FICHTNER

Consulting Engineers Limited

Gweedore Bioenergy and District Heating Scheme

Údarás na Gaeltachta, LECo (Local Energy Communities) Project

Feasibility Study

Northern Periphery and Arctic Programme 2014-2020

An tAontas Eorpach
Ciste Forbartha Réigiúnach na hEorpa

LECo
Local Energy Communities

ENGINEERING CONSULTING

Document approval

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Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
00	02-04-2019	First issue to client	RLB	NPG, FT
01	18-04-2019	Update following client comments	RLB	NPG
02	02-05-2019	Change of client name	RLB	NPG

Management Summary

Údarás na Gaeltachta (Údarás) has engaged Fichtner Consulting Engineers (Fichtner) to undertake a feasibility study involving the improvement of energy efficiency performance of four sites (a community centre, a primary school, a day care centre and a theatre) in Gweedore, Co Donegal. The buildings date from 1932 (with the newest completed in 1993) and have undergone varying levels of extension and refurbishment works. An audit conducted in February 2019 concluded that a range of improvement measures totalling €141,000 could be implemented, with a total cost saving of around €16,000/annum. Indicative payback periods range from 3 to 33 years, so an implementation strategy would need to be developed, accounting for potential funding options and social benefits.

The Ionad Lae Day Care Centre is served by a 25 year old 113 kW SIME 2R6 oil fired boiler which provides space heating and domestic hot water. A proportion of the heat demand is offset by a solid fuel open fire and electric heat emitters and showers in the apartments, which are to be retained for social needs and service resilience. Analysis of energy consumption records, in combination with projections made for six sheltered housing units on the wider site, indicate a total heat demand of 116,223 kWh/annum served by the boiler.

A number of significant challenges exist in replacing the existing unit with a biomass boiler, principally the lack of space within the existing boiler house (circa 2m^2), which is not sufficient to house a biomass boiler and associated fuel storage and handling systems. A nearby storage building could potentially be repurposed to house a biomass boiler however this approach would add considerably to the time and cost of the installation. An overfed stoker design with fixed/stepped grate in combination with thermal store is proposed, with an estimated capital cost of €82,000 ±20%. The biomass boiler would be fuelled by wood pellets at a cost of around €7,400/annum, based on a quote from an established supplier.

An alternative strategy would be to install a ground or air source heat pump within the existing boiler house, which would minimise service interruption at the centre and require considerably less manual intervention when in operation. The site electrical connection and ground conditions (in the case of a ground source heat pump) would need to be verified as suitable. The cost savings of this solution are partially undermined by the need to replace the radiators within the day care centre with low temperature emitters or underfloor heating, resulting in an estimated cost of €65,000 ±20% for the simplest air source heat pump (ASHP) option.

Implementing a district heating scheme to serve additional consumers is not recommended at this time. The preferred approach at Gweedore is to establish a renewable heating system to serve the day care centre initially, with the inclusion of the adjacent sheltered housing units.

A range of fiscal incentives exist to support capital delivery of the improvement projects and heating system upgrade, subject to the solution selected. Under the Support Scheme for Renewable Heat (SSRH) administered by the Sustainable Energy Authority of Ireland (SEAI), installation grants of up to 30% are available to support installation of heat pump technologies. If the biomass boiler were progressed, a tariff could be paid against useful heat output for up to 15 years, although the support level has not been published.

To support delivery of the energy efficiency upgrades funding levels of up to 50% are available from SEAI under the Better Energy Communities programme. The budget for 2019 has been allocated to projects pending evaluation, so funding may not be available until 2020 at the earliest. Competitive loans ranging from €10,000 to €100,000 are also available from the Community Loan Fund offered by the Western Development Commission.

Contents

Management Summary 3

1 Introduction 5
1.1 Background 5
1.2 Objective 5

2 Conclusions 6
2.1 Energy efficiency audit 6
2.2 Biomass boiler system 6
2.3 Capital cost estimate 7
2.4 District heating feasibility 7
2.5 Fiscal support 8
2.6 Fuel supply chain 8

3 Discussion 9
3.1 Building energy efficiency audit 9
3.2 Biomass boiler system 11
3.2.1 Current configuration 11
3.2.2 Heat demand profile 12
3.2.3 Design considerations 13
3.2.4 Boiler location 15
3.2.5 Heat pump alternative 16
3.2.6 Health and safety compliance 17
3.3 Capital cost estimate 17
3.4 District heating feasibility 18
3.5 Fiscal support 19
3.5.1 Údarás na Gaeltachta 19
3.5.1.1 Community Employment Scheme 19
3.5.1.2 LEADER Programme 19
3.5.1.3 Capital Assistance Programme 20
3.5.2 SEAI 20
3.5.2.1 Support Scheme for Renewable Heat 20
3.5.2.2 Better Energy Communities 21
3.5.3 Western Development Commission 21
3.5.4 Climate Action Fund 22
3.6 Supply chain for biomass fuel 22

Appendices 24
A Energy Audit – An Chrannóg 25
B Energy Audit – Scoil Adhamhnáin 32
C Energy Audit – Ionad Lae Day Care Centre 39
D Energy Audit – Amharclann Ghaoth Domhair 47

1 Introduction

1.1 Background

Comharchumann Forbartha Ghaoth Dobhair (Comharchumann) is a community-based co-operative in Gweedore, Co Donegal which operates a combined community and enterprise centre. Comharchumann is proposing to form a local energy community scheme in conjunction with several other community groups within the area.

This scheme could potentially involve the improvement of energy efficiency performance at several key sites in the area of Gweedore. In conjunction with these improvement measures, it may also be possible to upgrade a fossil fuelled boiler at the Ionad Lae Day Care Centre with a renewable heating system, subject to technical and economic viability. To maximise the benefits associated with the scheme, exporting heat to local heat consumers is also being considered.

1.2 Objective

Údarás has engaged Fichtner to conduct a feasibility study for energy efficiency upgrades to four local sites and the district heating scheme. The principal objectives of this study are as follows.

1. Conduct non-intrusive review of the main elements of each building and recommend energy efficiency improvement measure(s).
2. Review energy consumption records / bills for each site and undertake initial sizing of a suitable biomass boiler.
3. Assess the feasibility of a district heating scheme in the area and propose a route for the distribution pipework to buildings that we have determined are suitable for connection.
4. Based on the conclusions of the feasibility review, carry out a preliminary cost estimate of the optimal solution.
5. Review potential sources of funding for the scheme.
6. Conduct a review of woodchip and wood pellet suppliers in Co Donegal and neighbouring counties.

2 Conclusions

2.1 Energy efficiency audit

The following sites were subject to an energy efficiency audit on 27 February 2019.

1. An Chrannóg, a combined community and enterprise centre dating back to around 1960 underwent an extension in 2003/2004, but is in need of a deep retrofit and as such could see a dramatic improvement in energy efficiency.
2. Scoil Adhamhnáin, a primary school originally dating back to 1945 has seen the addition of classrooms and offices / library in 1985 and 2010 respectively. The roof is in poor condition and has suffered a series of leaks, resulting in damp and mould which was evident. Despite window and lighting upgrades in 2012, areas of the school would benefit from dry-lining, insulation and ventilation measures, in addition to a modern boiler system.
3. Ionad Lae Day Care Centre, a centre for elderly people was completed in 1993, with the addition of seven contained apartments (including warden accommodation) and six sheltered housing units in 1996. The general standard of building fabric and insulation is not in accordance with modern standards. The outdated and inefficient oil boiler was surveyed for conversion to a renewable system.
4. Amharclann Ghaoth Domhair, a local theatre dating from 1932, underwent a major renovation in 2016, accordingly the building fabric and services are therefore in very good condition. An extension is planned to provide additional space for rehearsals and additional kitchen facilities for the café.

A range of improvement measures were proposed, including addition of insulation, upgrade of heating systems and replacement of lighting with more efficient alternatives, with the majority directed towards older buildings. Implementing all improvements at the four sites is estimated to cost €141,000, with a total cost saving of around €16,000/annum. There is a large variance in the cost and payback period across the range of improvement measures.

Based on fuel bills from 2017/2018 (unadjusted for degree days), total energy consumption (electricity and heat) is greatest at An Chrannóg (225,243 kWh/annum), followed by Ionad Lae Day Care Centre (136,264 kWh/annum). This result is not surprising given the size of the buildings, occupancy levels and the age of the building services at each site. A proportion of the heat demand at the day care centre is offset by a solid fuel open fire and electric heat emitters and showers in the apartments.

2.2 Biomass boiler system

The feasibility of upgrading the existing heating system at Ionad Lae Day Care Centre, comprising 113 kW oil fired boiler, was undertaken. Owing the space restrictions in the existing boiler house and the inaccessibility for fuel deliveries, the preferred solution for installation of a biomass boiler would be to install the new unit in a storage building which is located some 23m to the south-west. This approach would also optimise the fuel delivery route, but would add substantially to the time and cost of the project due to the need to extend services to this location and the installation of a new flue.

As an alternative, the installation of a ground or air source heat pump may be a preferable solution at the centre. Either type of heat pump could be installed within the existing boiler house but an ASHP would minimise service interruption at the centre, which is of high value. Heat pump technology also requires far less manual operational input relative to a biomass boiler. The site

electrical connection and ground conditions (in the case of a ground source heat pump) would need to be verified as suitable.

2.3 Capital cost estimate

We have prepared capital costs estimates for three heating system upgrade scenarios at the Ionad Lae Day Care Centre, but these have not been verified by the market at this stage.

1. Upgrade with a biomass boiler, including relocation of the boiler house and repurposing of the storage building, €82,000 ±20%. Based on projected fuel costs (see section 2.6) and offsetting against the existing fuel oil cost, we estimate a simple payback of around 15 years (without subsidy).
2. Install an ASHP, accounting for the upgrade of the load circuit and heat emitters (radiators) within the buildings, €65,000 ±20%. Assuming a typical coefficient of performance (equating to electricity consumption of approximately 38,000 kWh/annum) and offsetting against the existing fuel oil cost, we estimate a simple payback of around 11 years (without subsidy). This could be improved by securing more favourable electricity purchase pricing terms.
3. Extend heat supply to the six sheltered housing units, including distribution pipes and heat interface units at each property, €37,000 ±20%. This figure is additional to the preceding costs.

Operation of a biomass boiler would require a relatively high level of involvement from a facilities manager to control fuel deliveries and to ensure the boiler and fuel handling/ash removal systems are operating accordingly and safely, in addition to cleaning of the boiler. Owing to high combustion temperatures, the abrasive environment and number of moving parts, reliability can be a concern, so boiler specification, design, installation and maintenance is critical. There would be a need to implement safe systems of work for the boiler and fuel storage areas. The space constraints and service interruption which would result undermine the case for a biomass boiler installation.

The ongoing labour needed to operate an ASHP is not dissimilar from that of an automatic oil or gas fired boiler, and therefore represents a no more onerous solution relative to the existing arrangement. Reliability of such a system, provided that it is procured from a reputable supplier and serviced annually, is not a major concern and warrantees of up to three years are available. The carbon case for such a solution may be less attractive given that consumption of electricity would be required (albeit to service a highly efficient system) which is dependent on the carbon intensity of the grid.

Based on our experience and the project specifics outlined in this report, we would recommend initially that option 2 is progressed. Subject to the level of funding provisionally offered and feedback from a reputable installer, option 3 could be progressed in parallel.

2.4 District heating feasibility

In our opinion, opportunities to expand heat provision to other premises in the locality through installation of a district heating scheme is limited. The preferred approach at Gweedore is to establish a biomass boiler or heat pump system to serve the day care centre initially, with the inclusion of the adjacent sheltered housing. Subject to the success of the scheme over the short to medium term, the appetite for uptake of district heating by local businesses and building owners could be reconsidered.

Heat demand in the locality is lower than would typically be expected to facilitate a district heating scheme, and a review of historical degree day data in the region indicates that 2017/2018 energy consumption figures are marginally higher than would be expected in a typical year, owing to lower ambient temperatures in the period analysed.

Aras Ghaoth Dobhair, a nursing home neighbouring the day care centre, was not included within the energy audit but was found to have a substantial space heating demand of 390,114 kWh/annum, which is served by a two efficient oil fired boilers. Discussion with the facilities manager indicated that the heating systems were upgraded within the last two years and their preference is to maintain critical services on a self-reliant basis.

In the event that a district heating scheme to serve additional (non day care centre) consumers is progressed, the operator should be aware of the financial and legal risks that accompany this type of venture and ensure that it is adequately resourced to offer the contracted services.

2.5 Fiscal support

Under SEAI's SSRH, installation grants of up to 30% are available to sectors not covered by the Emission Trading System. At present only heat pump technologies are supported, so upgrade of the day care centre on this basis would be required for eligibility. To secure support, the applicant must satisfy a range of criteria covering energy efficiency, Building Regulations and air and technology quality standards.

On-going operational support is available, via a tariff under the SSRH, whereby payments are made on the useable heat output from renewable heating systems. This mechanism could be utilised to increase revenues over the operating life of the project, assuming a biomass heating system was installed the day care centre. Tariffs are awarded for a period of up to 15 years, but as of March 2019, the mechanism remains subject to state aid approval, so the level of support is not known.

