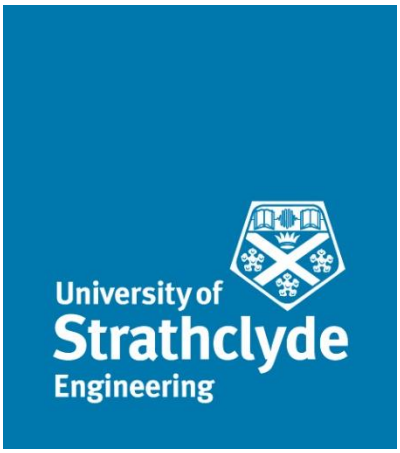

Department of Mechanical and Aerospace Engineering

Investigating the Sustainability Performance of Housing Co-operatives using West Whitlawburn Housing Co-operative as a Case Study

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Abstract

Changes in the global landscape, depletion of resources and climate change have left their mark. Efforts are now being made to shift from a one-dimensional thinking which was previously focused on economic gains alone. Sustainability reporting has become a widespread strategy for organisations to communicate their environmental and social performance, apart from their economic performance alone. However, various frameworks for sustainability reporting are mainly developed for investor-owned companies (IOCs). A Co-operative on the other hand, has a different governance structure and principally aims at serving its members rather than generating profits. It is therefore essential to develop a framework focused towards co-operatives, rather than enforcing existing frameworks on co-operatives that do not reflect their organizational model.

The project aims to develop an assessment tool for housing co-operatives to communicate their social and environmental performance to their stakeholders, members and the general audience. West Whitlawburn Housing Co-operative was chosen as a case study for assessment. Various reporting frameworks and guidance documents were reviewed, and key aspects that could be related to communicate a co-operative's performance were identified. The assessment tool developed involved scoring the co-operative across 8 categories: Governance, Community Development, Health and Social Wellbeing, Food and Water, Transport, Waste, Energy, and Innovation.

For West Whitlawburn, the site selected for analysis could not cover the whole estate and so, was limited to a certain area of the development. Interviews were conducted with various members of staff and information was gathered. The tool was then applied to the co-operative to evaluate its performance. The co-operative received an overall score of 71.93, with a potential for further improvement being highlighted in places where points were lost.

The assessment tool is subjective at times and is open to modification. Several other indicators and parameters can be added to it once the reporting is done on a full scale by incorporating the entire housing stock over a year's time, which would vary the overall score.

Acknowledgements

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Chapter 1. Introduction

Faced with various challenges such as climate change, economic decline, diminishing oil prices, globalization and ecological degradation, initiatives pursuing sustainability transitions are taking place all around the world (Forrest & Wiek, 2014). Organisations of all shapes, sizes and objectives, are now focusing on implementation of sustainability actions to promote themselves as something more than just being focused on profits.

A sustainability report is essentially a report published annually by an organization about the economic, environmental and social impacts, both positive and negative, caused by its daily activities. It also presents an organisation's governance structure, and demonstrates its commitment towards embedding sustainability into their work. It helps companies to measure, understand and communicate their economic, environmental, social and governance performance, by setting goals, and reporting against them (Global Reporting Initiative, 2011). Sustainability reporting is in many cases synonymous to the likes of triple bottom line reporting, corporate social responsibility (CSR) reporting, non-financial reporting and more.

Many companies are very well advanced in developing their sustainability reports and engaging with stakeholders to deal with the issues that arise. However, for others it represents a new challenge for which an appropriate framework is yet to be developed. The quality of reporting also varies due to continued advancement of sustainability reporting guidelines, companies' experimentation in determining the most useful content, key indicators chosen, and way of presentation. Sustainability reporting is not one-size-fits-all, as disclosure guidelines cannot be uniformly applied across companies that vary in terms of size, risk, ownership and governance structure (World Business Council for Sustainable Development (WBCSD), 2002) (International Chamber of Commerce (ICC), December 2015). In this evolving field, many companies that have been publishing financial reports every year, are now moving towards the complex route of sustainability reporting- in line with the economic, environmental and social dimensions.

1.1Aim

Based on the existing frameworks, guidance documents and assessment tools for sustainability reporting in companies and organisations, this thesis aims at producing a broadly applicable assessment tool, which reflects the co-operative nature of functioning, and communicate results of non-financial environmental and social information to members and stakeholders.

The assessment tool should act as:

- an assessment of a co-operative's performance in relation to its mission statement, strategic goals and other objectives.
- a tool for reporting to the community and a wider audience
- a tool for future planning and reporting social and environmental impacts, both positive and negative.

1.2 Problem to be addressed

After reviewing websites of various housing co-operatives across the UK, it was observed that most of them produced annual reports. These reports covered information regarding the organizational profile, financial reports (in terms of revenue income and expenditure), reporting of property services (maintenance and repairs), and community engagement.

While these reports were mainly focused on financial reporting, this study aims at providing a significant proportion of non-financial reporting under the framework of sustainability. Factors like community engagement seem to be a step forward towards a sustainable approach, however, much work needs to be done to factor in all environmental and social parameters to create a sustainability report.

''The Co-operative Values and Principles codify a particular concept of community wealth and prosperity – one that has recognized economic, social, and environmental criteria in symbiosis long before the coining of the 'triple-bottom-line'. It is a story that needs to be told and sustainability reporting for and by co-operatives can contribute to telling that story'' (ICA, 2016). An extract from a recent report published by the International Co-operative Alliance states the need on providing appropriate guidance for sustainability reporting for co-operatives. The report states the important role that co-operatives have to

play in contributing to sustainable development. It also acknowledges the lack of sustainability reporting in co-operatives as compared to large organisations and provides some valuable information required for co-operatives to develop a sustainability report.

1.3 Scope

The scope of this project is limited to housing co-operatives. The case study addressed in this thesis is West Whitlawburn Housing Co-operative. However, this framework has been made in a way that can be implemented by other housing co-operatives across Scotland.

Since every housing co-operative already produces annual reports with financial statements, the economic aspect of reporting has not been focused upon. This report project only covers Environmental, Social and Governance (ESG) aspects of the housing co-operative.

1.4 Overall Approach

Before proceeding to develop a tool to report for sustainability, it was essential to understand whom the tool was being developed for. For this, a literature review of different types of co-operatives and how co-operatives work was done. The co-operative model was then described in working through a few selected examples in order to understand how their structure and way of functioning differs from investor-owned and non–profit organisations. Also, the co-operatives importance to the UK economy was also highlighted.

Following that, a number of different sustainability frameworks were reviewed to understand the trends of how reporting is currently being carried out and whether any of these frameworks suit our needs for reporting on co-operatives. Along with sustainability frameworks, various sustainability checklists and guidance documents were reviewed.

To fulfill this thesis, the assessment tool required to be implemented and so, West Whitlawburn Housing Co-operative was approached with the idea. A visit to West Whitlawburn gave the opportunity to speak to staff members and also helped in the process of scoping out elements, as the whole estate could not be covered in this thesis. Once the co-operative has accepted the proposal to become a case study, the framework for the assessment tool was developed. This framework implemented a five step approach which began with site selection (the area of the estate that could be reported on), which was

confirmed after the interview. The categories, relevant to housing co-operatives, that needed to be reported on were chosen, based on the different frameworks and guidance documents reviewed. Under each category, different indicators/issues were selected, and allocated a certain number of points. Each category was allocated a certain weighting depending upon its importance to the co-operative's social and environmental development, and each indicator was awarded a certain weighting depending upon its importance to the category.

