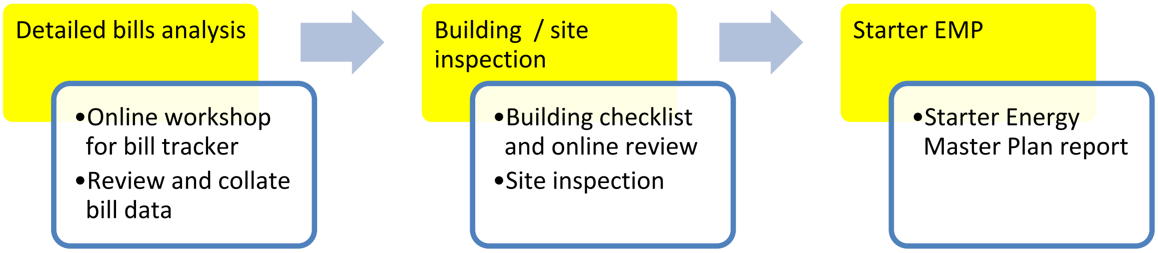



**Fig 20. Medium cost club strategy**

### *5.2.1.4. High cost clubs*

Clubs in the high-cost category may be eligible for the SEAI Support Scheme for Energy Audits (SSEA) https://www.seai.ie/business-and-public-sector/small-and-medium-business/supports/energy-audits/.

The SSEA offers eligible organisations a €2,000 voucher towards the cost of a high-quality energy audit. In most cases, this will cover the total cost of the audit. We will support the eligible high-cost clubs to apply to this scheme immediately. A detailed bills analysis will be carried out in advance of the audit to provide a starting point.

**This is subject to the club having a registered company, which may be limited to those clubs operating on a more commercial basis.**

The high-cost clubs which are not eligible for the SSEA, can be included for an energy audit in a GAA County SEC model as part of the Energy Master Plan.

### 5.2.2. Club members

The GAA network is extensive and well established in the community. All clubs, even those in lower energy use categories, can support their members through a range of engagements supported by SEAI. Some examples are outlined below:

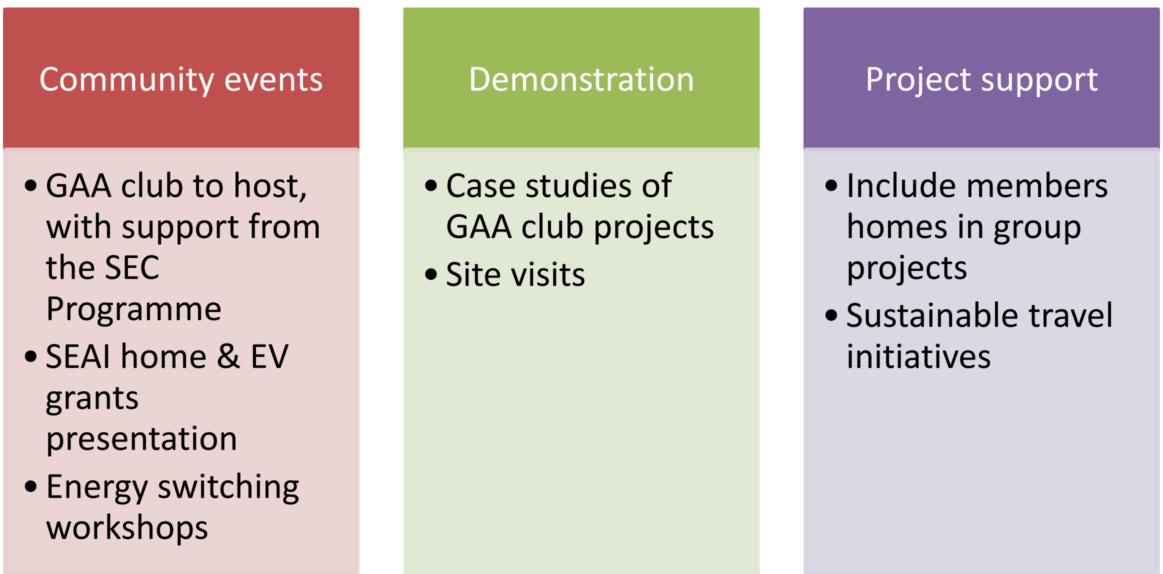



**Fig 21. Club member engagement options**

SEAI have a considerable resource of knowledge and information which will be of interest to club members for their homes and businesses. In response to the ongoing energy crisis, SEAI are developing a series of workshops to help people stay Warm and Well this winter. The SEC network is a growing pathway for dissemination of this resource.