To support delivery of the energy efficiency upgrades funding levels of up to 50% are available from SEAI under the Better Energy Communities programme, which grants up to €28 million in funding each year. Due to the community oriented nature of the proposals, and providing that a reasonable pay pack period can be demonstrated, securing a grant appears possible. As of March 2019, 13% of the annual budget was committed across five projects, with the remainder allocated to projects which were pending evaluation.

The Community Loan Fund offered by the Western Development Commission could be accessed for loans ranging from €10,000 to €100,000 at competitive rates. Loans are available to support capital delivery of projects for which a strong business case and social value can be demonstrated.

2.6 Fuel supply chain

To fuel a biomass boiler at the day care centre, we would recommend the use of sustainable wood pellets from an established supplier registered with the Wood Fuel Quality Assurance (WFQA) Scheme. A quote from Balcas Timber Ltd (trading as Brites) offers a price of €777 (excluding VAT) for a 3-tonne delivery for a typical pellet specification, which equates to an annual fuel cost of €7,378. This cost is verified by reference to a market report which suggests that the annual fuel cost would be in the range €7,300 to €8,600 subject to delivery size.

Balcas' pellet manufacturing plant is based in Enniskillen, Northern Ireland, located approximately 126 km (by road transport) from the day care centre. The fuel strategy should be optimised from a carbon perspective at a later stage.

3 Discussion

3.1 Building energy efficiency audit

In order to assess energy efficiency performance, Fichtner and REMTec Consulting undertook joint visits to the following sites on 27 February 2019. The visits comprised non-intrusive visual inspection of each of the main elements of the building structures (wall, floor and ceiling insulation), windows/doors and a review of building services. The purpose of the visits was to recommend the most useful energy efficiency measure(s) for each building and provide a cost estimate for implementing these measures.

1. **An Chrannóg**

   The combined community and enterprise centre dates back to the late 1950s or early 1960s, but was extended 2003/2004. The centre, which is attended by over 500 people per week, comprises two communal halls, a library/museum, a workshop and a number of smaller rooms including offices, stores, a kitchen and toilets. Approximately 30 people are employed by the centre and other businesses that lease premises within the various buildings, which include a pharmacy and a creche.

2. **Scoil Adhamhnáin**

   The original primary school building dates back to 1945 and was expanded in 1985 to accommodate six additional classrooms, then again in 2010 when an entrance, office and library were added at the front of the building. The current configuration is a six-classroom primary school with 136 pupils.

3. **Ionad Lae Day Care Centre**

   The day care centre was opened in 1993 and comprises a large central building, with communal spaces, kitchen dining and laundry facilities, offices and six one-bedroom self-catering apartments (plus one warden's apartment), which were added retrospectively in 1996. There are also six sheltered, single storey housing units on the wider site, each comprising two bedrooms, sitting room, kitchen and bathroom. These houses were completed in 1999 and the insulation was upgraded in 2012/2013.

4. **Amharclann Ghaoth Domhair**

   The theatre, which was opened in 1961 (although the original building dates from 1932), has capacity for around 300 patrons in a single main performance hall, and also includes rehearsal space, offices and ancillary plant rooms. The building underwent a major renovation in 2016, which included the addition of a café and kitchen facilities, installation of modern heating system and roof mounted solar photovoltaic (PV) panels.

5. **Aras Ghaoth Dobhair**

   As part of the visit to the Ionad Lae Day Care Centre, it became apparent that a neighbouring nursing home may have a reasonable heat demand in close proximity to the day centre, and may therefore present an opportunity to expand any district heating scheme (as discussed in section 3.2). Based on publicly available information, the nursing home was established in 2004 and is licensed to accommodate 41 residents. An energy audit was not undertaken for this site, but we were provided with space heating consumption data which is presented in Table 1.

A summary of energy consumption at each site and the recommended upgrades is provided in the following tables.

Table 1: Energy consumption figures

Site	Annual consumption (kWh/annum)[1]		
	Electricity	Oil	Propane
An Chrannóg	38,623	186,620	-
Scoil Adhamhnáin	17,893	66,840	-
Ionad Lae Day Care Centre	16,349	119,915	-
Amharclann Ghaoth Domhair	37,686	-	33,018
Aras Ghaoth Dobhair	Not provided	390,114[2]	Not provided

[1]Energy consumption data is provided for a mix of 2017 and 2018 calendar years. Data does not account for degree day adjustment.

[2]Inferred from oil invoices assuming a delivered energy cost in line with SEAI data[1].

Table 2: Summary of recommended upgrades

Upgrade	Capital cost (€)	Annual cost saving (€)	Payback period (years)
An Chrannóg			
Replace 72m^2 of windows from U=4.8 to 1.4 W/m^{2}K. Replace #9 external doors from U=5 to U=1.4 W/m^{2}K.	€25,896	€781	33.1
Install cavity insulation, improving U-value from 2.1 to 0.3 W/m^{2}K.	€7,020	€1,932	3.6
Install 300mm of mineral wool insulation in attic, improving U-value from 2.3 to 0.24 W/m^{2}K.	€8,580	€2,683	3.2
Replace old boiler with a new heat pump, new radiators designed for lower temp flow, and new heating controls.	€85,000	€8,518	9.9
Replace all lighting with light emitting diodes (LEDs), internal and external.	€14,500	€2,169	6.7
Scoil Adhamhnáin			
Replace all lighting with LEDs, internal and external.	€11,000	€1,331	8.3
Replace old oil boiler with condensing oil boiler, 98.5% efficiency, insulate all piping, replace older radiators, mechanical assisted powerflush and magnetic filter.	€16,000	€1,813	8.1
Ionad Lae Day Care Centre			
Add 200mm of mineral wool to attic void to increase roof U-values from 0.45 W/m^{2}K to 0.13 W/m^{2}K. Including roof ventilation.	€3,500	€505	6.9
Pump all cavity walls with insulation beads increasing U-value from 1.86 W/m^{2}K to 0.35 W/m^{2}K.	€4,000	€741	5.4
Apply modern standards of thermal insulation to hot water storage tanks and associated piping.	€250	€225	1.1

[1] https://www.seai.ie/resources/publications/Commercial-Fuel-Cost-Comparison.pdf

Upgrade	Capital cost (€)	Annual cost saving (€)	Payback period (years)
Replace all lighting with LEDs, internal and external.	€8,000	€920	8.7
Amharclann Ghaoth Domhair			
Replace all lighting with LEDs, internal and external.	€15,000	€938	16

Source: REMTec Consulting

Implementing all improvements at the four sites is estimated to cost approximately €141,000, with a total cost saving of around €16,000/annum. Clearly there are a number of higher priority upgrades aimed at the older sites, some of which offer more attractive payback periods. The complete suite of energy audits, prepared by REMTec Consulting, is provided in Appendices A through D.

3.2 Biomass boiler system

3.2.1 Current configuration

The day care centre is heated by a 113 kW SIME 2R6 oil fired boiler which serves a radiator system and two hot water storage tanks throughout the building for space heating and domestic hot water. The boiler is 25 years old and is assumed to have an efficiency of between 65% and 75%. The heating system is controlled by a time clock and is divided into two zones as per the phases of construction previously described. The boiler is situated in a boiler house measuring approximately 2m by 1m, with a stack for exhaust of flue gases emerging directly above.

Figure 1: Existing boiler house

Figure 2: Boiler house entrance

The radiators in the apartment bedrooms have self-regulating thermostatic radiator valves (TRVs) attached to control the flow of hot water and heat release into the rooms. The apartments also have electric fires for additional heating provision and the showers are also electric.

The day room at the centre has an open fire which burns turf and peat briquettes (the stack for which can be seen to the right in Figure 2). While this asset and the electric fires in the apartments are not integrated with the oil boiler (and would therefore not benefit from any associated cost and carbon benefits when upgrading to biomass), there is a need to retain these fires for the perceived social benefits and link with local heritage.

3.2.2 Heat demand profile

The day care centre is open five days per week, from 9am until 5pm. While the day care centre is closed in the evenings and at weekends, the six associated apartments are used during normal residential hours i.e. early mornings, evenings and weekends. The six sheltered housing units on the site are also subject to a similar occupancy pattern.

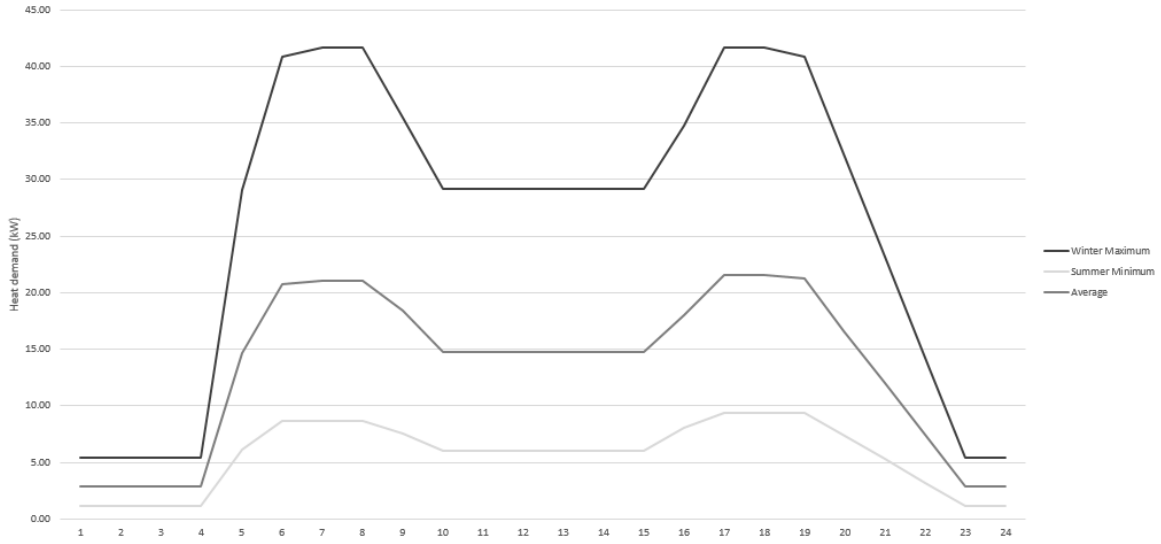
Figure 3: Ionad Lae Day Care Centre

Figure 4: Sheltered housing units

Based on the energy consumption figures provided by the centre manager, we have developed the following heating profile for the site. In lieu of high-resolution energy consumption data, we have used a generic residential heat demand profile (adjusted to account for daytime occupancy levels) to project the monthly oil consumption figures across an annual heat demand model.

We have added in the anticipated heat demands for the sheltered houses, based on benchmark figures from the Chartered Institution of Building Services Engineers (CIBSE) Guide F (Energy Efficiency in Buildings)[2]. This document provides good practice benchmark figures based on energy performance of existing buildings. In the CIBSE Guide, loads are expressed in terms of kWh per square metre of floor space per year of fossil fuel use (natural gas is typically assumed). Based on estimates of floor areas and an assessment of the development type, it is possible to estimate annual energy usage.

Figure 5: Head demand profile at Ionad Lae Day Care Centre including sheltered housing



The heat demand for the site appears lower than might be expected on first impression. The heat demand level can be reconciled when considering the open fire in the day room and electric fires and showers in each of the apartments, in addition to casual gains from solar irradiation, high person density and compact fluorescent lamps (CFL) currently installed at the centre, all of which offset the amount of heat that needs to be supplied by the boiler.

The biomass boiler should be designed to satisfy the heat demand profile above, subject to detailed heat demand modelling and accounting for any insulation upgrades which may be implemented at the site. The boiler should also be designed, in combination with a thermal store / buffer vessel, for sufficient turn-down capability to ensure that minimum summer demands (around 5 kW) can be met.

3.2.3 Design considerations

Several different types of biomass boiler are available, each with different features, configurations and levels of automation. Given the projected heat demands at the day care centre, the importance of ensuring a reliable source of heat to the elderly residents and the limited experience of operating biomass boiler systems, an overfed stoker design with fixed/stepped grate is likely to be a

[2] CIBSE Guide F: Energy Efficiency in Buildings

preferable solution. This design is relatively simple and is able to respond to variable demands, with a turn down ratio of up to 5:1 when burning dry fuels. In terms of fuel selection, combustion of wood pellets (see section 3.6) would result in small quantities of ash residue, which could be extracted with a simple ash pan.

Automatic cleaning of boilers tubes is possible by compressed air pulsing or the inclusion of turbulators to encourage displacement of ash by the flue gases. Regardless, occasional (every several weeks or months, subject to boiler design) shutdown and manual cleaning of boiler tubes and flue gas filtration systems will be required. Both ash and clinker build-up should be monitored and addressed during servicing intervals to ensure longevity, performance, efficiency and safety standards.

Hydronic integration with the existing radiator circuit is critical to ensure the boiler achieves the intended levels of performance. A replacement pressurisation system is likely to be required for compatibility with a biomass boiler. The load circuit (hot water system) should be drained and cleaned at the time of installation of the new boiler, with the addition of dirt separation or straining components to protect the new heat exchanger. Correct installation of heat meters, in accordance with manufacturer recommendations, is required to ensure accurate readings for fiscal billing and subsidy accreditation purposes.