Once the tool was developed, site visits were performed to West Whitlawburn and various staff members were interviewed who had knowledge in their specific roles and had access to the required data to report on various indicators. Once all the data was obtained, it was assessed using the tool and the final score was reported. The scoring clearly indicated what areas needed to be improved and further suggestions for improvement were then highlighted.

Chapter 2. Literature Review

2.1 Understanding Co-operatives

A co-operative is defined as ‘‘an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise’’ (International Labour Organization, 2011). Co-operatives are distinct from other organisations as they are owned by their members, while corporations are generally investor owned and non-profit organisations are not owned by members or investors (International Cooperative Alliance (ICA), 2007).

The co-operative movement had emerged in 1844 during the period of the industrial revolution which had affected the working class of Rochdale. A group of 28 workers met to form a co-operative society, by setting up a small shop and bought food which everyone needed – sugar, butter, flour and oatmeal. The workers could buy these provisions and also join the customer members to become part owners of the co-operative. They saw co-operation to be the best way forward by all members having an equal share in decision making and a fair share in profits (Co-operative Heritage Trust, 2013). The co-operative idea has grown since and developed along several lines and fields like Credit co-operatives, Agricultural co-operatives, Housing co-operatives, Worker co-operatives, Consumer co-operatives etc (Birchall, 2004).

The co-operative model is now being viewed as an innovative way for people to tackle social and economic issues. From pubs and shops to football clubs that are either being bought by people without considering the community’s interest or are facing the danger of closure, communities are now pooling their resources together to save the assets themselves (Co-operatives UK, 2015).

Apart from financial co-operatives, co-operatives generally exist in five different forms:

- Consumer co-operatives are owned by the people who use the co-operative services or buy goods from it. They are a common form of business in retail food sales.
- Worker co-operatives are owned and governed by the employees working in the business. These are the most versatile form of co-operative that exist from a small

business to a large organisation, by providing employees an opportunity of ownership.

- Housing co-operatives are owned by the tenants, where each tenants own a share of the co-operative that owns all of the property.
- Producer co-operatives are owned by people who produce similar types of commodities. Another common form of model that is adopted by farmers in the agricultural sector.
- Purchasing/Shared co-operatives are owned by independent business owners that combine together to enhance their purchasing power and cut cost for services such as insurance and payroll (Northwest Cooperative Development Center, 2006).

A few examples of different co-operative models are briefly described further.

Co-operatives play an important role in the rural economy. Farming is an important source of income in rural areas. Agricultural co-operatives facilitate farmer's access to natural resources such as food and water, enable them to buy in bulk and market their produce together to reduce risks, increase productivity and provide a greater access to the wider market so as to work in a business model yielding sufficient profit while providing a fair deal to customers (FAO, IFAD, WFD, 2012). Some of the most famous brands like Lurpak Butter, Ribena, and Birdseye Peas are supplied by farmer co-operatives (Co-operatives UK, 2015).

In the face of climate change and volatile oil prices, communities are now wanting to generate their own clean energy and have a say in how their energy is generated and used. Edinburgh Community Solar Co-operative (ECSC) are working to deliver a co-operative energy project within the city of Edinburgh by installing solar panels on 25 public buildings by offering Edinburgh residents to collectively own the solar panels and obtain a reasonable return on investment. ECSC will receive income through the Feed in Tariff, along with receiving income from surplus electricity being exported back to the grid (Edinburgh Community Solar Co-operative (ECSC), 2015).

With the urban population growing constantly, people are struggling to find jobs or a home. This has led to the setup of housing and worker co-operatives. Housing co-operatives are

jointly owned and run by their tenants. This means that tenants take responsibility for deciding rents for the flats, handling maintenance issues and repair work, providing improvements and refurbishments, and deciding who joins or leaves the co-operation (Shelter Scotland, 2008). West Whitlawburn Housing Co-operative Ltd. (WWHC) is a tenant run co-operative that provides affordable housing and promotes community and environmental sustainability. West Whitlawburn follows a collective home ownership structure where every tenant is a member of the co-operative.

Greencity Wholefoods, a wholesaler of food and drinks, operates as a worker co-operative where every staff member has a share in the co-operative and has a say on how business in done (Greencity Wholefoods, 2016).

Research into the economic importance of co-operatives done by Co-operative Development Scotland indicated that Finland, Switzerland and Sweden have between 13% and 21% of GDP from Co-operative Trading, while Scotland has only 4% (Cooperative Development Scotland, 2009). However, The UK co-operative economy report 2016 indicates a gradual overall growth since 2012 in the UK co-operative sector, contributing £34 billion to the British economy. Along with a good financial performance, the number of people who own or control the UK's co-operatives has grown to nearly a quarter of the UK population (Co-operatives UK, 2016).

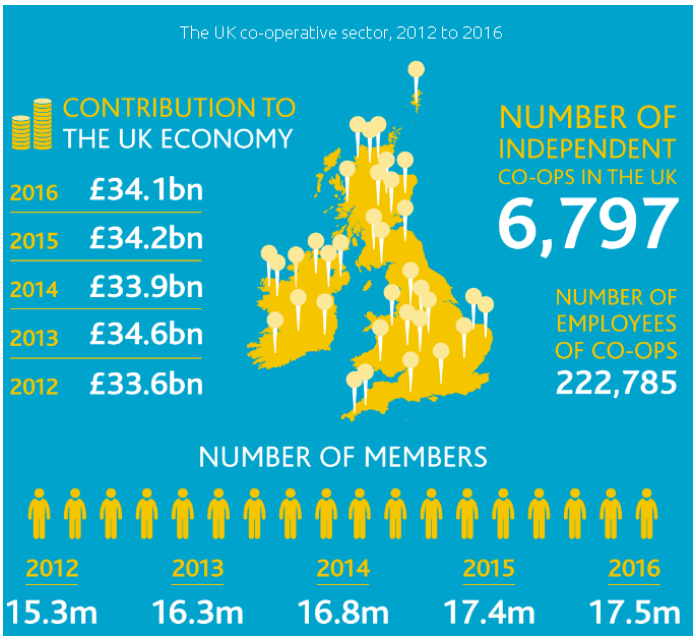

Figure 1: The UK co-operative economy report 2016 (Co-operatives UK, 2016)

Since 1895, the International Cooperative Alliance (ICA) has been the final authority for defining cooperatives and for elaborating the principles upon which cooperatives should be based (Prakash, 2003). Co-operatives are based on the values of self-help, self-responsibility, democracy, equality, equity and solidarity. These co-operative values are put into practice through the seven principles of co-operatives (ICA, 2014) as highlighted in Appendix 2.

2.1.1 Housing Co-operatives

Housing co-operatives as mentioned earlier are basically housing associations governed by tenants where tenants collectively act as their own landlord. Housing co-operatives are being set up for numerous reasons. Sometimes people with low income are unable to find a decent home and require to pool resources with other people in order to afford housing. This allows people to borrow money and raise mortgages which could not be possible individually. It allows housing to become a resource rather than a commercial commodity by transferring the property from private ownership to shared ownership (Radical Routes, 2004).