The proposed action plan for club members is illustrated below:


**Fig 22. Action Plan for club members**

This action plan will seek support from the SEC mentor team and other SEAI resources.

# Annex 1. Register of Opportunities

| Opportunity | Total capital cost (€) | Grant amount if available (€) | Total investment cost | Annual electricity savings (kWh) | Annual thermal fuel savings (kWh) | Annual renewable electricity exported (kWh) | Annual cost savings (€) | Simple payback | Annual emissions reduction (tCO2) |
|---|---|---|---|---|---|---|---|---|---|
| Solar PV system - Roof mounted - 150kWp | €163,000 | €81,500 | €81,500 | 79,894 | - | 65,368 | €29,198 | In Year 3 | 43 |
| Solar PV system - Ground mounted - 150kWp | €270,000 | €135,000 | €135,000 | 73,283 | - | 59,958 | €26,781 | In Year 5 | 39 |
| Upgrade Floodlights to LED | €220,000 | €110,000 | €220,000 | 34,040 | - | - | €10,212 | In Year 7 | 10 |
| Replace diesel generators with main electricity supply | €3,000 | €0 | €3,000 | -34,040 | 70,150 | - | €311 | In Year 9 | 8 |
| Heat pump installation for space & water heating | €75,000 | €22,500 | €52,500 | -97,706 | 359,971 | - | €13,885 | In Year 4 | 54 |
| Wind turbine 30kW x 3 | €150,000 | €0 | €150,000 | 55,188 | | 55,188 | €20,971 | In Year 8 | 33 |
| **Total** | **€881,000** | **€349,000** | **€642,000** | **110,658** | **430,121** | **180,514** | **€101,358** | **In Year 7** | **187** |

# Annex 2. Proposal to replace LPG boilers with Heat Pump system

## Outline Specification issued to supplier

### Project Intent

The project is to remove the use of LPG fuels for the space and water heating on the site. We are now seeking proposals from suitable suppliers & professionals to replace these with heat pump systems.

| Parameter | Notes on detail sought |
|---|---|
| Energy Source | Either Ground or Air source are acceptable |
| SCOP | SCOP for space heating and water heating seperately |
| Energy use | Estimate of electricity demand |
| Costs | Estimates of capital and operating costs |

### Existing heating systems

The Centre of Excellence Building is up to current building standards in terms of insulation, windows doors and building services. Therefore, no further major fabric upgrades are recommended at this time. Building maintenance and energy management are also performed well on-site.

Space and water heating systems are currently served by LPG boilers, installed in 2012. In 2020 LPG use accounted for 38% of all $CO_2$ emissions for the centre.