Given the age of the existing boiler (circa 25 years), it is anticipated that the unit would be decommissioned and removed from the site upon installation of a biomass boiler system, rather than being retained for back up. The incorporation of a buffer or thermal storage would therefore be required to ensure that heat demands can be satisfied under all conditions throughout the year. This approach also represents best practice by virtue of maximising energy supply from the low carbon heat source and avoiding overheating and oversizing the boiler.

Combustion of biomass fuels results in the formation of gaseous (NO_x, CO, CO_2, H2O) and particulate (salts, ash, condensing organic compounds, volatile organic compounds) emissions. Competent design measures, including control of air supplies to primary and secondary combustion zones, flue gas recirculation, post combustion abatement technologies and ensuring the boiler is specified for the specific fuel type, will help to keep emissions within permissible levels. The Environmental Protection Agency (EPA) is the regulator responsible for environmental protection and enforcement within the ROI. There is currently no formalised method for cumulative emissions assessment in the ROI but this will need to be reviewed at a later project stage. If support under the SSRH (see section 3.5.2.1) was secured, the boiler system would also need to comply with minimum air quality standards. These standards have not yet been defined[3] but should be considered prior to specification and procurement of a boiler.

A well designed flue will include correctly sized horizontal and vertical sections, a draught stabiliser, a condensate drain and no ‘top hat’, which can lead to excessive turbulence and inadequate emissions dispersion. Sufficient air inlet must also be provided to the boiler house, typically via louvers, to ensure sufficient combustion air is available for combustion of the fuel and adequate flue gas velocity.

A key divergence from fossil fuelled boiler systems is the need to take receipt of and handle a solid biomass fuel. The fuel store must be located next to the boiler, but internal or external stores may be used provided that the store is waterproof and adequately ventilated. To feed fuel to the boiler, a rising auger from fuel store is preferred to prevent back flow of the flame front to the fuel store.

[3] https://www.seai.ie/resources/publications/SSRH-Installation-Grant-Terms-and-Conditions.pdf

3.2.4 Boiler location

The layout and geometry of the boiler house and its peripheries must be able to accommodate:

- fuel delivery including access for delivery vehicles;
- fuel storage and feed system;
- boiler with access for operation and maintenance activities;
- ash removal system;
- thermal storage / buffer tank;
- load circuit ancillaries including pressurisation system, pumps and heat meters; and
- correct flue position, integration and design.

Based on initial sizing of the biomass boiler, sufficient space is not available within the existing boiler house to accommodate the necessary infrastructure and minimum clearance distances. Extending the boiler house to facilitate the addition of fuel handling and thermal storage areas is not viable due to the surrounding rooms on three sides, and the preference to retain the adjacent courtyard. Extension would also require consent from the local planning authority and additional structural engineer and architect fees would be incurred. A large proportion of grassed courtyard and seating area would be lost to enable fuel deliveries, which is undesirable.

Alternatively, the entire boiler house would need to be relocated. A storage building measuring approximately 10m by 4m, which is currently used a general storage area, is available at the opposite site of the courtyard, located approximately 23m to the south-west. This building has the added benefit of being directly accessible from the site access road, which would make fuel deliveries and handling much more straightforward.

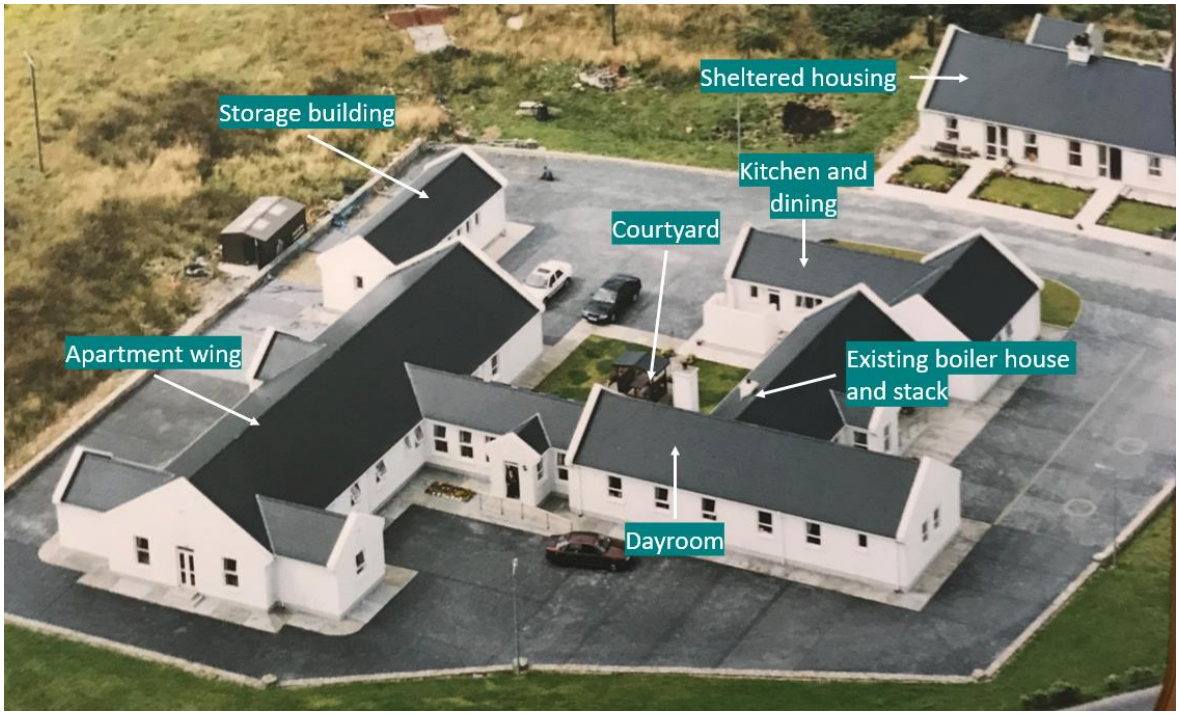
Figure 6: Courtyard

Figure 7: Storage building

The downside of the relocation approach would be the need to extend the existing load circuit pipes and control signals to the storage building, in addition to installation / upgrade of services including electricity, water and oil/gas supplies (subject to the ignition system installed. These modifications would increase the installation time and cost.

At the time of our visit, the storage building contained various items including general consumables, decorative and cleaning products and equipment, gardening tools, etc. If the building was repurposed to accommodate a biomass boiler, a system to ensure segregation of these items (particularly flammable materials) would be needed. Alternatively, these items could be moved to the containerised storage unit located several meters away at the site periphery.

Figure 8: Annotated aerial layout



3.2.5 Heat pump alternative

If the cost or service interruption resulting from a biomass boiler installation is found to be unpalatable, or if engagement with the local planning authority determines that proposed changes to the building are not permissible, then the installation of a ground or air source heat pump may offer an alternative renewable energy strategy at the day care centre. This approach would allow the limited space constraints to be overcome but would require specialist design input. The long term operational needs of a heat pump are also far less involved than for a biomass boiler. A heat pump does not rely on combustion of a fuel so local air quality impacts would be nil. This approach is however unlikely to enable a wider district heating scheme to be progressed, unless of the heat consumer heating systems are upgraded for compatibility with a low temperature network.

Heat pumps are energy efficient way to create hot water to heat buildings and are seeing increasing levels of support from public funds, due to the increasing environmental benefit as the electricity grid decarbonises. Heat pumps work by absorbing heat from an environmental source (either ambient air or ground heat in this case) and transferring it to a working fluid, which is compressed to increase the temperature further. The heat is transferred from the working fluid into the load circuit (hot water) which is used to provide heating for a property, either through radiators or underfloor heating. Much like the biomass boiler solution, we would recommend complete drain

and clean of the load circuit, with the addition of dirt separation or straining components to protect the new heat exchanger.

The installation of an air source heat pump (ASHP) is relatively straightforward and could be located within the existing boiler house (and the fan unit on the adjacent external wall). The electrical demand of the site would be increased (since electrical energy would be used to satisfy site heat demands), so the adequacy of electrical connection capacity would need to be confirmed with the local network operator. While ASHPs are not as efficient as the ground source alternative (since water in the ground circuit has a greater thermal capacity than that of air), the overall efficiency of the system could be improved by upgrading the radiator system to underfloor heating, which operates at lower temperatures. This approach has not been recommended as part of the building upgrades since this would necessitate a deep refurbishment of the building and cause major interruption to all areas of the centre and the service provision.

Installing a ground source heat pump (GSHP) would require a capital outlay of 50% to 100% more than that of an ASHP, primarily due to the need to install a ground circuit into the land outside the buildings. Ground conditions have not been assessed as part of this study but would need to be confirmed as suitable. The benefit of this approach would be higher efficiency, meaning that electrical consumption would be lower for the same level of heat provision.

3.2.6 Health and safety compliance

The Health and Safety Authority (HSA) is the national statutory body responsible for the administration and enforcement of health and safety at work in Ireland. Under the Safety, Health and Welfare at Work (Construction) Regulations 2013, legal obligations are placed on a range of duty holders involved with commissioning, design and construction activities.

It is the duty of the Client to notify the HSA when a construction project is likely to last more than 500 persons days or 30 working days. This may be the case in the event of installation of a biomass boiler / heat pump and will almost certainly be the case if a district heating scheme is progressed. The Client must appoint a project supervisor design process (PSDP) and a project supervisor construction stage (PSCS), in addition to satisfying a number of other duties[4] throughout the project.

The ongoing operation of a biomass boiler system would require much more onerous procedures to be established, relative to the existing arrangements for operation of the fossil fuel boiler. These responsibilities sit outside the scope of this report but should be considered if the scheme is progressed. In the case of a heat pump, the level of operational and maintenance tasks would be reduced considerably.

3.3 Capital cost estimate

We have prepared a capital cost estimate for upgrading the heating system at the Ionad Lae Day Care Centre with a wood pellet biomass boiler. As discussed in the preceding sections, this would require the relocation of the boiler house and the repurposing of the storage building including the addition of a new flue, which we have accounted for. We estimate the total cost of this solution to be in the order of €82,000 ±20%.

The strategy of upgrading the existing boiler with a heat pump would not require the relocation of the boiler house and would therefore be more straightforward. There are however a number of unknowns in this case, making the costs less certain. Accounting for the upgrade of the load circuit

[4] https://www.hsa.ie/eng/Your_Industry/Construction/Construction_Duty_Holders/Client/Client_Duties.html

and heat emitters (radiators) within the buildings to ensure compatibility with a low temperature system, the cost of installing an ASHP is estimated as €65,000 ±20%.

It would be possible to distribute heat to the sheltered housing units by installing hot water pipes in the ground (with associated civil works) and upgrading the existing heating systems with compatible heat interface units. In this case, costs could be optimised through the application of relatively small diameter polymer distribution pipework, as a result of the relatively low system temperatures and pressures. On this basis, the option of connecting the six sheltered housing units at the site would increase costs by around €37,000 ±20% (subject to ground conditions and final pipe routing selection).

We have not approached the market to verify costs at this stage. To progress any of the outlined solutions, a full tender process should be carried out with proposals requested from multiple suppliers and reviewed against relevant criteria.

3.4 District heating feasibility

In district heating schemes, heat is typically distributed using buried pipework. Pre-insulated steel pipes can be used to supply pressurised hot water and to return cooler water. Less expensive polymer pipes can be incorporated where the temperature and pressure are within design limitations. Where pipes are small, two pipes may be integrated within a single insulated sleeve. Pipe technology is well proven and can provide a heat distribution system with a design life of 30 years or more. Additional pipe work can be added retrospectively, and it is reasonably straightforward to add branches to serve new developments.

Heat delivery arriving at a consumer's premises usually terminates using a secondary heat exchanger (or heat interface unit). The heat exchanger is typically arranged to supply heat to a tertiary heating circuit upstream of the customers' existing boiler plant. The water in the tertiary circuit is boosted to the temperature required to satisfy the heating needs of the building.

Water is pumped continuously around the district heating system. Pumps are operated with 100% standby capacity to maintain heat supply in the event of a pump fault. Pumps are likely to utilise variable speed drives to minimise energy usage.

The Ionad Lae Day Care Centre is the principal focus for a biomass boiler installation. Subject to technical compatibility, financial viability and willingness of building owners to accept heat from a third party, there may be an opportunity to expand heat provision to other premises in the locality, thereby increasing the level of carbon and cost savings which could be achieved. This approach would require an appropriately sized centralised biomass boiler and the installation of district heating pipelines (flow and return) to supply hot water to additional heat consumers. Under this arrangement, the operator of the biomass boiler at the day care centre would be contractually obliged to supply heat in accordance with the terms stipulated by a heat supply contract and may face financial penalties or legal recourse if it failed to deliver. The entity supplying heat from the day care centre would be paid by heat consumers for the provision of heat.

The neighbouring nursing home visited alongside the day care centre. Space heating demand is served by a two efficient, De Dietrich GT 305 oil fired boilers. Domestic hot water is served by two gas fired Lochinvar cylinder heaters. The heating systems were refurbished and upgraded within the last two years. Based on discussions with the facilities manager at the time of our visit and considering the recent investment and the preference for the nursing home to maintain critical services on a self-reliant basis, the likelihood of connecting the nursing home is low at this stage.