There are three kinds of housing co-operatives:

- Short life co-operatives: Properties that are in poor condition, usually on the verge for renovation, are rented out to these co-operatives. These properties are owned by individuals or companies that rent the property or building to the co-operative at a minimal charge due to its deteriorated state. The rent that the co-operative charges its member should be sufficient enough to cover the landlord's rent and also perform any maintenance work on the building.
- Tenant Management Co-operatives (TMC): They are formed by renting property from a landlord, who may be an individual, a company or a housing association. On reaching an agreement with the landlord, the co-operative takes control and responsibility over certain aspects of the property, like maintenance for example. TMCs are similar to short life co-operatives because they only have partial control over the property, as they still have to pay rent to landlords who fully control the properties. They differ in that their housing is more permanent and of a better quality.
- Housing Owned by the Cooperative: Tenants have complete control over their property and make managements decisions similar to that of a private owner, but in a collective manner (Radical Routes, 2010).

The Commission on Co-operative and Mutual Housing published a report which indicated the most recent analysis of the co-operative housing sector. In the UK, the proportion was very small, with co-operative housing making only 0.6% of the housing supply, compared to 18% in Sweden, 15% in Norway and 8% in Austria (CCH Confederation of Co-operative Housing, 2009).

2.2 Sustainability

Sustainable development is a term that was popularized in *Our Common Future*, a report published by World Commission on Environment and Development (WCED) in 1987. Also known as the Brundtland Report, it defined 'sustainable development' as ''development that meets the needs of the present without compromising the ability of future generations to meet their own needs'' (WCED, 1987). Sustainable development is a

concept that has been defined in a number of ways over the past few decades (Lozano, 2008). But in general, the definition calls for a business to take responsibility for its own impacts on environment and the society.

In many cases, sustainability has been perceived as being anthropocentric, compartmentalized, lacking interconnectedness, completeness and continuity. While in other cases, there is a bias towards sustainability being considered only in terms of environmental sustainability, due to lack of information on social issues compared to environmental ones (Lozano & Huisingh, 2011). Realising that economic sustainability alone cannot guarantee the success of an organization is key. This is the most important departure of the sustainability concept from orthodox management strategy to shift focus from economic sustainability to focus on all three dimensions simultaneously (Dyllick & Hockerts, 2002).

The three dimensions were included under the concept of ‘’Triple Bottom Line’’ (TBL), which was coined by Elkington (1997). This provides a framework for measuring the performance of an organization along lines: economic, social and environmental. He defined sustainability and its development as ‘’the simultaneous pursuit of economic prosperity, environmental quality and social equity’’ (Elkington, 1997). So there is great importance now being put on organisations to not only focus on financial indicators for business development, but also integrate environmental and social parameters.

2.3 Trends in Sustainability reporting

There is an increasing interest and acknowledgement towards sustainability from various organisations. Sustainability reporting is the critical first step in implementing a strategy that can help an organization understand the impact on its stakeholders, and ways in which it might mitigate a negative impact on the economy, society and the environment (EY, 2014). Over the last two decades, sustainability reporting has grown to become a widespread tool to inform stakeholders about the impacts of businesses. Growing environmental (e.g., climate change, water usage, waste) and social (e.g., corruption, poverty, social inequality) concerns have led to increasing efforts being made to mandate the disclosure of environmental, social and governance (ESG) data, apart from financial

disclosure, in a systematic way by how they are utilizing and affecting human capital and natural resources (Ioannou & Serafeim, 2014).

With this widespread recognition came a number of different approaches to focus on the social and ecological spheres. Corporate Social Responsibility (CSR) initially gained attention due to impact of labour on supply chain particularly child labour, and human rights abuses. Next trend to come along was the triple bottom line (TBL) reporting that incorporates the three dimensions: social, environmental and financial, by measuring these dimensions independently and reporting them. As trends for disclosure of sustainability evolved, a number of frameworks and guidelines emerged that emphasized on different aspects.

There are a number of widely used sustainability frameworks: ISO 14000, an environment management standard in 1996; the Global Reporting Initiative (GRI) in 1997; AccountAbility (AA1000 framework) in 1999 focusing on social and ethical issues accounting; ISO 26000 in 2004 focusing on social responsibility; and the International Integrated Reporting Framework (IIRC) in 2013 that combines financial and non-financial impacts into a single report (Herbert, 2015). GRI is the most common framework being implemented and acts as a complete framework by encompassing social, economic and environmental dimensions (International Co-operative Alliance, 2016) (Lozano & Huisingh, 2011).

Apart from established frameworks, sustainability checklists have been produced to benefit ecovillages and community housings. These reports are more inclined the case for housing co-operatives, with a varying governance structure.

The Global Ecovillage Network developed the Community Sustainability Assessment (CSA) tool, a subjective tool to assist communities in the assessment of their overall sustainability. The assessment was divided into 3 aspects or ‘legs’, namely Ecological, Social and Spiritual (Global Ecovillage Network, 2015). Similarly, the Fife Council produced their own sustainability checklist to guide future developments in Fife towards a sustainable approach. The sustainability framework was based on 7 key themes, broadly suitable for projects associated with construction of new developments (Fife Council,

2010). One Planet Living (OPL), an initiative provided by Bioregional and WWF, aims at communities to reduce their ecological footprint and make sustainable living attractive and affordable. OPL is guided by ten principles which form a holistic framework for sustainable living (Bioregional, 2015).

With this project revolving around housing co-operatives, the focus is mainly on community development and the built environment in which the community resides. The assessment criteria for this thesis is mainly based on technical documents produced by Leadership in Energy and Environmental Design (LEED) in North America and Building Research Establishment Environmental Assessment Method (BREEAM) in the UK, both of which aim to promote environmentally sustainable construction with an added attention on the social impact of the development. LEED for Neighbourhood Development (LEED ND) rating system encourages development not just on sustainable buildings, but also emphasises on building healthier communities (U.S. Green Building Council, 2014). Similarly, BREEAM Communities is a framework that addresses key issues and opportunities related to social, environmental and economic impacts on a development and determines how sustainable a community is within the development (BRE, 2012). Similar frameworks illustrating a similar concept have been published by BREEAM, such as BREEAM-SE manual for new construction and refurbishment (BRE, 2013) and the BREEAM refurbishment manual for domestic buildings (BRE, 2012). The above mentioned guidance documents have been briefly described in Appendices 4-8.

Sustainability reporting has now become a default concept in management for large organisations. The number of companies reporting on sustainability has been ever increasing. The KPMG surveys, of the global top 250 (G250) companies of the Fortune 500, shows the rate of reporting as 92% in 2015, up from about 64% in 2005 (KPMG, 2015). However, an important highlight of the report is the lack of carbon reporting in companies as they do not report targets for carbon reduction or report on their performance against targets (KPMG, 2015).