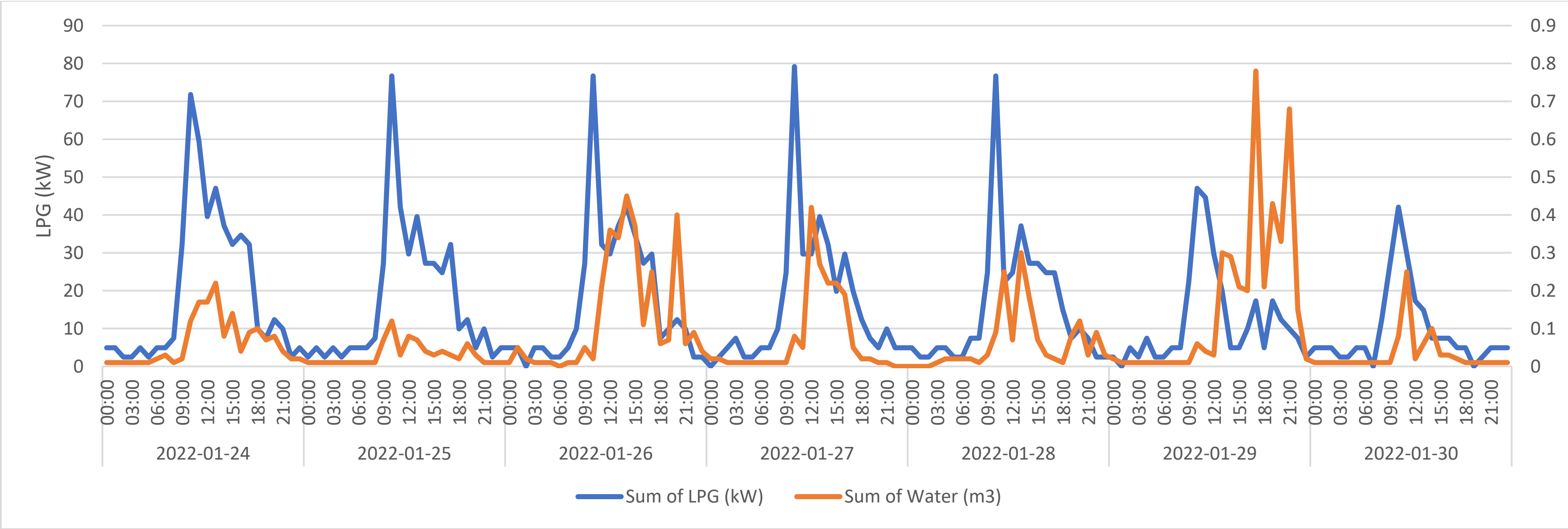
Details of the existing heating systems are outlined below.

| System / function | Notes |
|---|---|
| **Space heating** | Currently provided by 2 No. Ferrol Energy W80 (17kW – 75kW) Condensing LPG boilers**.**  |
| **Water heating** | Currently provided by 1No. floor standing Heatmaster 85TC Condensing LPG boiler.  |

## Current operation

The BEMS meters total LPG and Water usage. The charts below show the LPG (kW) and Water (m3) usage over a week in January and a week in July. Please note:

- LPG usage is the total gas flow to all systems (space and water heating)
- Water usage is total water flow to all systems

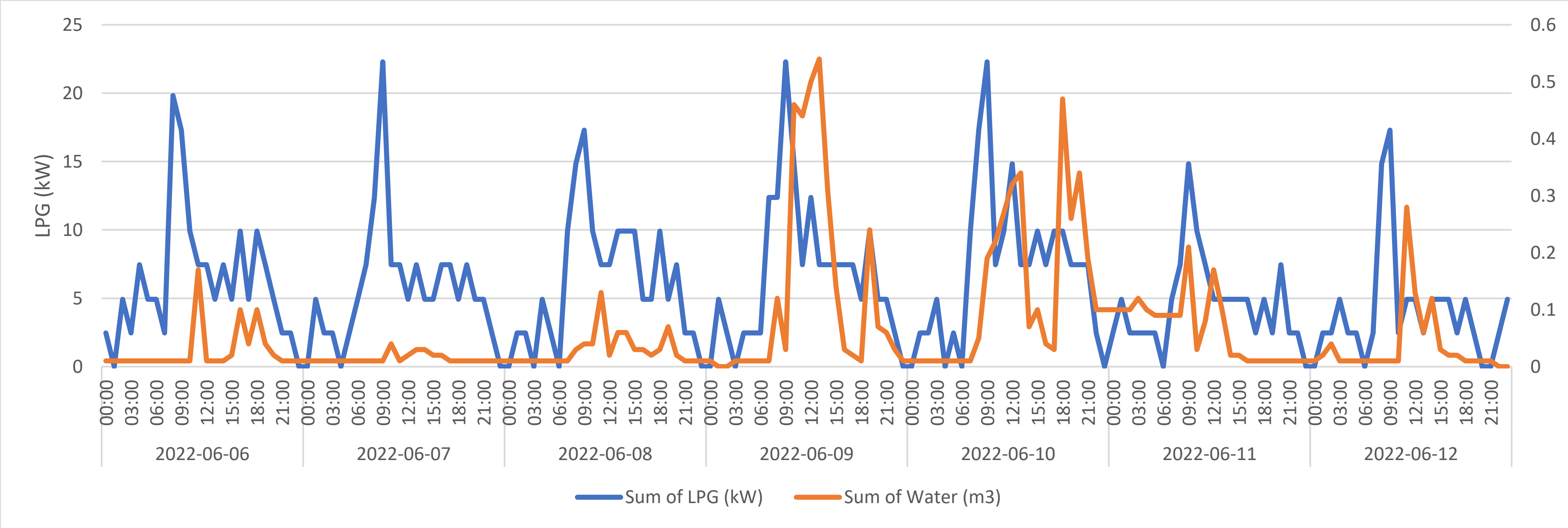



**Week starting Jan 24th 2022**

Notes:

- Peak LPG demand C. 80kW
- Peak water use C. 0.8m3 is expected to indicate shower room use after matches or training

ANNEX




**Week starting June 6th 2022**

Notes:

- Peak LPG demand C. 25kW
- Peak water use C. 0.6m3 is expected to indicate shower room use after matches or training

## Supplier outline response

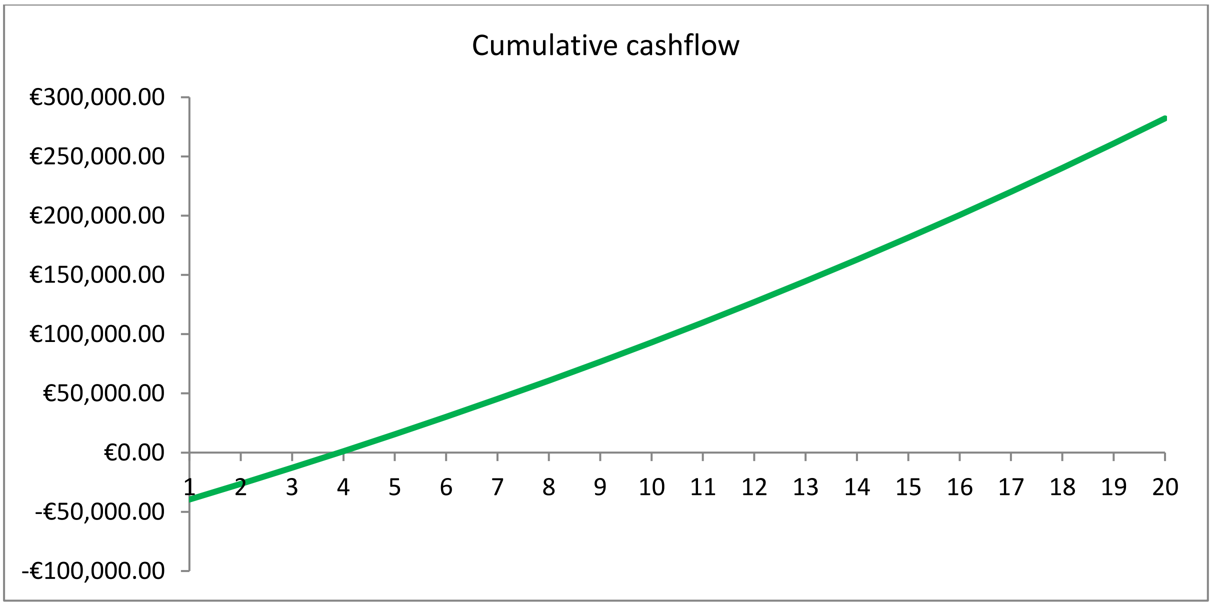
The outline proposal for the heat pump system is summarised below.

| Heat Pump system to replace LPG boilers – outline proposal | | |
|---|---|---|
| **Parameter** | **Value as specified by supplier** | **Notes for analysis** |
| **Technology** | Air to Water | |
| **Power output** | 40 kW | Proposed product is a Heliotherm S40L-M-Solid |
| **Seasonal Coefficient of Performance (SCOP)** | 6 (5.2 referred to in product manual) | The product proposed in the outline proposal is a very efficient unit with a SCOP of 5.2. For the purpose of estimations in this report a more conservative SCOP of 3.5 |
| **System life** | 20 years + expectancy<br><br>Stainless steel chassis with anodised aluminium casing | Scheduled maintenance required |
| **Control** | Weather compensation heating controls included. Remote monitoring included. | |
| **Capacity** | 1000 litre heating buffer for space heating,<br><br>2250 litre hot water buffer with 2 80kw hot water heat exchangers allowing for maximum demand and redundancy if one had to be taken out of service for descaling etc. | |
| **Cost estimates** | €40,000 for heat pump installed and commissioned<br><br>€10,000 for hot water system installed and commissioned<br><br>Prices ex vat, electrical supplies not included, building works not included<br><br>Piped to allow existing ACV to be used as backup for hot water in emergency | These costs would be subject to review and site specifics. |