Taking account of these complexities, the preferred approach at Gweedore is to establish a biomass boiler or heat pump system to serve the day care centre initially, with the inclusion of the adjacent

sheltered housing. Subject to the success of the scheme over the short to medium term, the appetite for uptake of district heating by local businesses and building owners could be reconsidered.

Potential additional heat consumers, all of which are located within 2km of the day care centre, identified as part of this study were Aras Ghaoth Dobhair, St Mary's Church, Gweedore Credit Union, and subject to the pipe route selected, other businesses and commercial premises along Derrybeg high street. There are also a handful of businesses at Gweedore Industrial Estate, located approximately 1.2km to the south of the day care centre.

The details of the heating systems at these sites is unknown but would need to be reviewed to determine whether connections to these sites could be progressed, both in terms of compatibility of the individual heating systems and the feasibility of district heating pipe installation. Given the low heat demand density in Gweedore, a district heating network serving consumers located further from the day care centre is unlikely to be financially viable in our opinion.

3.5 Fiscal support

The following sections detail fiscal incentives which may be available to support delivery of the district heating and energy improvement projects outlined in this report.

3.5.1 Údarás na Gaeltachta

3.5.1.1 Community Employment Scheme

Údarás na Gaeltachta's community development strategy aims to empower Gaeltacht communities to optimise and develop their local resources. Of interest to the potential projects outlined in this report are the social employment schemes, which are focused on the development of social infrastructure and provision of services for the elderly.

The Community Employment Scheme offers funding to employ and train unemployed people as participants, typically for one year, for an average of 39 hours per fortnight. This scheme would therefore only help to offset the employment costs associated with the operation of a wider district heating scheme, for which an additional employment position may be justified. There is also a risk of loss of the participant and funding since the intention is to integrate the participant into subsequent employment elsewhere in the local economy after one year.

Similarly, the TÚS Community Work Placement Initiative aims to provide short-term, quality work opportunities for those who are unemployed and to provide services of benefit to communities. However, it is not clear whether funding is offered to the employer under this scheme, and therefore offers no commercial benefit to the project.

3.5.1.2 LEADER Programme

The LEADER Rural Development Programme (RDP) provides grant funding to projects aiming to promote the quality of life and economic opportunities in the Donegal / Múscraí Gaeltacht, where Údarás is responsible for administration of the programme. According to the promotional material, funding up to a cumulative ceiling of 12% of the capital costs of eligible projects is available to subsidise professional fees. However, it is not clear what level of support is available to construction activities, purchase of machinery and equipment and staff training (although these elements are listed as eligible project areas).

The programme spans three main themes:

1. economic development, enterprise development and job creation;
2. social inclusion; and
3. rural environment.

Themes 1 and 3 present the strongest funding routes for the projects outlined in this report, however it could also be argued that upgrade of the day care centre heating system would represent an improvement to basic services and support for community facility development, which is a priority area under theme 2.

To be eligible, the project must align with the framework of the approved Local Development Strategy. Project compliance with the Donegal Local Development Strategy[5] sits outside of the scope of this study, however based on high level review the strategy calls for the use of renewable energy resources with a transition away from use of peat (which is increasingly viewed as unsustainable). Stimulating uptake of renewable technology, promoting energy efficiency, and supporting renewable energy and sustainable development are listed as local objectives. The proposals outlined in this study therefore appear to align with the strategy, however heat pump technology is not explicitly mentioned.

3.5.1.3 Capital Assistance Programme

Community-based committees/organisations, operating through Irish, are eligible to apply for the Department's Clár Tacaíochtaí Pobail agus Teanga (CTPT). Funding is provided to assist with the costs associated with the construction or renovation of community facilities and the purchase of equipment or fittings.

Further information can be found at the following weblink.

https://www.chg.gov.ie/gaeltacht/the-gaeltacht/language-support-schemes-programmes/capital-programme/

3.5.2 SEAI

3.5.2.1 Support Scheme for Renewable Heat

The proposed Support Scheme for Renewable Heat (SSRH) is a government funded initiative designed to increase the energy generated from renewable sources in the heat sector. The scheme is open to public and private sector non-domestic heat users. SEAI has been appointed by the Department of Communications, Climate Action and Environment as the administrator for the SSRH.

Two support mechanisms are available under the scheme.

1. Installation grants are intended to bridge the gap between the cost of installation of renewable heating systems and to conventional fossil fuel alternatives. The installation grant provides funding of up to 30% of eligible costs to commercial, industrial, agricultural, district heating or other non-domestic heat users not covered by the Emission Trading System. At present only air, ground and water source heat pump technologies are supported, so only upgrading the day care centre with a heat pump (rather than biomass boiler) would be eligible.

[5] https://www.donegalcoco.ie/media/donegalcountyc/community/lcdc/Local%20Development%20Strategy%20for%20Donegal.pdf

2. On-going operational support is available, via a tariff and based on useable heat output in renewable heating systems in new installations, or installations that currently use a fossil fuel heating system and convert to an eligible technology. Eligible technologies include biomass boilers or biomass CHP heating systems, or biogas (anaerobic digestion) boilers or biogas CHP heating systems. The tariff will be made available to successful applicants for a period of up to 15 years.

   The tariff mechanism is subject to state aid approval from the European Commission and is anticipated to open for applications in early 2019 (according to SEAI's website). Accordingly, the tariff support level is not known at this stage.

In order to access funding, the applicant must demonstrate that:

- buildings and heat using processes must adhere to verified energy efficiency criteria;
- heat generating technologies and project installations must comply with Building Regulations, Construction Products Regulations, EN Standards, efficiency, technology standards and air quality standards in relation to emissions;
- designers and installers shall be competent to carry out works; and
- recipients of payments must be subject to tax clearance procedures.

On this basis, Comharchumann would qualify support under the SSRH tariff mechanism.

3.5.2.2 Better Energy Communities

To support delivery of the energy efficiency upgrades outlined in section 3.1, funding levels of up to 50% are available from SEAI. The most suitable scheme to deliver these grants that is currently open to applications is the Better Energy Communities programme. This is a national retrofit initiative and supplies up to €28 million in funding each year. Delivery of the biomass boiler system could also be supported through this programme provided that other state aid support (i.e. under the SSRH) was not anticipated.

To be eligible, projects should be community oriented with a cross-sectoral approach and must present a sustainable financial case. Projects able to deliver community benefits, those with multiple elements, which have a clear road map, justified energy savings and which can demonstrate innovation and project ambition, are preferable.

As of March 2019, the application process for 2019 was open with 13% of the annual budget committed across five projects, and the remainder allocated to projects which were pending evaluation. Based on the grant status report[6], applications continue to be received on a regular basis.

3.5.3 Western Development Commission

The Western Development Commission (WDC) aims to support the counties of Donegal, Sligo, Leitrim, Roscommon, Mayo, Galway and Clare in the Western Region. Support is provided through a combination of investment, regional development and policy analysis.

Of relevance to the district heating and energy improvement projects is the Community Loan Fund for community and not-for-profit enterprises. Loan amounts ranging from €10,000 to €100,000 are available provided that the applicant can meet the assessment criteria, the key consideration being repayment capacity of the venture. The project must also deliver a positive social impact, or 'social dividend', for its community and the Western Region.

[6] https://www.seai.ie/__uuid/cd83e4dc-10a8-4f09-acea-d7cbc6896a49/Communities-grant-status-tracker.pdf

Interest rates are subject to the loan type.

1. Bridging Finance – EU Reference rate for Ireland (currently -0.15%) plus 1%.
2. Community Loans – EU Reference rate for Ireland (currently -0.15%) plus 3%.

Interest rates are variable and are reviewed on an annual basis. The repayment term typically ranges from three to ten years, but other durations will be considered subject to the business case.

On the basis that the projects outlined in this report are aimed at socially valuable community and education centres, support a vulnerable demographic, would have a material impact on carbon emissions and local air quality, and would support the local economy, the ambitions of the WDC Community Loan Fund align strongly. We would therefore expect the fund to be accessible to Comharchumann.

3.5.4 Climate Action Fund

The Climate Action Fund is one of four funds established under the National Development Plan 2018-2027 as part of Project Ireland 2040. The fund aims to support initiatives that contribute to the achievement of Ireland's climate and energy targets in a cost-effective manner. The Department of Communications, Climate Action and Environment has responsibility for implementing the fund, which will have an allocation of at least €500 million over the period to 2027.

The fund is aimed at a broad range of projects including renewable energy, energy efficiency and district heating, amongst others. Up to 50% of the total investment costs may be supported with specific ceiling thresholds applicable to different types of projects. In the case of energy efficiency measures, offers for up to 30% of 'extra investment costs' (being the difference between the level of investment that would otherwise be made and the project cost including energy efficiency measures) are available.

The results of the first call for applications under the fund were announced in November 2018. Seven projects were approved as eligible, with support levels ranging from €1.4 million to €20 million, with an average size of €11 million. It is evident that the fund is aimed at larger projects and the guidance for the first call stipulates a minimum support level of €1 million. On this basis, the projects outlined in this report would not qualify for support.

3.6 Supply chain for biomass fuel

Our experience is that the development of a district heating scheme and a fuel supply chain to the boiler are very different projects. It is easier to develop the district heating scheme and then procure fuel from existing providers, rather than developing a supply chain in parallel. Once the district heating scheme is built and operational, it may be appropriate to develop a more local, or community owned, supply chain.

Solid biomass fuels for community scale biomass boiler systems are generally split into two categories.

1. Wood pellets are made from compressed sawdust. They offer high calorific value in combination with low moisture content (typically around 10%), and when burnt produce a low volume of ash residue (<0.5% by weight). Pellets are also comparatively easy to handle and are therefore preferred in fully automated heating systems. However, pellets give off gas carbon monoxide for up to six weeks after manufacture and must therefore be held within a well ventilated store.

2. Woodchip is chipped woody biomass in the form of pieces with a defined particle size and are mainly used in commercial and industrial heating systems. The moisture content of wood chip varies between 20% and 55% subject to the drying process undertaken. The moisture content of the fuel must match the specification of the biomass boiler to avoid complications, but it is not uncommon for fuel quality to vary. Hazardous spore or mould growth on wet fuel must be avoided with adequate ventilation. The lower energy content of woodchip relative to pellets is offset by its lower cost.

We would not recommend the use of alternative biomass fuels, for example waste wood, straw, grain and husks, in this case. The additional operational considerations and the lack of supply chain availability for smaller fuel volumes would render these options prohibitive.

The Wood Fuel Quality Assurance (WFQA) Scheme for Ireland was established to increase consumer confidence in wood fuel products that are accurately described, meet the supplier's stated product specifications, and are produced in compliance with EUTR (EU Timber Regulation).

We have contacted a single biomass fuel supplier, Balcas Timber Ltd (trading as Brites), that is registered with the WFQA Scheme, to obtain a representative quote for supplying wood pellets to an assumed biomass boiler at the day care centre. Balcas' pellet manufacturing plant is based in Enniskillen, Northern Ireland, located approximately 126 km (by road transport) from the day care centre. The fuel strategy should be optimised from a carbon perspective at a later stage.

Assuming an annualised boiler efficiency of 85%, being a conservative assumption for a newly installed system, and taking a typical pellet specification (6mm ENplus A1, moisture content <10%), a price of €777 (excluding VAT) for a 3-tonne delivery is offered. This equates to an annual fuel cost of €7,378.

To verify this cost, we have also referenced a biomass market report, 'Potential Biomass Prices in Ireland' version 5, issued October 2017[7], prepared by Ricardo Energy & Environment on commission of SEAI. The report concludes that for wood pellets, small 'blown' bulk deliveries of around 3 tonnes generally cost in the range of 5 to 5.3 c/kWh, with bulk bags (of about 1 tonne) slightly higher than this. Applying the same assumptions as above, the annual fuel cost would be €7,300 to €8,600 subject to the delivery size which could be accepted into the fuel store. These figures align well with the quote received.

[7] https://www.seai.ie/resources/publications/Advice-on-biomass-price-Final-Issue-5-25-Oct-20-2017.pdf

Appendices

A Energy Audit – An Chrannóg

REMTec Consulting

Preliminary Energy Audit

for

An Chrannóg, Comharchumann Forbartha

At Gaoth Dobhair Teo

Date: 6th March 2019

REMTec Consulting

REMTec Consulting Ltd. Main Street Mountcharles Co. Donegal

Tel: 087-6418902 Email: info@remtec.ie Web: www.remtec.ie

1 CONTEXT

This work was commissioned by Fred Tottenham at Fichtner Consulting Engineers Ltd requesting a high level assessment of the energy efficiency of the building, and a short written report including a suggestion of the top energy efficiency, or renewable energy, item to be considered, a rough estimate of the cost (subject to the building quotes from contractors), details of any grants applicable for the measure and any other general observations.

The site visit took place on the 27th February 2019 and information supplied included a plan of the building, electricity and fuel bills for the year 2018.

2 ENERGY CONSUMPTION

The annual energy bill for the facility is €20,330. The following table summarises the fuel types that are used at the site.