2.4 Need for Sustainability Reporting for Co-operatives

In 2009, the United Nations General Assembly declared 2012 as the International Year of Co-operatives, highlighting the potential of co-operatives in attaining socio-economic development, particularly through eradication of poverty, employment generation and social integration (United Nations General Assembly, 2009). In 2012, the ICA drafted the *Blueprint for a Co-operative Decade*, to establish the co-operative model of business to become the leader in economic, social and environmental sustainability by 2020. The Blueprint concentrates on 5 critical themes, one of which is to take actions to position co-operatives as builders of economic, environmental and social sustainability; while another one calls for building and securing their co-operative identity (International Cooperative Alliance (ICA), 2013). Sustainability reporting can help achieves both these objectives.

Apart from financial reporting, the 7 Co-operative Principles highlight the social aspects that need to be considered. These Co-operative Principles do not necessarily incorporate all dimensions of the triple bottom line i.e., the environment. The environmental or the energy aspect seems to be partially aligned to the principle of 'Concern for Community' which states the need for co-operatives to work to achieve sustainable development of their communities. However, with global threats such as climate change being high on every government's agenda, this factor needs to be given even more importance, and one way of achieving this is through sustainability reporting.

Co-operatives are based in a number of sectors similar to those in which investor owned companies (IOC) function, such as retail, housing, banking, healthcare etc. But while the main goal of IOCs is to generate wealth for shareholders, co-operatives aim at serving their members and looking after their interests (Beaubien, 2011). To target the issue of sustainability, there is a temptation among co-operatives to participate in applying frameworks such as GRI and Integrated Reporting. However, by doing so, co-operatives restructure their model of functioning into a framework designed for IOCs. So, in a world where co-operatives exist within a neoliberal economy, it is necessary for co-operatives to establish themselves as the leaders of sustainable development by drifting away from the existing framework, and embraces their own identity as co-operatives (Herbert, 2015).

2.5 The Case Study: West Whitlawburn Housing Co-operative

West Whitlawburn, located in Cambuslang in the south-east of Glasgow, was built in the late 60s and had initially been a council-run social housing. This housing estate suffered from poorly designed high-rise buildings, poor planned investment and funding, high crime rates and social problems forced tenants of the estate to take matters into their own hands by managing the estate themselves. This historic movement came about in 1989, when West Whitlawburn became a tenant-run Co-operative. Since then about £50 million has been invested in improvement of existing flats and also building new houses.

2.5.1 Legal structure

West Whitlawburn Housing Co-operative is a 'fully mutual' and 'par value' housing co-operative. Fully Mutual housing association was first defined under the Housing Association Act 1985, which states that only those people living in the property can become members of the co-operative and moreover, that no one is granted a tenancy by the housing co-operative unless they are a member (Housing Association Act, 1985).

All tenants in the co-operative own the same value (par value) of share, a nominal £1, and this behaves like a traditional share. This is kept in a separate bank account and can only be taken out if the co-operative is dissolving and those share funds would be the members' contribution to pay any debtors. This share is not transferrable and a member cannot gain more than one share in the co-operative. The fully mutual and par value status ensures the shared ownership of the co-operative and keeps in line with the one member, one vote policy. The legislations that bound West Whitlawburn are the Co-operative and Community Benefits Society Act (2014) and the Housing (Scotland) Act (2010).

2.5.2 Housing Stock

The housing stock has changed since its inception. Since 1989, West Whitlawburn have invested over £48 million through successful funding.

Around £31 million has been invested in the six multi-storey flat tower blocks alone. This included CCTV across the estate, controlled entry systems, remodeling of ground floor areas, implementation of laundry system and external improvements. Improvements to the fabric of the multi-storey blocks has been ongoing since 2000. The six multi-storey

residential towers have been overclad and reroofed, along with internal remodelling of the accommodation. An aluminium cassette system was selected, combined with curtain walling to enclose balconies and integrate the space within each dwelling (RIAS, 2016).

Figure 2:Tower block before refurbishment (D&B Facades, 2013)

Figure 3: Tower block post refurbishment (RIAS, 2016)

Table 1: WWHC housing stock breakdown

	1989	**2010**
Type of stock	**Number of flats**	**Number of flats**
2 apartment multi storey flat	0	13
3 apartment multi storey flat	432	406
4 apartment multi storey flat	0	13
2 apartment low rise flat	0	3
3 apartment low rise flat	78	68
4 apartment low rise flat	30	41
2 apartment cottage flat	0	16
3 apartment house	0	50
4 apartment house	0	29
5 apartment house	0	5
Total	**540**	**644**

2.5.3 Eliminating fuel poverty

Being placed in one of Scotland's poorest regions, fuel poverty was also a great concern for the people at West Whitlawburn, also with high heating and hot water bills. This resulted in an investment in a low carbon district heating scheme primarily fueled by a biomass boiler.

This project has been jointly funded by the Warm Homes Loan, European Structural funding, and npower's Energy Company Obligation (ECO) scheme. The new energy centre contains a 740 kW (685kW continuous output) Pyrotec biomass boiler and a 50,000 litre thermal store, which replaced the electric storage heaters. It is also backed up by three 1300 kW Vitoplex low temperature gas boilers (Viessmann, 2016).

Woodchips to the biomass boiler were fed by an automated charging screw from a store located underground beneath the energy centre. The Pyrotec boiler can achieve efficiency levels of up to 92% due to a proven combustion technology, three- pass heat exchanger, modulating output control and a regulated air supply. It is also suitable for a wide variety of fuels, ranging from dry (W10) to moist (W50) (Viessman, 2010).

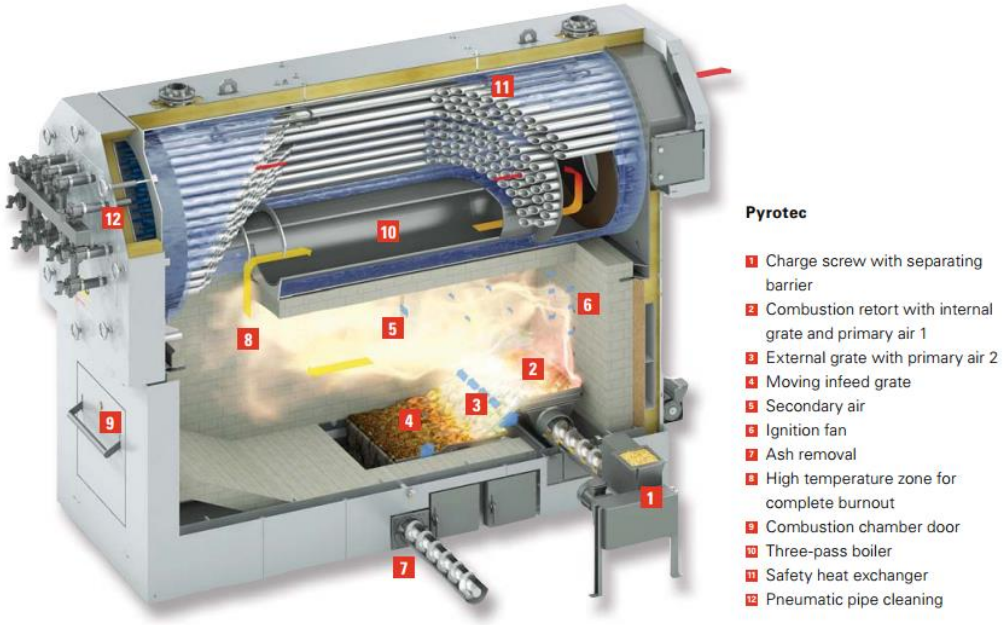

Figure 4: Pyrotec Biomass Boiler (Viessman, 2010)

The energy obtained from the fuel is transferred from the thermal store to each property through external underground pipes. This in turn heats each unit's individual heating system, comprising of a heat exchanger, radiators and a hot water tank (Viessmann, 2016). Also residents were allowed better temperature control within each room through implementation of thermostats and radiators which included Thermostatic Radiator Valves.