## Financial analysis

The financial analysis is outlined in the table and charts below:

| Heat pump installation for space & water heating | | Notes |
|---|---|---|
| Air to water heat pump system rating (kW) | 40 | |
| SCOP of heat pump system | 3.5 | |
| Existing energy use from LPG boilers (kWh/year) | 359,971 | |
| LPG boiler efficiency | 95% | |
| Actual useful heat output (kWh/year) | 341,972 | |
| Energy consumed by heat pump system (kWh/year) | 97,706 | |
| Energy savings (kWh/year) | 262,265 | |
| **Energy costs** | | |
| Electricity costs this year (€/kWh day unit) | €0.30 | Check with supplier rate |
| LPG costs this year (€/kWh) | €0.12 | |
| Energy price rise per year (%) | 2.5% | |
| Maximum electricity costs in future (€/kWh) | €0.85 | |
| **Investment** | | |
| Total upfront investment cost (€) | €75,000.00 | |
| Own funding | €52,500.00 | |
| Grant (if applicable) | €22,500.00 | 30% grant from SSRH |
| Annual O&M cost (€) | €1,000.00 | |
| **Savings & value** | | |
| Simple Payback period | In Year 4 | |
| Project value by 10 years | €93,054.43 | |
| Project value by 16 years | €200,586.59 | |
| Levelised Cost of Heat over 15 years (€/kWh | €0.01 | |

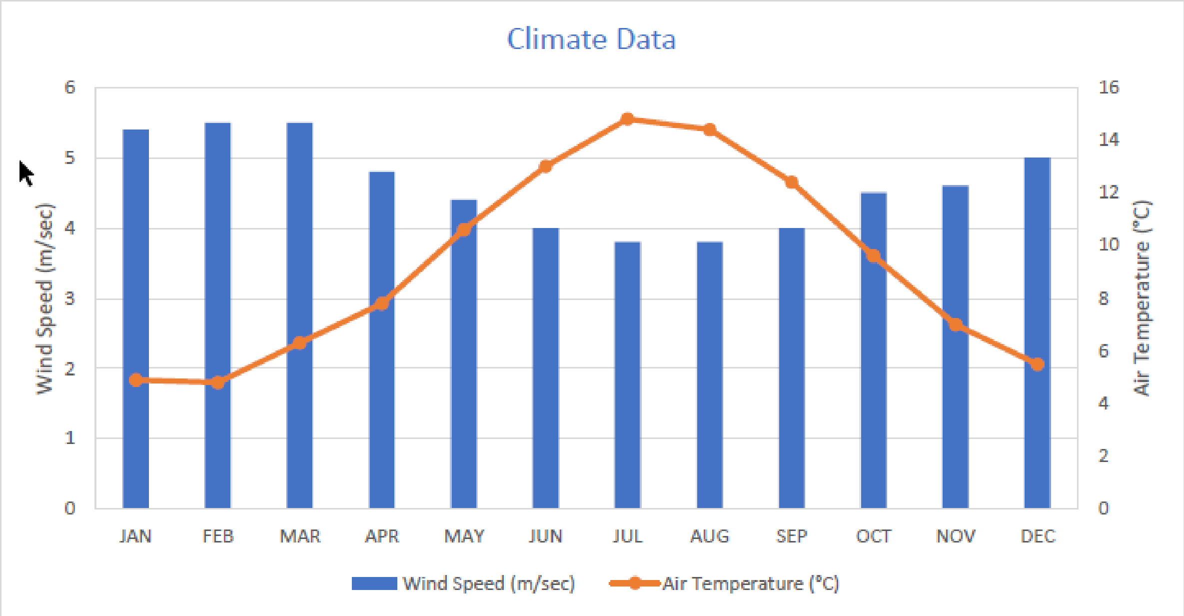


# Annex 3. Wind energy analysis

The wind energy analysis is based on the local climate and recent industry data outlined below.