	Energy		Cost	
Fuel Type	kWh/yr	%	€/year	%
Oil	186,620	74%	€ 13,027	64%
Electricity	38,623	26%	€ 7,303	36%
Total	225,243	100%	€ 20,330	100%

Figure 1: Summary of fuel types

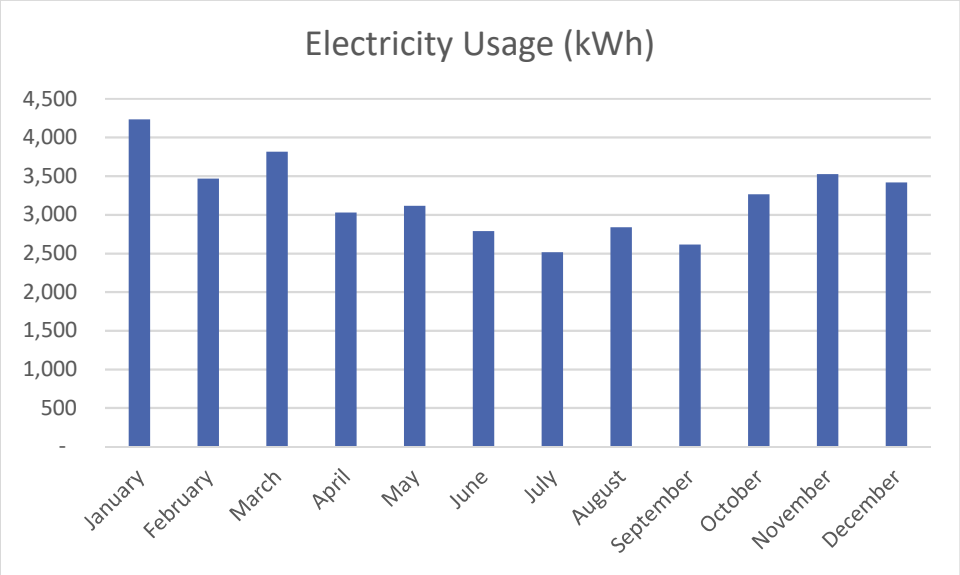


Figure 2: Annual Energy Consumption (kWh)

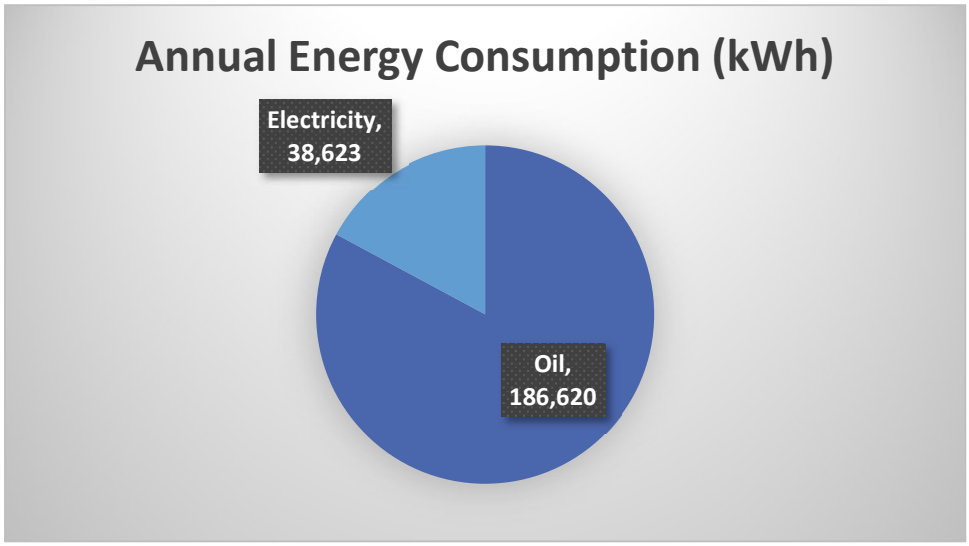


Figure 3: Annual Energy Consumption (kWh)

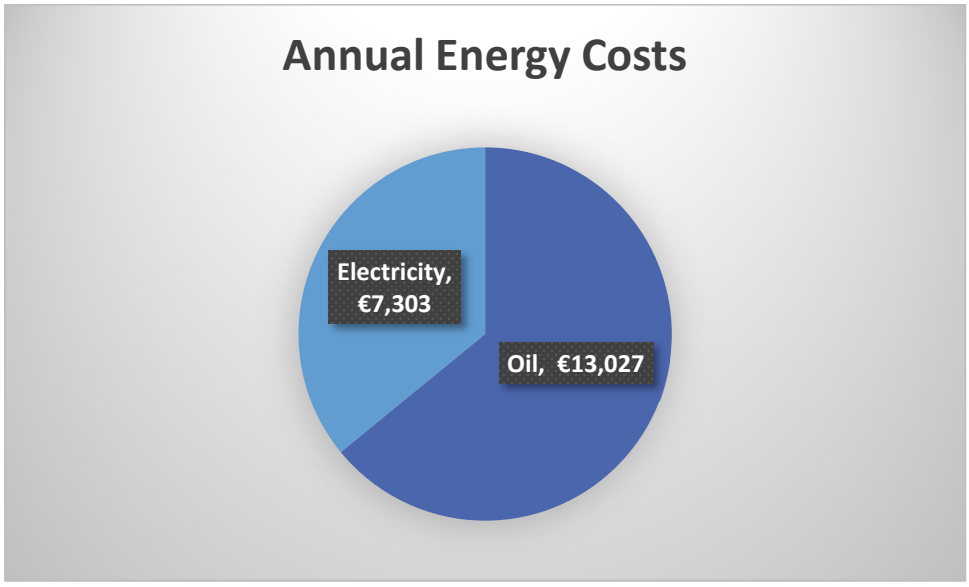


Figure 4: Annual Energy Costs

3 BUILDING SURVEY INFORMATION

3.1 GENERAL INFORMATION

Building Name:	An Chrannóg
Site Address:	Derrybeg, Gweedore, Co. Donegal
Date of Visit:	27th February 2019
Energy Auditor:	Stephen O'Sullivan, REMTec Consulting, Mountcharles, Co. Donegal
Visit Hosted by:	Aisling Nic Aoidh, Udaras

Figure 5: Building Layout (noting lightly shaded hatched areas denoting the pharmacy at the front and the creche building to the rear)

3.2 BUILDING SURVEY INFORMATION:

Building Details	Description / Comments / Observations
Building Age	The main building is a single storey and dates back to the late 1950s or early 1960s. There was a two-storey extension at the rear of the building in 2003/2004 and a pharmacy at the front of the building, however these parts of the building were not subject to the survey.
Building Activities	The building is used primarily as a community centre, with two halls to accommodate regular gatherings such as music and dance practice and a library/museum with bookshelves and some IT equipment. There is also a number of smaller rooms including 2 offices, 2 stores, a kitchen and toilets. There is also a workshop used for wood framing which has it own separate heating system, although there was no access to this during the site visit. The building is generally in use from 9am to 9pm, 5 days a week. This equates to an annual usage of 3,120 hours.
Building Area	The approximate area of the building is 725m^2.
Building Fabric	The building is a product of the era from which it was built and there has not been any significant investment in the energy efficiency measures to note. External wall construction is cavity wall with no insulation and an assumed U-value of 2.1 W/m2K. The roof is predominantly a pitched roof with an attic void, and also a small area of flat roof, with an assumed U-value of 2.3 W/m2K. The windows are single glazed timber frame with a U-Value of 4.8 W/m2K. There is some evidence of condensation on the windows and frames. There is a mixture of old solid timber doors with a U-value of 5 W/m2K and some newer PVC doors.
Building Services	The building is heated by an old Grant Oil Boiler 110-140kW capacity which is in a severe state of disrepair, including serious health and safety issues associated with a broken and disconnected flue and an actively leaking expansion vessel. It is assumed based on a brief visual inspection that the efficiency of the boiler is no greater than 60% and the pipework is poorly insulated. The system is also poorly controlled and poorly distributed via a one pipe heating system to single panel radiators throughout the building. Domestic Hot Water is provided via electric under sink heaters. A separate heating system, for the creche building that also links into the back hall was installed in 2003/2004, includes two Grant Multi Pass Oil Boiler of 140-160kW. These are in good working order.
Ventilation	There is limited natural ventilation in the building, leading to some evidence of condensation on windows. One of the halls which was once used as a technical school has an Air Conditioning unit installed but it is no longer operational.
Lighting	The lighting is provided by outdated inefficient fluorescent tubes and CFL's throughout. Emerging lighting was not evident and this should be addressed.
Lighting Controls	Existing lighting switched on/off control.
External Lighting and control	External light fittings are bulkheads and controlled by manual switching.

4 Opportunities for Improvements in Energy Efficiency

This building is need of a full deep retrofit and as such could see a dramatic improvement in energy efficiency. It is recommended that a heat pump system in combination with a full fabric upgrade is required, as the heating system is in desperate need of replacement and it should not be replaced until the heat loss issues in the building's thermal envelopes have been addressed.

It was also noted in discussions with the facilities manager that an extension to the existing building is being considered, however these recommendations are made based on the building as it is today.

4.1 Recommended Measures

Element	Upgrade	Net Area (m2)	Thermal Savings (kWh)	Electrical Savings (kWh)	Annual Savings (€)	Capital Cost (€)	Payback Period (years)
Windows & Doors	Replace 72m2 of windows from U=4.8 to 1.4 W/m2K Replace #9 external doors from U=5 to U=1.4 W/m2K	72 27.6	6,718		€781	€25,896	33.1
Walls	Install cavity insulation, improving U-value from 2.1 to 0.3 W/m2K	390	16,613		€1,932	€7,020	3.6
Attic Insulation	Install 300mm of mineral wool insulation in attic, improving U-value from 2.3 to 0.24 W/m2K.	660	23,063		€2,683	€8,580	3.2
Heat Pump and Controls	Replace old boiler with a new heat pump, new radiators designed for lower temp flow, and new heating controls.	n/a	65,578	-23,847	€8,518	€85,000	9.9
Lighting	Replace all lighting with LEDs, internal and external	n/a		11,471	€2,169	€14,500	6.7
Total			111,972	-12,375	€16,085	€140,996	8.8

4.2 Grants

Funding levels of between 30% and 50% are available from SEAI to support the capital investment required for the energy efficiency upgrades outlined above. The most suitable scheme to deliver these grants that is currently open to applications is the Better Energy Communities programme. This is a national retrofit initiative and supplies up to €28 million in finding each year. Further details are available here https://www.seai.ie/grants/community-grants/.

With the grant, the payback period could be reduced to between 5 and 6 years.

B Energy Audit – Scoil Adhamhnáin

REMTec Consulting

Preliminary Energy Audit

for

Scoil Adhamhnáin, An Luinnigh

At Derrybeg, Co. Donegal

Date: 7th March 2019

REMTec Consulting

REMTec Consulting Ltd. Main Street Mountcharles Co. Donegal

Tel: 087-6418902 Email: info@remtec.ie Web: www.remtec.ie

1 CONTEXT

This work was commissioned by Fred Tottenham at Fichtner Consulting Engineers Ltd requesting a high level assessment of the energy efficiency of the building, and a short written report including a suggestion of the top energy efficiency, or renewable energy, item to be considered, a rough estimate of the cost (subject to the building quotes from contractors), details of any grants applicable for the measure and any other general observations.

The site visit took place on the 27th February 2019 and information supplied included a plan of the building, electricity bills for 2018 and oil bills for 2017 and 2018.

2 ENERGY CONSUMPTION

The annual energy bill for the facility is €7,966. The following table summarises the fuel types that are used at the site.