Chapter 3. Framework for Assessment Tool Development

For reporting on sustainability measures for a co-operative, it was important to note that the report cannot be targeted to a single stream of audience. Different sets of audience would be entitled to reap different benefits from analysing the report. However, all audience would be interested in the broad spectrum covering all issues of sustainability. The main requirement of the co-operative performance measurement was the understanding of how the reporting reflects on the Co-operative Values and Principles. The advantage of having co-operative values and principles established by the ICA was that it provided an initial base for understanding the co-operative identity (Co-operatives UK, 2013). The principles have been described in brief in Appendix 2.

Development of the assessment tool followed a five step approach to evaluate a co-operative's sustainability score. This model would serve as a base to evaluate sustainability of all housing co-operatives.

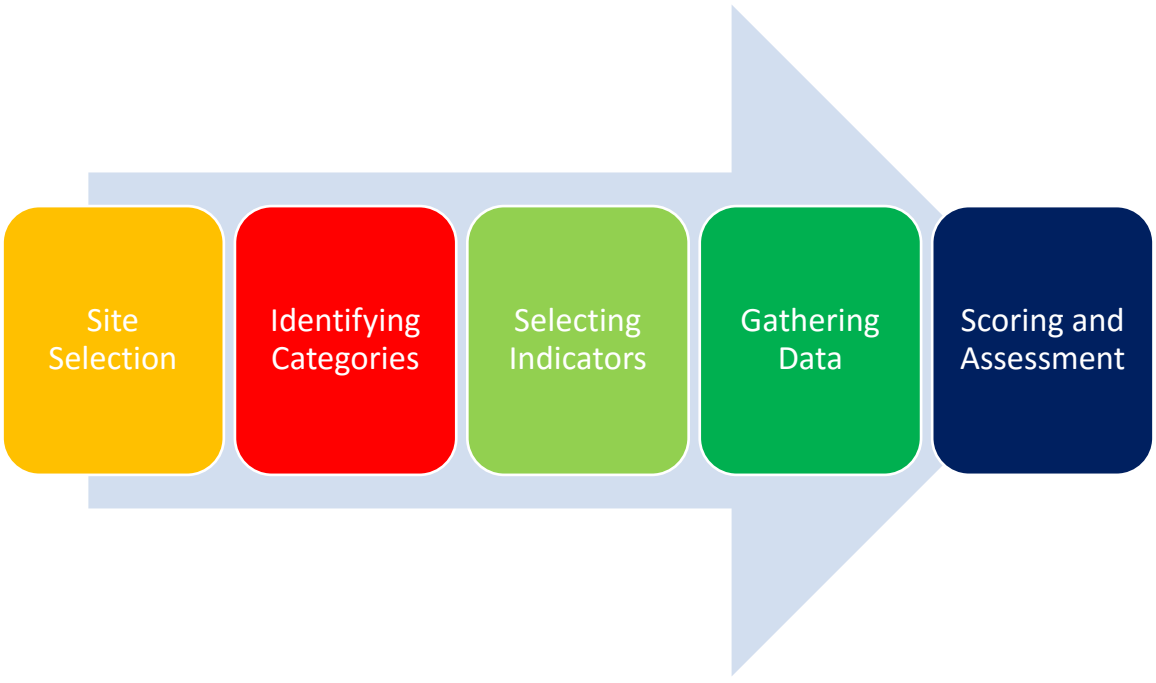

Figure 5: Five step approach for assessment tool development

3.1 Site Selection

Firstly, the site to be assessed was agreed upon. Any further developments or refurbishments were limited to this site, apart from procurement or transport. Any developments beyond this site would be regarded as out of scope.

It is important to note that when a co-operative is aiming at fully implementing sustainability reporting, everything within the site's boundaries should be taken into account to provide a complete picture.

3.2 Categories for Social and Environmental Development

The social and environmental parameters have been divided into a number of categories, which address a variety of issues. The division into categories was essential as it allowed each category to be weighted differently based on the impact they have on the broad spectrum of sustainability. Generally, co-operatives are looked upon mainly for their social aspect. However, this framework aims to provide nearly equal weightage to the social and environmental aspects. The categories are listed below with a description of its aim and also how the different frameworks have been used to identify these categories.

- Governance: To establish a strong governance structure that promote the co-operative values and principles, and promote community involvement in the decision-making process (Ernst & Young, 2012).
- Community Development: Promotes development by providing social, recreational and educational facilities along with health and economic development projects.
- Health and Social Wellbeing: Taking measures to improve tenants' health and wellbeing through societal factors such as adequate housing, employment opportunities, tenant safety and satisfaction (BRE, 2012).
- Food and Water: Achieving food security by promoting sustainable procurement and consumption of food (GRI, UN Global Compact, WBSCD, 2015). Considers installations to monitor water usage, and strategies in place to reduce water use (BRE, 2012).
- Waste: Aims at effective minimization and recycling of household wastes.

- Transport: Considers the design and provision to use sustainable modes of transport (BRE, 2012).
- Energy: Build sustainable infrastructure and provide access to renewable energy to reduce carbon emissions (GRI, UN Global Compact, WBSCD, 2015).
- Innovation: Promotes the development of innovative projects to result in social, environmental and financial benefits for the co-operative (BRE, 2012) (U.S. Green Building Council, 2014).

The figure below indicates how each category and the indicators under them were influenced by the various documents reviewed. The colour coded key indicates the extent of use of these documents:

- 'Fully referred' indicates that the category, its indicators and their respective benchmarks were taken directly from those documents.
- 'Partially referred' indicates that the document was used for a few indicators under the category and the benchmarks are potentially self-illustrated rather than what the document specifies.
- 'Principle referred' indicates that the document shares the same idea for the category as the assessment tool, but indicators used to rate the categories are different.
- 'Not referred' indicates the document was not used for the given category.

	KS&CPIs- Cooperatives UK	OPL- Bioregional	CSA- Global Ecovillage Network	BREEAM Communities- BRE	LEED ND- U.S. Green Building Council
Governance					
Community Development					
Health and Social Wellbeing					
Food and Water					
Transport					
Waste					
Energy					
Innovation					
Key:					
Fully referred					
Partially referred					
Principle referred					
Not referred					

Figure 6: Influence of various guidance documents on the categories chosen.

3.3 Select indicators

The indicators chosen express the relationship between the dynamics of a co-operative and its impact on sustainable development. These indicators were chosen by evaluating a number of existing frameworks mentioned earlier. However, the frameworks had an extensive list of indicators, some of which are not prevalent to the co-operative model of functioning. Moreover, unlike large organisations, sustainability projects have limited budgets in housing co-operatives. A key to choosing the right indicators is addressing those issues that are relevant to the stakeholders. Stakeholders, in the case of co-operatives, are those who are affected by the existence of the co-operative. They include staff members, management, tenants, academics and all organisations that work closely with the co-operatives (International Co-operative Alliance, 2016).