## Climate Data

| | Unit | Climate data location |
|---|---|---|
| **Name** | | **Co. Mayo, IRL** |
| **Latitude** | °N | 53°46'29.08"N |
| **Longitude** | °W | 8°51'9.85" |
| **Climate Zone** | | 5A - Cool - Humid |
| **Resolution of the data** | Hour | 1 |



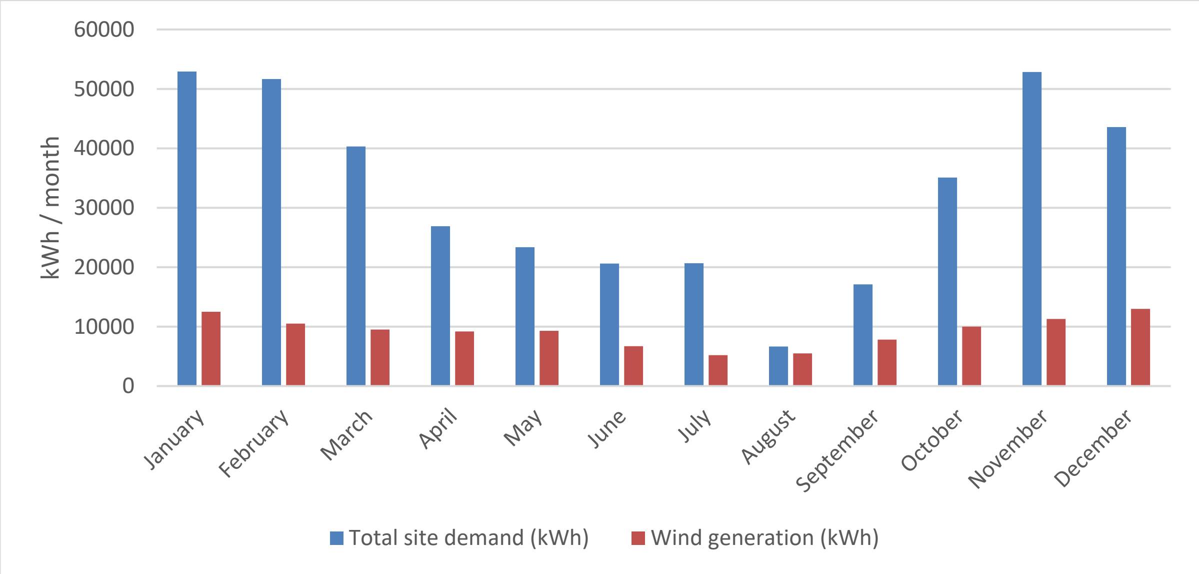

**Wind Speed vs Air Temperature (Monthly)**

## Wind energy system and generation

The presumed wind energy system is outlined in the table below:

| **Outline wind energy system** | |
|---|---|
| **Parameter** | **Value & notes** |
| **Technology** | Horizontal Axis Wind Turbine (HAWT) |
| **Power output per turbine** | 30 kW |
| **No. of turbines** | 3 |
| **Hub height** | 18m to 20m |
| **Rotor diameter (swept area)** | 14m (150 m2) |
| **Number of blades** | 3 |
| **Cut-in wind speed (Uci)** | 3 m/s |
| **Cut-out wind speed (Uco)** | 25 m/s |

Analysis was carried out using proprietary software for the estimate of electricity generation from the proposed wind turbine system. The estimated annual wind generation (C.110,000 kWh) is shown below against the most recent annual site electricity demand.