	Energy		Cost	
Fuel Type	kWh/yr	%	€/year	%
Gas Oil	66,840	79%	€ 4,639	58%
Electricity	17,893	21%	€ 3,327	42%
Total	84,733	100%	€ 7,966	100%

Figure 1: Summary of fuel types

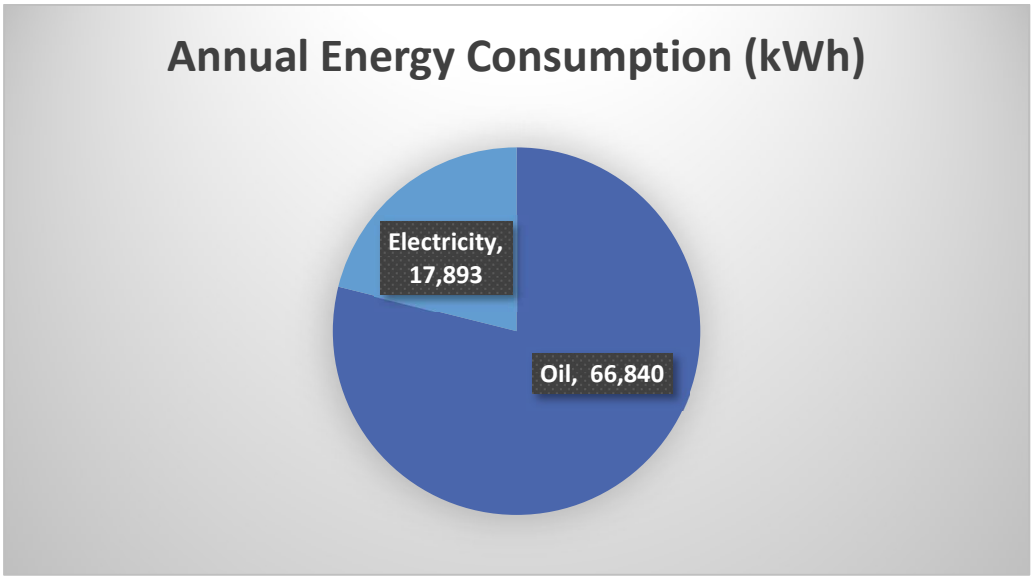


Figure 2: Annual Energy Consumption (kWh)

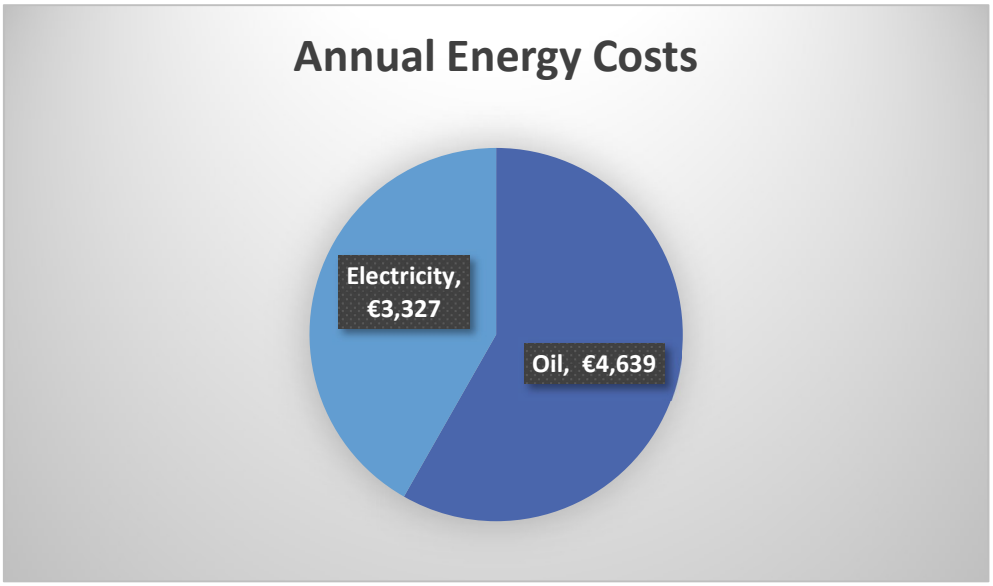


Figure 3: Annual Energy Costs

3 BUILDING SURVEY INFORMATION

3.1 GENERAL INFORMATION

Building Name:	Scoil Adhamhnáin, An Luinnigh
Site Address:	Derrybeg, Gweedore, Co. Donegal
Date of Visit:	27th February 2019
Energy Auditor:	Stephen O'Sullivan, REMTec Consulting, Mountcharles, Co. Donegal
Visit Hosted by:	Bridie Verry, Principal

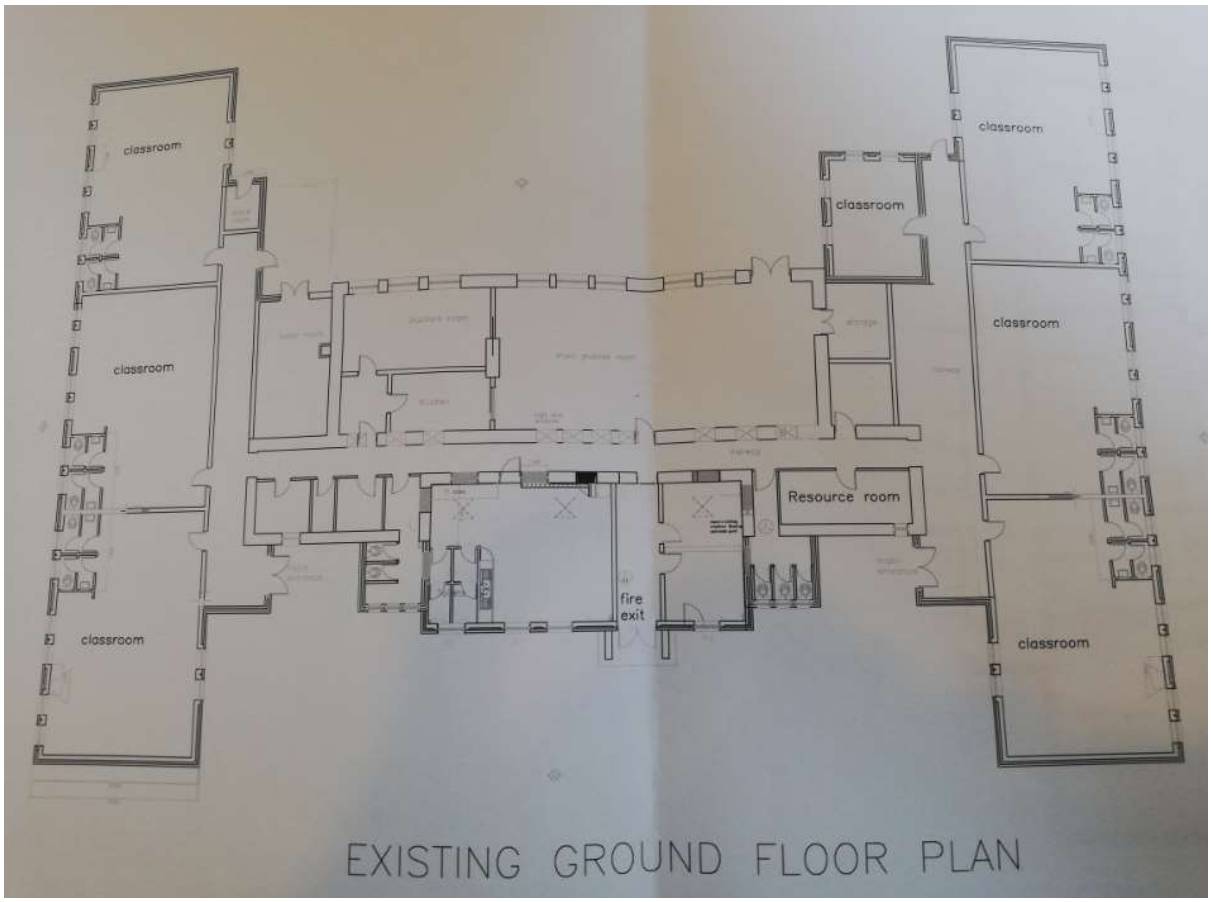


Figure 4: Building Layout

3.2 BUILDING SURVEY INFORMATION:

Building Details	Description / Comments / Observations
Building Age	The original school building dates back to 1945 and is evident by the thick solid walls that make up the central core of the floor plan in Figure 4. In 1985 six classrooms were added, three along each side and the central core became a multi-function hall, staff room, toilets and storage. In 2010, an entrance, office and library were added at the front of the building.
Building Activities	The building is a six-classroom primary school with 136 pupils. It is in use from 8am to 3pm during the 185 days a year i.e. annual usage of approximately 1,295 hours.
Building Area	The approximate area of the building is 576m^2.
Building Fabric	The original building dating from 1945 is constructed of 500mm solid walls with no insulation and the elements of this are still directly connected to the exterior are in very poor condition, with extensive evidence of mould, damp and general degradation. There is a pitched roof and a void to a flat ceiling and there is 100mm of mineral wool insulation although it is in poor condition. The

	roof in general is in very poor condition and has been regularly in need of repair due to leaks. One section of the roof, above the resource room, collapsed due to water ingress and subsequent rotting of the timbers. The windows throughout the entire building were upgraded in 2012. They are double glazed and in good condition. The section of the building built in 1985, housing the six classrooms, is a cavity wall construction and they were pumped with beads in 2010. The roof is a pitched roof with vaulted ceiling and exposed trusses, with a number of Velux windows integrated into the roof structure. Assuming building standards from 1985, there is a minimal amount of quilt insulation resulting in an overall roof U-value of 0.38 W/m2K. There is also some evidence of leaking through the roof near a Velux window. The windows throughout the entire building were upgraded in 2012. They are double glazed and in good condition.
Building Services	The building is heated by a Ferroli oil boiler and Reillo 40 G20S burner. The boiler is in good working order although it is at least 15 years old and would have an assumed efficiency of approx. 60%. The heating is delivered to the building mostly by flat panel radiators and controlled by a timing system but no temperature controls. Domestic Hot Water is provided via electric undersink heaters in the toilets and the kitchen.
Ventilation	There is natural ventilation provided by vents in most of the rooms, although not sufficient to avoid condensation in the older sections.
Lighting	The lighting is provided mainly by CFLs following a full lighting retrofit in 2012.
Lighting Controls	Existing lighting is switched on/off control.
External Lighting and control	External light fittings are bulkheads and controlled by manual switching.

4 General Observations

As detailed in the Building Survey Information, this school comprises of a number of different construction types as various sections were changed and added since its original construction in 1945. Some areas of the school are only in need of minor upgrade, such as internal dry-lining of the classroom ceilings, while other areas such as the roof over the multi-purpose hall has been suffering from years of leaks and probably needs to be completely replaced (subject to a full architectural and structural survey). In addition to this, there are plans for extending this part of the building so the integration of upgraded measures, such as a new and highly insulated roof and external walls, would be required under current building standards.

5 Opportunities for Improvements in Energy Efficiency

The older section of the building is in serious need of proper insulation and ventilation, however this would be addressed in the instance of the planned extension mentioned above.

The sections of the building housing the classrooms built in 1985 are in good condition.
Consideration is given to the potential for additional roof insulation, however this would require

significant capital cost and result in only marginal cost savings. This, along with dry lining the external walls and window/Velux upgrade, could be considered if there are ongoing issues with the heat levels in the rooms.

The main opportunities for improvements in energy efficiency is the upgrade of the lighting to LEDs and replacement of the oil boiler, with estimates of savings and costs below.

5.1 Recommended Measures

Element	Upgrade	Net Area (m2)	Thermal Savings (kWh)	Electrical Savings (kWh)	Annual Savings (€)	Capital Cost (€)	Payback Period (years)
Lighting	Replace all lighting with LEDs, internal and external	n/a		7,157	€1,331	€11,000	8.3
Boiler	Replace old oil boiler with condensing oil boiler, 98.5% efficiency, insulate all piping, replace older radiators, mechanical assisted powerflush and magnetic filter.	n/a	26,125		€1,813	€16,000	8.8
Total			26,125	7,157	€2,791	€27,000	8.6

5.2 Grants

Funding levels of 50% are available from SEAI to support the capital investment required for the energy efficiency upgrades outlined above. The most suitable scheme to deliver these grants that is currently open to applications is the Better Energy Communities programme. This is a national retrofit initiative and supplies up to €28 million in finding each year. Further details are available here https://www.seai.ie/grants/community-grants/.

Department of Education guidelines state that a 'fabric first' approach should be undertaken when considering energy efficiency upgrades. Also, the grants no longer cover fossil fuel related systems.

C Energy Audit – Ionad Lae Day Care Centre

REMTec Consulting

Preliminary Energy Audit

for

Ionad Lae / Gweedore Day Care Centre

Gweedore, Co. Donegal

Date: 12th March 2019

REMTec Consulting

REMTec Consulting Ltd. Main Street Mountcharles Co. Donegal

Tel: 087-6418902 Email: info@remtec.ie Web: www.remtec.ie

1 CONTEXT

This work was commissioned by Fred Tottenham at Fichtner Consulting Engineers Ltd requesting a high level assessment of the energy efficiency of the building, and a short written report including a suggestion of the top energy efficiency, or renewable energy, item to be considered, a rough estimate of the cost (subject to the building quotes from contractors), details of any grants applicable for the measure and any other general observations.

The site visit took place on the 27th February 2019 and information supplied included a plan of the building and most of the utility bills for 2018, noting that one of the oil bills was ineligible and the electricity bills provided costs only – therefore the figures provided in the following sections were completed using extrapolation and standard electricity pricing estimates.

2 ENERGY CONSUMPTION

The annual energy bill for the facility is €10,977. The following table summarises the fuel types that are used at the site.

	Energy		Cost	
Fuel Type	kWh/yr	%	€/year	%
Oil	119,915	88%	€ 7,912	72%
Electricity	16,349	12%	€ 3,066	28%
Total	136,264	100%	€ 10,911	100%

Figure 1: Summary of fuel types

The building is also served by an open fire in the centre's day room, which burns some turf and briquettes. A recommendation for replacing this with a wood-burning stove is included in section 5 however no further analysis of the energy consumption or cists is included in this report.