The approach chosen was the SMART approach suggested by Co-operatives UK, to ensure that the indicators are material and can deliver the biggest impacts. SMART is an abbreviation that means that a chosen indicator must be Specific in terms of what it exactly measures so as to avoid any misinterpretation; Measurable to provide a real value to the indicator; the targets set must be Achievable; the achieved targets set against the indicator

must be Relevant for the success of the co-operative; the indicators must be Time phased so as to measure it over a pre-defined period of time (Co-operatives UK, 2013).

The initial standard considered was the 10 key social and co-operative performance indicators developed by Co-operatives UK. These indicators offered a national standard on which co-operatives could measure, monitor and report on their environmental and social responsibilities in line with the International Co-operative Alliance Principles (Co-operatives UK, 2004).

However, for specifically targeting housing co-operatives, additional indicators were required that would focus on communities and housing. So, technical documents, BREEAM guidance documents and LEED ND, were considered appropriate for this thesis. Both BRE and the U.S. Green Building Council are heavily focused on sustainable building industry. The technical documents published by the respective organisations aim at benefitting the community whilst reducing the environmental impacts on the built environment.

Also the metric for reporting on the indicators is specified. For example, data will be measured per person or per sq. metre, or according to quantity, or according to percentage. Usually existing frameworks have predefined metrics, and if any new indicators are chosen, the metrics are clarified (International Co-operative Alliance, 2016).

Table 2 identifies the indicators under each category that a co-operative will be judged upon.

Table 2: Relevant indicators assessed under each category

Category	Indicators
Governance	Governance Structure and Composition
	Sustainability Action Plan
	Annual General Meeting
	Earning Differentials
	Gender Equality
Community Development	Social Facilities
	Recreational Facilities
	Educational and Employment Facilities
Health and Social Wellbeing	Safety
	Health
	Social Wellbeing
Food and Water	Accessibility to Sustainable Food
	Water Consumption
	Rain Water Harvesting
Transport	Public Transport Facilities
	Bicycle Facilities
	Local Parking
Waste	Accessibility of Waste bin
	Segregation of wastes
	Waste Recycled
Energy	Building Energy Consumption
	Lighting (external)
	Lighting (internal)
	Feasibility Study
	On-site Renewable Energy Generation
	District Heating
Innovation	Innovative setup or technology implemented

3.4 Collect data

Once the key indicators have been identified, it is required to collect data to provide the indicators with an end result. For co-operatives, a consistent approach should be set to indicating how the data is collected and managed, the sources and format of the data, and the frequency of data collection. At the same time, co-operatives should not be overburdened and data collection should be made simple.

For this thesis, the data was collected by visiting West Whitlawburn and conducting interviews with staff members who were heads of their respective department. Data such as meter readings, resource usage etc., was gathered.

3.5 Scoring and Assessment

Once the data is obtained, the different key indicators are evaluated based on site surveys, calculation, software or existing regulations. Finally, the co-operative's sustainability performance is judged by benchmarking these indicators in order to judge their impact. This was performed by weighting or scoring the indicators.

The assessment technique chosen was evaluated by consulting schemes such as the BREEAM Communities Scheme Document (BRE, 2012), BREEAM Domestic Refurbishment Scheme Document (BRE, 2012), Sustainability Checklist (Fife Council, 2010), and LEED Neighbourhood Development (U.S. Green Building Council, 2014).

Each category is given a certain weightage and every issue under a category is provided with a variable number of points. This means that the value of the points varies depending on the weighting of the category. The weightage for even distribution for environmental and social factors in outlined below.

Table 3: Category Weighting

Category	Weighting
Governance	10.0
Community Development	15.0
Health and Social Wellbeing	16.0
Food and Water	8.0
Transport	8.0
Waste	4.0
Energy	35.0
Innovation	4.0
TOTAL	**100**

The framework consists of performance indicators divided across seven categories, along with an additional category for innovation. Each category has its own weight attached, depending upon the impact that the category has against social and environmental spheres. Efforts have been made to provide equal weightage to the social and environmental categories. Once the categories were assigned weights, each performance indicator was assigned a specific number of points, depending upon the impact it had on its own category. These points are then awarded when the performance meets the standard of the indicator that is specified.

The credits assigned to each indicator are more of a personal reflection associated with the housing co-operative. These points are subjective and can be varied when similar reporting is carried for co-operatives with different organizational structure.

Finally, the base framework chosen for assigning category weighting and indicator points was the BREEAM Communities weighting system, as the point structure offered a good potential for varying indicator scores and providing justified importance to some categories over the others. A sample scoring system of the assessment tool is provided below.

Indicator	Points Achieved	Points Available	% of points received	Indicator weight	Indicator score	Total Category Score	Category Weighting
Governance							
Governance Structure and Composition	2	4	50%	2.20	1.10	5.85	10.00
Sustainability Action Plan	1	4	25%	3.00	0.75		
Annual General Meeting	1	1	100%	1.70	1.70		
Earning Differentials	1	1	100%	1.50	1.50		
Gender Diversity	1	2	50%	1.60	0.80		
Community Development							
Social Facilities	1	2	50%	5.00	2.50	10.25	15.00
Recreational Facilities	4	5	80%	5.00	4.00		
Educational and Employment Facilities	3	4	75%	5.00	3.75		
Health and Social Wellbeing							
Safety	2	4	50%	5.00	2.50	12.70	16.00
Health	6	6	100%	5.40	5.40		
Social Wellbeing	6	7	86%	5.60	4.80		
Food and Water							
Accessibility to Sustainable Food	2	3	67%	4.50	3.00	4.10	8.00
Water Consumption	2	4	50%	2.20	1.10		
Rain Water Harvesting	0	1	0%	1.30	0.00		
Transport							
Local Public Transport Accessibility	3	4	75%	4.00	3.00	5.33	8.00
Bicycle Facilities	1	2	50%	2.00	1.00		
Local Parking	2	3	67%	2.00	1.33		
Waste							
Accessibility of Waste bin	1	2	50%	1.00	0.50	3.50	4.00
Segregation of wastes	2	2	100%	2.00	2.00		
% waste recycled	1	1	100%	1.00	1.00		
Energy							
Building Energy Consumption	6	11	55%	6.00	3.27	19.73	35.00
Lighting (external)	1	2	50%	2.50	1.25		
Lighting (internal)	3	4	75%	2.50	1.88		
Feasibility Study	2	3	67%	6.00	4.00		
On-site Renewable Energy Generation	4	6	67%	8.00	5.33		
Distict Heating or Cooling	8	12	67%	6.00	4.00		
Innovation	1	2	50%	4.00	2.00	2.00	4.00
				FINAL SCORE		**63.46**	100.00

Figure 7: Sample Scoring on the Assessment Tool

Provided below is the description of various columns:

- Indicator: This column indicates the various categories and the indicators under each category.
- Points Achieved: This column indicates the points achieved by each indicator.
- Points Available: This column indicates the maximum points that can be scored from each indicator.
- Percentage of Points Received: This column indicates the percentage of the total points available for the indicator that have been achieved by the co-operative.