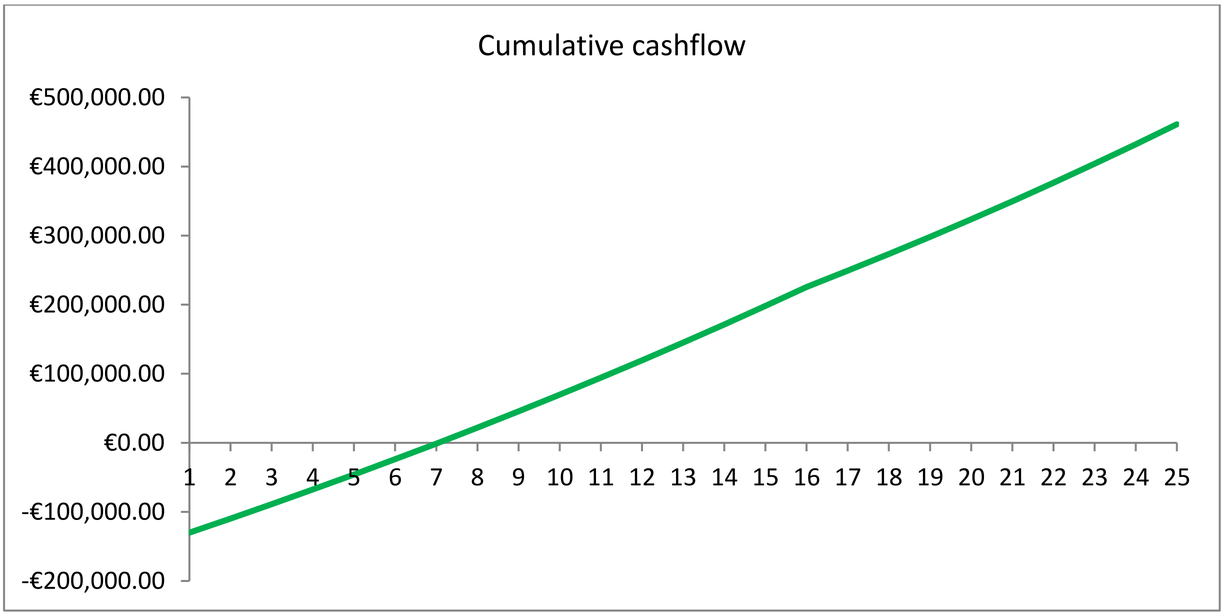

**Monthly wind generation V site electricity demand**

The analysis indicates a high proportion of self-consumption for the wind generated electricity. It should be noted that some wind generation may occur in low-demand times e.g. at night, and therefore a conservative assumption of 50% self-consumption is used in the financial analysis.

## Financial analysis

The financial analysis is outlined in the table and charts below:

| Wind turbine 30kW x 3 | | Notes |
|---|---|---|
| System size (kW) | 90 | 3No. 30kW turbines |
| Capacity factor | 14% | |
| Annual electricity generation | 110,376 | |
| Self consumtion (%) | 50% | |
| Self consumtion (kWh) | 55,188 | |
| Excess 'spilled' to grid | 55,188 | |
| **Energy costs / export prices** | | |
| Energy costs this year (€/kWh day unit) | €0.30 | Check with supplier rate |
| Energy price rise per year (%) | 2.5% | |
| Maximum energy costs in future (€/kWh) | €80.00 | |
| Export tariff this year (€/kWh) | €0.08 | Dependent on SSG / supplier |
| **Investment** | | |
| Total upfront investment cost (€) | €150,000.00 | |
| Cost/kWp | €1,666.67 | |
| Own funding | €150,000.00 | No grant funding presumed |
| Annual O&M cost (€) | €1,000.00 | |
| **Savings & value** | | |
| Simple Payback period | In Year 8 | |
| Project value by 10 years | €69,638.07 | |
| Project value by 16 years | €225,507.39 | |
| Project value by 20 years | €323,568.21 | |
| Levelised Cost of Electricity over 20 years (€/kWh) | **€0.08** | |



# Annex 4. Solar PV analysis

The solar energy analysis is based on the local climate and recent industry data outlined below.

## Climate Data

Climate data for the site is based on data from SolarGIS[7], and PVGIS-SARAH2[8].