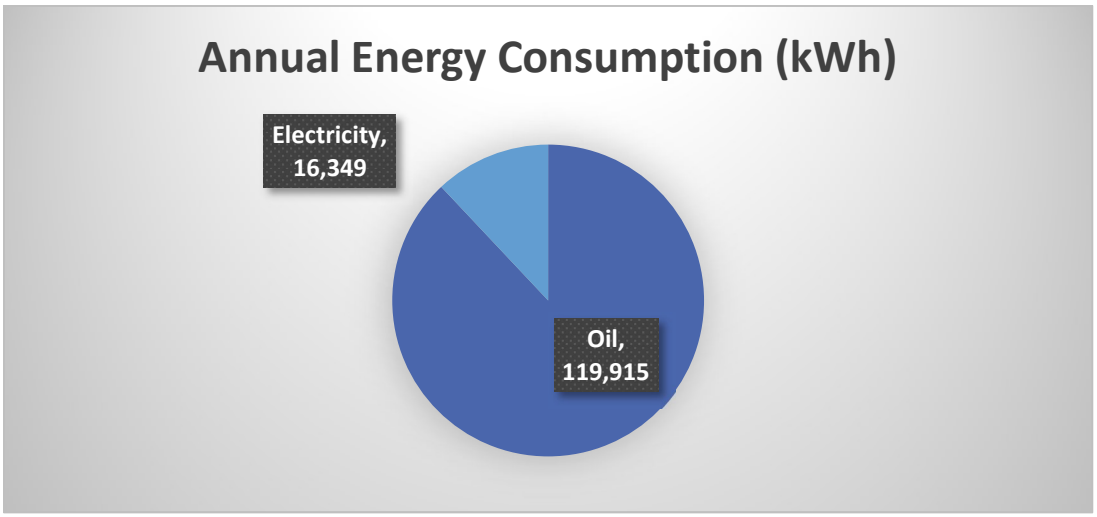


Figure 1: Annual Energy Consumption in kWh

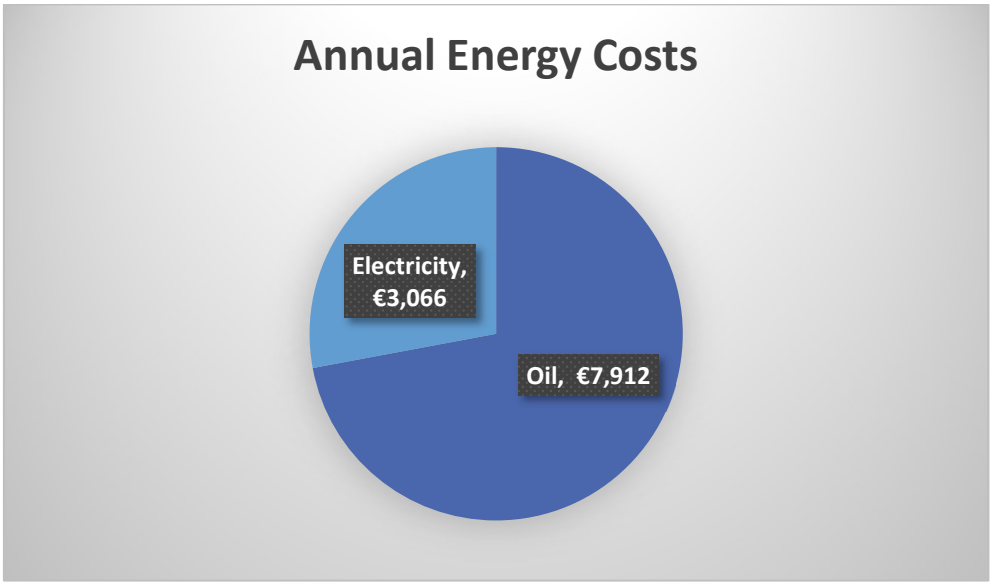


Figure 2: Annual Energy Costs in €euros

3 BUILDING SURVEY INFORMATION

3.1 GENERAL INFORMATION

Building Name:	Ionad Lae / Gweedore Day Care Centre
Site Address:	Gweedore, Co. Donegal
Date of Visit:	27th February 2019
Energy Auditor:	Stephen O'Sullivan, REMTec Consulting, Mountcharles, Co. Donegal
Visit Hosted by:	Eileen Curran, Centre Manager

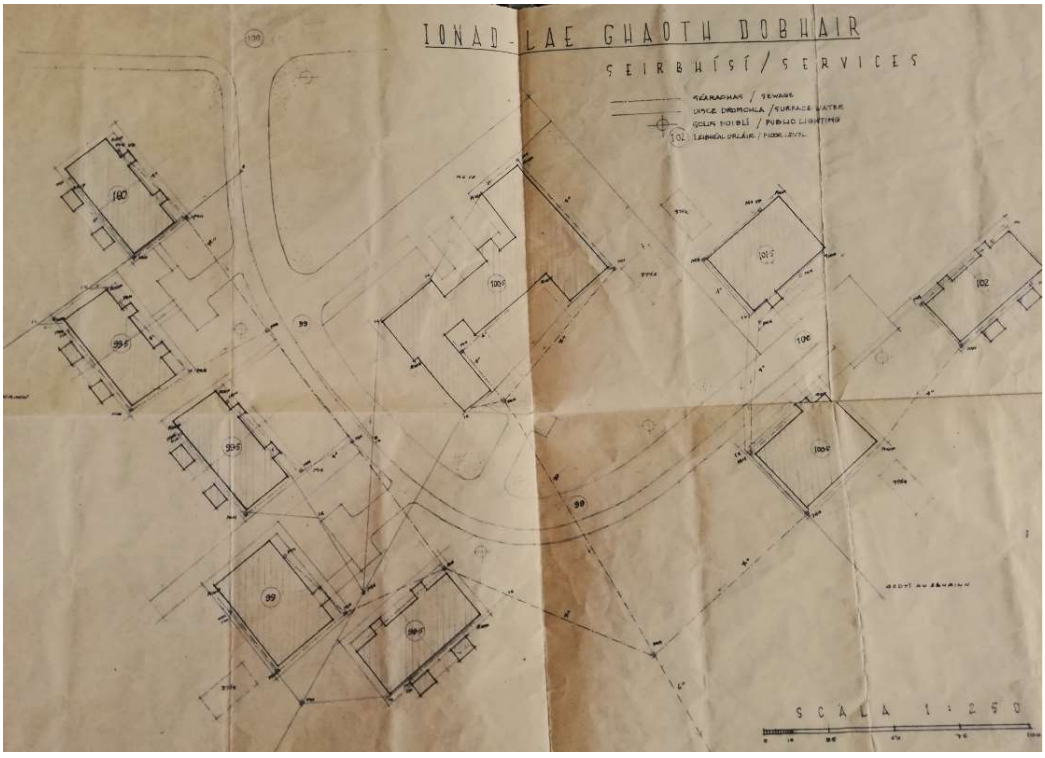


Figure 3: Building Layout with several housing units around the periphery

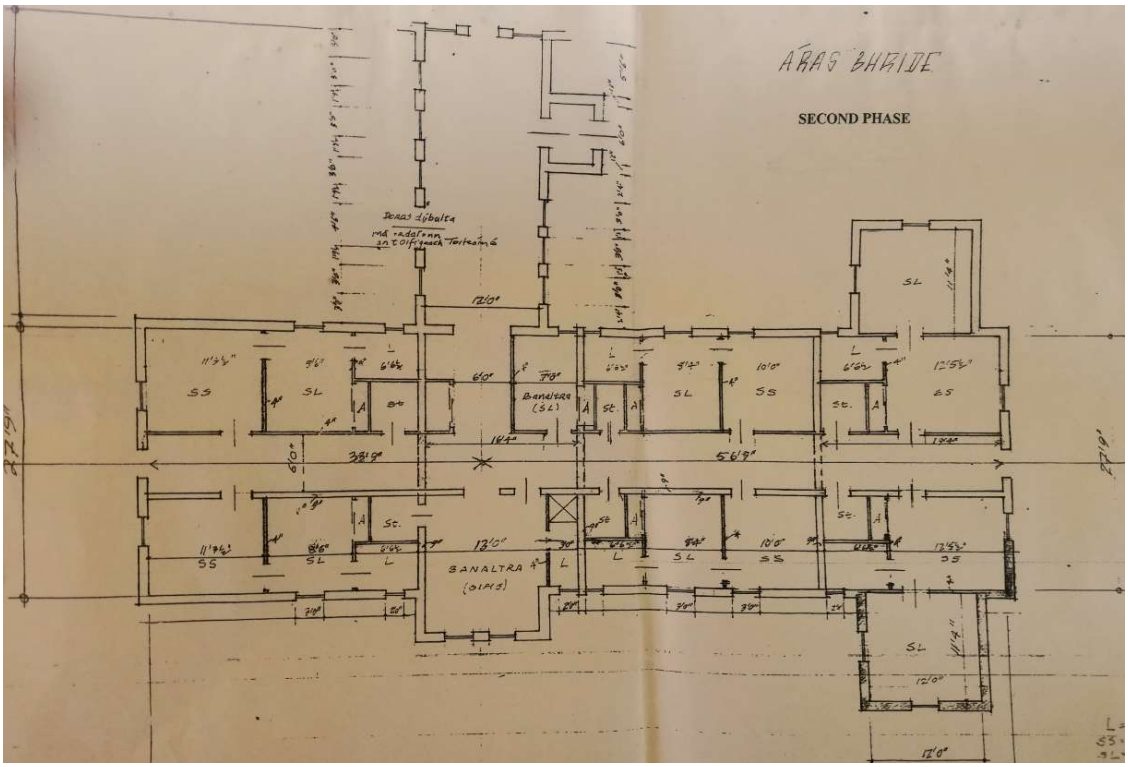


Figure 4: Phase 2 of the building, showing 6 self-catering apartments

3.2 BUILDING SURVEY INFORMATION:

Building Details	Description / Comments / Observations
Building Age	Construction of the Day Care Centre began in 1991 and was completed in August 1993, as shown in the centre of Figure 3. Phase 2 involved the addition of 6no. one-bedroom self-catering apartments, as shown in figure 4, and this section was completed in 1996. There are also 6no. sheltered housing units on the site but these were not part of the survey.
Building Activities	The Day Care Centre is open 5 days per week, from 9am until 5pm. There are a number of offices, treatment rooms, a laundry room, a day room with open fire, a large dining room and kitchen. There are activities such as bingo held in the day room and there is morning tea/coffee, 4 course lunch and afternoon tea. While the Day Care Centre is closed in the evenings and weekends, the apartments are used during normal residential hours i.e. early mornings, evenings and weekends.
Building Area	The area of the Day Care Centre is approximately 215m2. The area of the Phase 2 apartments, including the connecting corridor, is approximately 278m2. Total building area of 493m2.
Building Fabric	The building consists of cavity walls, with minimum insulation and a U-value of 1.86 W/m2K.

	The building has a pitched roof with attic void to flat ceilings covered by 100mm of mineral wool insulation, assuming a U-value of 0.45 W/m2K. The windows and external doors are double glazed with PVC frame, in reasonable condition although they are over 25 years old.
Building Services	The building is heated by an 113kW SIME 2R6 oil boiler which serves a radiator system and two hot water storage tanks throughout the building for heating and domestic hot water. The boiler is 25 years old and would have an assumed efficiency of between 65 and 75%. The showers in each of the apartments are electric and the 6no. apartments also have electric fires for additional heating provision. The radiators in the apartment bedrooms have TRVs attached to control the flow of heat. The heating system is controlled by a time clock and is divided into two zones as per the phases of construction previously described. There are two hot water storage tanks, one with minimal insulation and another in a compartment of a front office with no insulation at all. In addition to the oil-fired heating throughout the building and the electric fires in the apartments, the day room is heated on a daily basis by an open fire, burning turf and peat briquettes.
Ventilation	Natural ventilation throughout the building, with extractor fans in the showers and bathrooms.
Lighting & Controls	The building is lit by a number of outdated and inefficient CFLs and other fluorescent lighting solutions, although there is evidence of a single fitting that was recently replaced with an LED. All control is by means of manual switching.

4 General Observations

It is worth noting that the building was also being surveyed for a district heating solution, to replace the dependency on the outdated and inefficient oil boiler. It is expected that a separate report will be provided on this aspect.

The building and facilities manager also reported some recent leakage issues with a roofing valley but these issues have been completely resolved.

5 Opportunities for Improvements in Energy Efficiency

The following recommendations are provided based solely on a preliminary energy audit and all figures, particularly costing estimates, are subject to a full survey by appropriately qualified professionals.

5.1 Recommended Measures

Element	Upgrade	Net Area (m2)	Thermal Savings (kWh)	Electrical Savings (kWh)	Annual Savings (€)	Capital Cost (€)	Payback Period (years)
Attic insulation	Add 200mm of mineral wool to attic void to increase roof U-values from 0.45 W/m2K to 0.13 W/m2K. Incl. roof ventilation	493	7,657		€505	€3,500	6.9
Cavity Wall	Pump all cavity walls with insulation beads, increasing U-value from 1.86 W/m2K to 0.35 W/m2K.	715	11,233		€741	€4,000	5.4
Insulate Hot Water Storage Tanks	Apply modern standards of thermal insulation to hot water storage tanks and associated piping	n/a	1,199		€225	€250	1.1
Lighting	Replace all lighting with LEDs, internal and external	n/a		4,905	€920	€8,000	8.7
Total			20,088	4,905	€2,390	€15,750	6.6

In addition to the above recommendations, the replacement of the open fire with a sealed wood-burning stove should also be given serious consideration. It is noted that the open turf fire is seen as important for the staff and customer moral and is part of the local heritage. However a stove can increase efficiency from approximately 30% to 70%, and result in over 55% savings on solid fuel costs.

5.2 Grants

Funding levels of 50% are available from SEAI to support the capital investment required for the energy efficiency upgrades outlined above. The most suitable scheme to deliver these grants that is currently open to applications is the Better Energy Communities programme. This is a national retrofit initiative and supplies up to €28 million in finding each year. Further details are available here https://www.seai.ie/grants/community-grants/.