- Indicator Weight: This column indicates the maximum weight of an indicator under a category. The sum of all indicator weights under a category is equal to the 'Category Weighting'.
- Indicator Score: This column indicates the proportion of indicator weight that has been achieved.
- Total Category Score: This column indicates the total points that have been scored in each category.
- Category Weighting: This column indicates the maximum available weighting of each category.

Chapter 4. Assessment Tool

The tool below indicates:

- The categories and the aim of each category
- Total points available for the indicator in each category
- The indicator description and the points available for each indicator
- The method of evaluation.

4.1.1 Governance

In a standard housing co-operative model, members of the co-operative elect the board of directors. Apart from the committee board which comprises on members of the co-operative, paid staff employees are present who are not members of the co-operative.

4.1. Governance Structure and Composition

Points available for the indicator: 4 points

Aim: To clearly indicate the governance structure of the organisation by indicating committees responsible for various tasks such as setting strategies and overseeing organisation's operations (GRI, 2015).

Indicator	Points available	Method of Evaluation
Clearly defined organizational charts for staff and committee members. Clearly defined mechanism for interaction between various members, and defined responsibilities for each.	2 points 2 points	Site Visit and interview with staff members.

4.1.2. Sustainability Action Plan

Points available for the indicator: 4 points

Aim: To draw up a long term sustainability action plan, developed in consultation with members of the community and relevant stakeholders.

Indicator	Points available	Method of Evaluation
To draw up a policy and indicate the objectives.	1 point	Staff interview and sustainability policy documentation.
Set up a working group who work towards achieving these targets.	1 point	
To set up an action plan to meet the objectives.	1 point	
To report and review on these targets every 2 years.	1 point	

4.1.3. Annual General Meeting

Points available for the indicator: 1 point

Aim: To ensure the co-operative conducts a successful Annual General Meeting (AGM), where management gives an account to its members and members can express their views and offer suggestions for improvement.

Indicator	Points available	Method of Evaluation
Percentage membership attendance at the AGM.	1 point	As the membership at such co-operatives is likely to fluctuate, the attendance should be set at a percentage rather than a set number. This percentage or also defined as quorum, is set at 20% (Agricultural Cooperative Service, 1992).

4.1.4. Earning Differentials

Points available for the indicator: 1 point

Aim: To uphold the co-operative value of equality by minimising the difference in pay between members of the organisation.

Indicator	Points available	Method of Evaluation
Ratio of highest paid to lowest paid employee	1 point	Staff earning statements. Benchmark of 5:1.

Earning differentials can depend upon a variety of factors: type of organisation, occupation, region, and job distribution in the organisation. Ulgor, the oldest co-operative factory, where inequalities were assumed to be great, was studied for this purpose. Among a subset of 640 workers, the ratio of the maximum individual earning and the minimum individual earning equates to 5:1 (Thomas & Logan, 1982). This is the benchmark assumed for this reporting framework.

4.1.5. Gender Equality

Points available for the indicator: 2 points

Aim: To promote the co-operative value of equality by encouraging employment of women into the working groups.

Indicator	Points available	Method of Evaluation
Percentage of women employed as Staff Members	1 point	To promote gender equality, the benchmark is set at 50% or greater proportion of woman in working groups.
Percentage of women present in the Management Committee	1 point	

4.2 Community Development

4.2.1. Social Facilities

Points available for the indicator: 2 points

Aim: To ensure that members of the co-operative have a place to network in a social and a professional manner.

Indicator	Points available	Method of Evaluation
Presence of a resource centre containing: Café or similar place where members could interact socially. Area for professional meetings, conferences and workshops.	 1 point 1 point	Site Visit

4.2.2. Recreational Facilities

Points available for the indicator: 5 points

Aim: To provide recreational facilities to enhance community participation and improve public health for members of all ages.

Indicator	Points available	Method of Evaluation
Presence of a resource centre containing: Exercise facilities and gym equipment. Recreational facilities for young kids. Recreational activities for the old aged. Availability of indoor board games like scrabble, chess, jenga. Availability of a party hall or similar place for members to rent for occasions.	 1 point 1 point 1 point 1 point 1 point	Site Visit

4.2.3. Educational and Employment Facilities

Points available for the indicator: 4 points

Aim: To provide educational and training facilities to enhance knowledge and employment opportunities of the local community.

Indicator	Points available	Method of Evaluation
Availability of PC and internet facilities	1 point	Site visit, interviews, and annual facilities usage figures.
Training facilities to enhance employability of the members.	1 point	
Collaboration with institutes to provide learning and training opportunities to the local community	1 point	
Creation of employment opportunities for members.	1 point	

4.3 Health and Social Wellbeing

4.3.1. Safety

Points available for the indicator: 4 points

Aim: To ensure safety of all staff members and tenants present within the housing co-operative.

Indicator	Points available	Method of Evaluation
Ensure safety of tenants/staff through continuous monitoring of site deployment of CCTV cameras:		Site visit and interviews with the Concierge Services.
On the streets within the estate boundaries	1 point	
In building common areas	1 point	
In the backstairs of every building	1 point	

Ensure secure movement throughout the building by providing secure front and back doors, that are accessible only by the tenants.	1 point	

4.3.2. Health

Points available for the indicator: 6 points

Aim: To improve the physical and mental health of tenants by ensuring presence of open spaces within the estate that provide a variety of uses to encourage people to spend more time outdoors. The co-operative should also aim to provide services that ensure the physical security of the members.

Indicator	**Points available**	**Method of Evaluation**
To improve public health by conducting fitness related activities within the estate. Availability of services in case of: Fire alarms Medical emergencies Percentage of green space within the estate's footprint (BRE, 2016). • ≤10% • >10% to ≤40% • >40%	1 point 1 point 1 point 1 point or 2 points or 3 points	Site visit.

4.3.3. Social Wellbeing

Points available for the indicator: 7 points

Aim: Achieving tenant satisfaction through certain standards and outcomes that social landlords should aim to achieve (Scottish Housing Regulator, 2012).

Indicator	Points available	Method of Evaluation
Tenant Satisfaction • % of tenants satisfied by overall services. • Tenant Satisfaction- keeping tenants informed about various services and outcomes. • % of tenants satisfied with their participation in decision making processes. **Quality and Maintenance** • Homes that meet Scottish Housing Quality Standard. • Percentage of tenants satisfied by co-operative's repair and maintenance services. **Neighbourhood** • Resolving anti-social behaviour within target timescales. **Value for Money** • Total rent collected that was due in the year.	1 point 1 point 1 point 1 point 1 point 1 point 1 point	Each of the sections are weighted against the Scottish average benchmark. West Whitlawburn Landlord Report 2014/2015 (Scottish Housing Regulator, 2015)

As required by the Scotland (Housing) Act 2010, the Scottish Social Housing Charter sets out the standards and outcomes that all social landlords should aim to achieve. This charter involves tenant satisfaction of services, housing quality and maintenance, neighbourhood and community, and affordability of houses (Scottish Housing Regulator, 2012). Each of the sections are weighted against the Scottish average benchmark. If the housing performance is better than the benchmark, then a point is awarded to that section.

4.4 Food and Water

4.4.1. Accessibility to Sustainable Food

Points available for the indicator: 3 points

Aim: To collaborate with food organisations to ensure availability of local and sustainable food to meet the requirements of tenants, thereby reducing the need to travel far.