## Solar PV system and generation

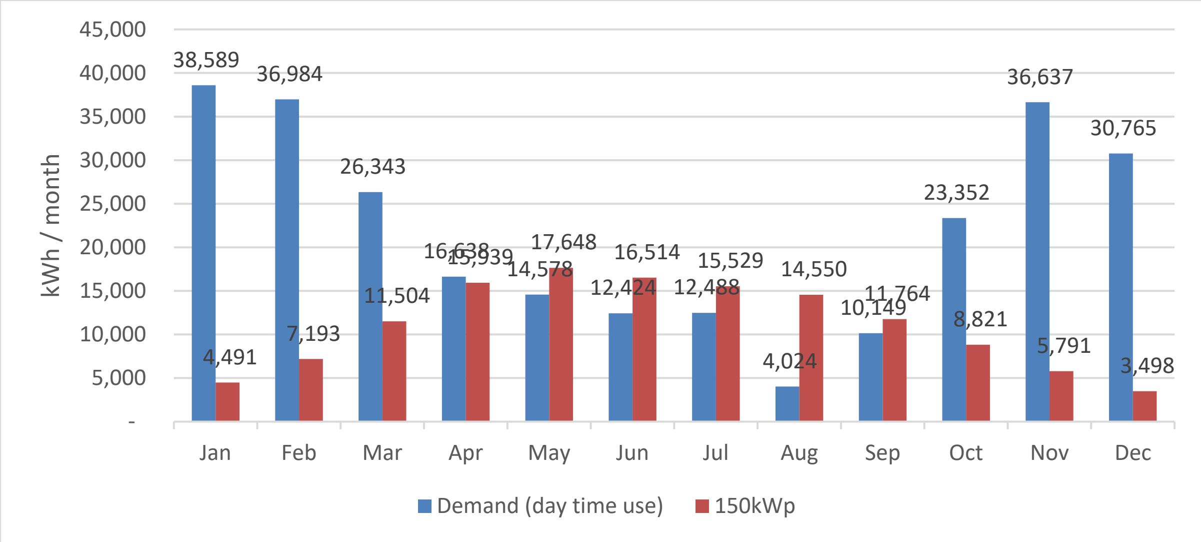
The presumed Solar PV system is outlined in the table below:

| **Outline Solar PV system** | |
|---|---|
| **Parameter** | **Value & notes** |
| **Technology** | Monocrystalline Solar PV |
| **System power** | 150 kWp |
| **Total Solar Array area** | C. 680m2 |
| **Siting** | Ground mounted |
| **Orientation** | South facing |
| **Inclination** | 35º |
| **Solar output factor** | 890 kWh/kWp |
| **Annual generation (year 1)** | 133,241 kWh |
| **System degradation rate** | 0.6% |

Analysis was carried out using PVGIS software for the estimate of electricity generation from the proposed Solar PV system. The estimated annual generation (C.133,000 kWh) is shown below against the most recent annual site electricity demand for day units.

[7] from https://solargis.com/maps-and-gis-data/download/ireland (© 2020 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis.)

[8] **PVGIS-SARAH2** (0.05º x 0.05º) Database produced by CM SAF to replace SARAH-1 (PVGIS-SARAH). It covers Europe, Africa, most of Asia, and parts of South America. Temporal range: 2005-2020. https://re.jrc.ec.europa.eu/pvg_tools/en/




**Monthly Solar PV 150kWp generation V site electricity demand (day units)**

The analysis indicates a high proportion of self-consumption for the solar generated electricity. It should be noted that some generation may occur in low-demand times e.g. low site activity at midday, and therefore a conservative assumption of 55% self-consumption is used in the financial analysis.

## Financial analysis

The financial analysis is outlined in the table and charts below:

| Solar PV system - Ground mounted - 150kWp | | Notes |
|---|---|---|
| System size (kW) | 150 | |
| Annual energy generation (kWh) Year 1 | 133,241 | |
| Solar self consumtion (%) | 55% | |
| Solar self consumtion (kWh) | 73,283 | |
| Excess 'spilled' to grid (capped to 80%) | 59,958 | |
| Degradation rate (%) | 0.6% | |
| **Energy costs / export prices** | | |
| Energy costs this year (€/kWh day unit) | €0.30 | Check with supplier rate |
| Energy price rise per year (%) | 2.5% | |
| Maximum energy costs in future (€/kWh) | €80.00 | |
| Export tariff this year (€/kWh) | €0.08 | Dependent on SSG / supplier |
| **Investment** | | |
| Total upfront investment cost (€) | €270,000.00 | |
| Cost/kWp | €1,800.00 | |
| Own funding | €135,000.00 | |
| Grant (if applicable) | €135,000.00 | 50% SEAI grant secured |
| Inverter replacement cost | €20,000.00 | |
| Inverter replacement year | 15 | |
| | | |
| **Savings & value** | | |
| Simple Payback period | In Year 5 | |
| Project value by 10 years | €146,157.42 | |
| Project value by 16 years | €316,528.92 | |
| Project value by 20 years | €436,485.67 | |
| Levelised Cost of Electricity over 20 years (€/kWh) | **€0.07** | |