With the addition of the grant, the payback period could be reduced to approximately 4 years.

D Energy Audit – Amharclann Ghaoth Domhair

REMTec Consulting

Preliminary Energy Audit

for

Amharclann Ghaoth Domhair

Gweedore, Co. Donegal

Date: 13th March 2019

REMTec Consulting

REMTec Consulting Ltd. Main Street Mountcharles Co. Donegal

Tel: 087-6418902 Email: info@remtec.ie Web: www.remtec.ie

1 CONTEXT

This work was commissioned by Fred Tottenham at Fichtner Consulting Engineers Ltd requesting a high level assessment of the energy efficiency of the building, and a short written report including a suggestion of the top energy efficiency, or renewable energy, item to be considered, a rough estimate of the cost (subject to the building quotes from contractors), details of any grants applicable for the measure and any other general observations.

The site visit took place on the 27th February 2019 and information supplied included a plan of the building, as-built drawings indication construction types and levels of insulation, electricity and fuel bills for the whole year of 2018.

2 ENERGY CONSUMPTION

The building's energy is provided by grid electricity, bulk propane and an 8.8kW solar PV system. Figures for the annual electricity output of the solar PV system were not available, however it can be safely estimated that the total electricity savings from an 8.8kW PV system would equate to 7,188kWh per year. On that basis and from the information garnered from the propane and electricity bills, the following figures on energy consumption and costs are produced:

	Energy		Cost	
Fuel Type	kWh/yr	%	€/year	%
Propane	33,018	47%	€ 2,802	37%
Electricity	37,686	53%	€ 4,691	63%
Total	70,704	100%	€ 7,493	100%

Figure 1: Summary of energy consumption and costs

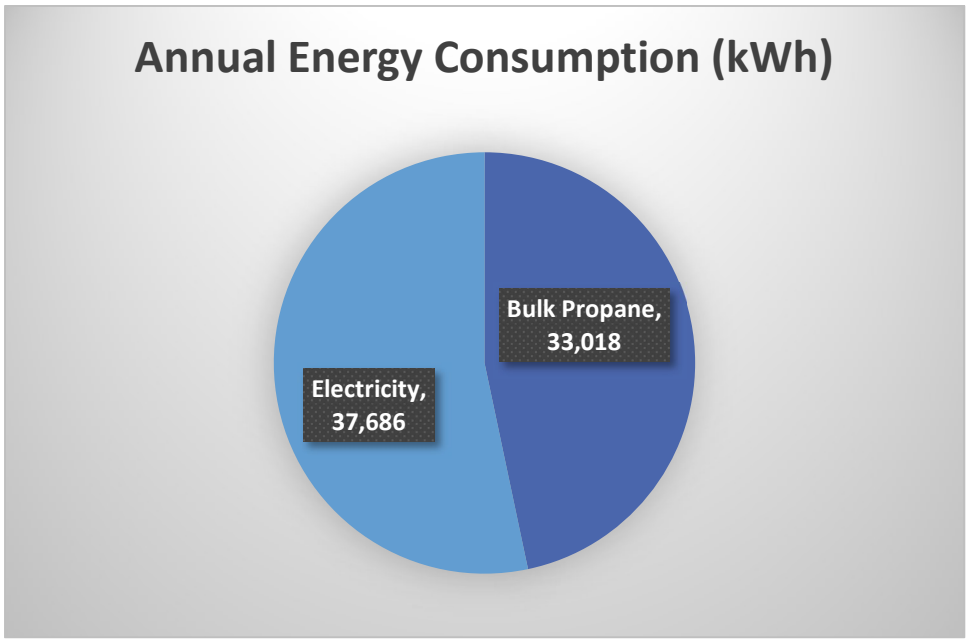


Figure 2: Annual Energy Consumption (kWh)

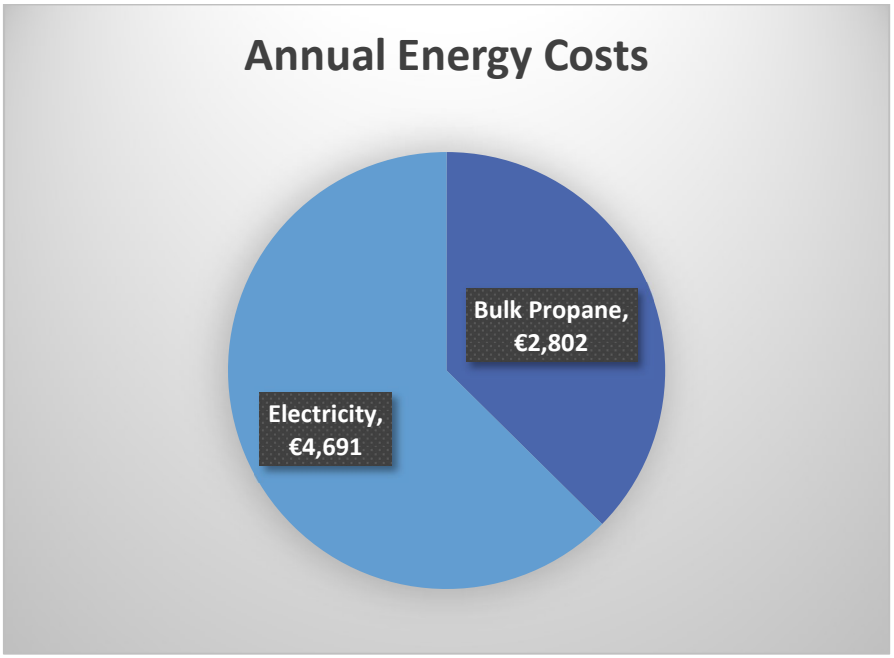


Figure 3: Annual Energy Costs (€euros)

3 BUILDING SURVEY INFORMATION

3.1 GENERAL INFORMATION

Building Name:	Amharclann Ghaoth Dobhair
Site Address:	Gweedore, Co. Donegal
Date of Visit:	27th February 2019
Energy Auditor:	Stephen O'Sullivan, REMTec Consulting, Mountcharles, Co. Donegal
Visit Hosted by:	Pól McCúl, Centre Manager

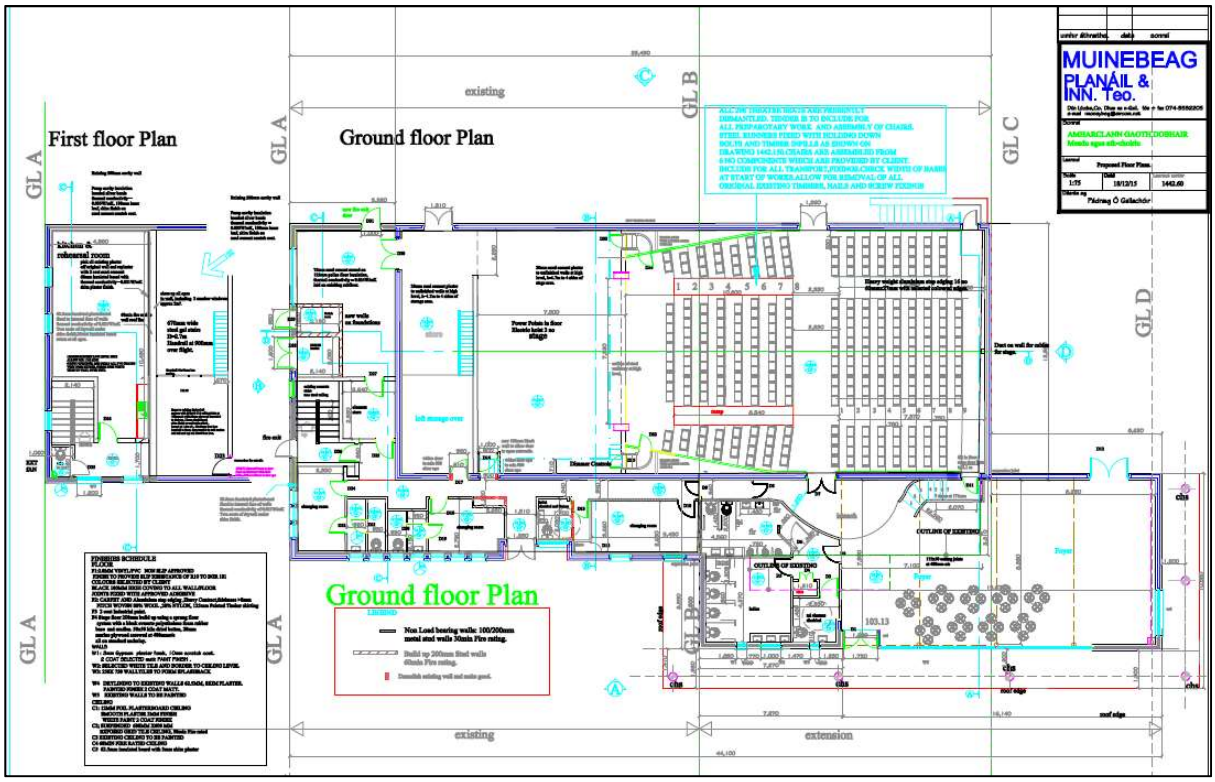


Figure 4: Building Layout

3.2 BUILDING SURVEY INFORMATION:

Building Details	Description / Comments / Observations
Building Age	The original building dates from 1932 and was officially opened as Amharclann Ghaoth Dobhair in 1961. However the building was completely renovated to its current condition in 2016.
Building Activities	The primary use of the building is as a theatre, and as such can have a varying level of usage depending on the types and frequency of shows. The majority of days the hall is not in official use and on average the building could host approximately 3 shows a week, in addition to practice and other events. The building also contains a café which is open daily, toilets, changing rooms, offices, a kitchen and rehearsal room.
Building Area	The area of the building is 908m2.
Building Fabric	The walls are 300mm cavity walls with pumped cavity insulation bonded silver beads, thermal conductivity of 0.033W/mK. Some of the newer external walls are also dry-lined with 62.5mm insulated plasterboard, thermal conductivity of 0.021W/mK. The roof is pitched with Tegral R6 sheeting on steel trusses, ceiling void and 300mm fibre insulation on ceiling. The section of the building with a flat roof over the café is 2.5mm PVC coating on 125mm of solid board insulation with thermal conductivity of 0.021W/mK. The floor is concrete screed on 125mm insulation, thermal conductivity of 0.022W/mK. The windows are aluminium powdered coated low e glass with argon filled U value = 1.5W/m2K. The external doors, including the main doors and the fire exits, have a U value < 1.1 W/m2K.
Building Services	The building is heated by two Immergas Vitrix Pro 100kW condensing gas boilers. The system is connected to a Joule Cyclone 150 litre storage tank with a 3kW immersion heating element. There is a sophisticated Building Energy Management system providing excellent control and visibility of the boilers, temperature throughout the building and gas metering. A solar PV system with 32 panels, each with a capacity of 275W, generate a total peak power of 8.8kW and cover an area of 52.4m2 on the south/south east facing roof.
Ventilation	The ventilation of the main theatre is provided by an air handling unit although there was no access to this during the site visit. The remainder of the building is served by natural ventilation.
Lighting	The lighting is provided by CFLs and other fluorescent lighting solutions. The lighting is controlled by manual switching.
External Lighting	The external lighting is provided by bulkheads.

4 General Observations

The following observations were noted, particularly in conversation with the facilities manager:

- An extension is planned to give additional space for rehearsals and additional kitchen facilities for the café at the space to the southwest of the main theatre and south east of the café.
- While the solar PV system is operating correctly as observed by the invertor displays, there has been a failure of the communications system that reports on the output of the system, which is subsequently sent to the user by email and also feeds into a live display in the lobby. For the last six months, there is no live feed of the system generation and no awareness by the staff or customers of the effectiveness of the solar panels, or even if they are working at all. It is assumed that the company responsible for the maintenance of the solar PV system needs to check the data communication components and repair any faults.

5 Opportunities for Improvements in Energy Efficiency

The building fabric of Amharclann Ghaoth Dobhair appears to be in very good condition, as would be expected from a building that was completely renovated in 2016. The building services, particularly the heating and PV systems are also in excellent condition, other than the minor data communications error noted in the previous system. The main opportunity for energy efficiency upgrade is the conversion of all lighting to LEDs, even though the current lighting is in an excellent working order, therefore any potential savings are not as significant as would normally be expected in a retrofit. The following figures are derived based on the preliminary energy audit, although more detailed savings and capital costs would need to be sought from a suitably qualified professional should this aspect be chosen for an upgrade.

5.1 Recommended Measures

Element	Upgrade	Net Area (m2)	Thermal Savings (kWh)	Electrical Savings (kWh)	Annual Savings (€)	Capital Cost (€)	Payback Period (years)
Lighting	Replace all lighting with LEDs, internal and external	n/a		7,537	€938	€15,000	16

5.2 Grants

Funding levels of 50% are available from SEAI to support the capital investment required for the energy efficiency upgrades outlined above. The most suitable scheme to deliver these grants that is currently open to applications is the Better Energy Communities programme. This is a national retrofit initiative and supplies up to €28 million in finding each year. Further details are available here https://www.seai.ie/grants/community-grants/.

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