Indicator	Points available	Method of Evaluation
Presence of a supermarket within 500 metres of the estate. Allow easy and economical access to food needs for the people lacking transport facilities to supermarkets or unable to travel due to old age. Onsite food growing: 5% of the food is to be produced on site and in community gardens (Bioregional, 2015).	1 point 1 point 1 point	 Site survey Evaluating food produced on site.

4.4.2. Water Consumption

Points available for the indicator: 4 points

Aim: To ensure sustainable use of water.

Indicator	Points available	Method of Evaluation
Pre requisite: It is essential to have metering for water consumption either for the whole site, or on a building level, or per tenanted area (BRE, 2016). The points are awarded as follows (BRE, 2013): • water consumption is 4.5 - 5.5m^3 per person per year • water consumption is 1.5 - 4.4 m^3 per person per year • water consumption is <1.5 m^3 per person per year	1 point 1 point or 2 points or 3 points	 Using metered data.

4.4.3. Rain Water Harvesting

Points available for the indicator: 1 points

Aim: To encourage the recycling of rainwater to be used for external watering purposes.

Indicator	Points available	Method of Evaluation
Whether a rainwater collection system has been put into place in the estate (BRE, 2012).	1 points	Site visit

4.5 Transport

4.5.1. Public Transport Facilities

Points available for the indicator: 4 points

Aim: To encourage the use of public transport to reduce dependence on private vehicles.

Indicator	Points available	Method of Evaluation
Presence of public transport infrastructure from the estate to the city centre (BRE, 2012). Proximity of bus station to the estates • ≤ 650m • ≤ 550m • ≤ 450m • ≤ 350m	1 point or 2 points or 3 points or 4 points	The public transport nodes' proximity and frequency are assessed for each building separately. The resulting 'points' are averaged to obtain the 'points' awarded to the whole development.

4.5.2. Bicycle Facilities

Points available for the indicator: 2 points

Aim: To promote cycling as a means of alternate transport and a recreational physical activity to improve public health (U.S. Green Building Council, 2013).

Indicator	Points available	Method of Evaluation
Presence of bicycle storage facilities at least 30% of building occupants, with no less than one storage space per flat (U.S. Green Building Council, 2013). Cycle storage provided within the dwelling provided the space is of adequate size and not in a living room, kitchen, bedroom, bathroom or dining room.	1 point 1 point	Site Visit

4.5.3. Local Parking

Points available for the indicator: 3 points

Aim: To provide adequate parking space for tenants, staff as well as visitors in the estate.

Indicator	Points available	Method of Evaluation
Parking dispersed throughout the estate Dedicated parking space available for each building Presence of underground parking, in order to reduce open space usage.	1 point or 2 points or 3 points	Site Visit

4.6 Waste

Points available for the indicator: 5 points

Aim: To have a dedicated storage space to cater for recyclable materials generated by the building during occupation.

Indicator	Points available	Method of Evaluation
Clearly labelled recycling storage space with minimum segregation to at least 4 categories: • Paper • Plastic • Cardboard • Metal • Glass • Waste Paper • Food Waste	2 points	Site Visit
Placed within accessible reach of the building: • ≤ 50m from the building • ≤ 20m from the building	1 point or 2 points	
Percentage of household waste recycled (EU target of 50% household waste recycled) (DEFRA, 2015)	1 point	

4.7 Energy

Co-operatives have a large role to play in tackling climate change and fuel poverty. Providing clean and affordable renewable energy to house co-operatives depends upon availability of land to construct renewable installations or for storage. Various schemes can be put into place for implementation of cleaner energy. Some of them include becoming an Energy Supply Company (ESCO) for the community or through community/shared ownership of renewable technologies.

4.7.1. Building Energy Consumption

Points available for the indicator: 11 points

Aim: To reduce building energy consumption to a minimum in order to reduce carbon emissions and energy bills.

Indicator	**Points available**	**Method of Evaluation**
Sub-metering of substantial energy uses in individual flats (BRE, 2013): • Space heating • Hot water • Lighting • Appliances	 1 point 1 point 1 point 1 point	Evaluating metered data.
Energy display devices in flats to display electricity consumption and/or heating fuel consumption data to tenants to promote awareness of usage (BRE, 2012).	2 points	Site visit.
Energy demand targets of a building: • ≤370 kWh/m^2/year • ≤300 kWh/m^2/year • ≤240 kWh/m^2/year • ≤200 kWh/m^2/year • ≤160 kWh/m^2/year	1 point or 2 points or 3 points or 4 points or 5 points	Dwelling modelling through HEM.

4.7.2. Lighting

Lighting is a massive contributor to energy usage and, more relevantly carbon emissions in buildings. This means that when looking to reduce both energy consumption and carbon emissions the lighting must be evaluated to determine the savings that can be made. A lot will ultimately depend on the initial lighting situation with the most savings being made through replacing older, less efficient lighting such as incandescent lamps whilst lesser

savings will be made from replacing newer lamps such as compact fluorescent lamps. The figure below indicates the comparisons between different lighting solutions.

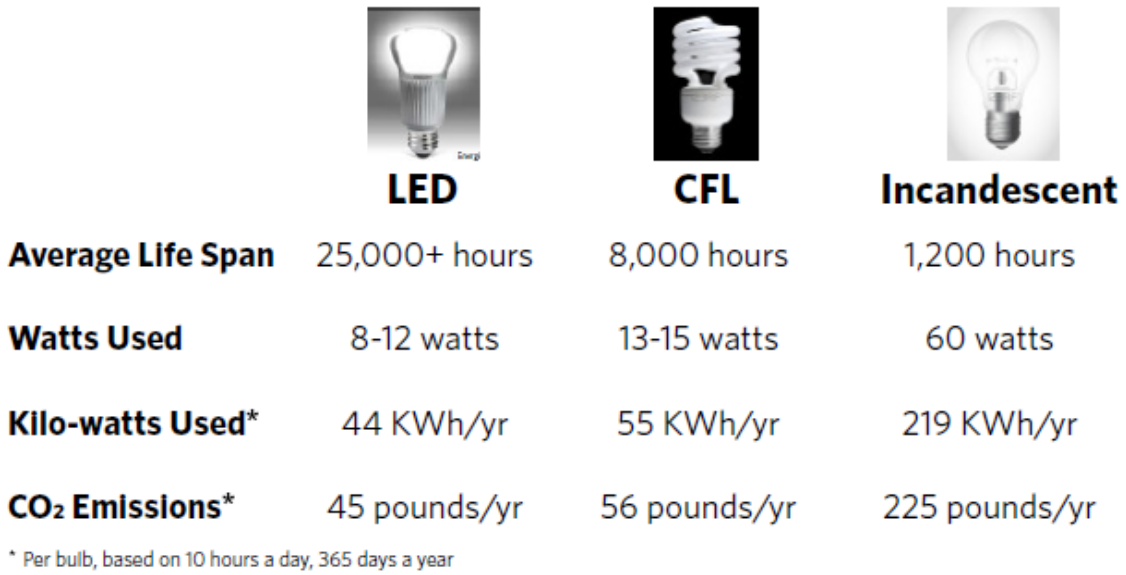

Figure 8: Comparison of lamp lighting solutions (Boston University, 2012)

4.7.2.1 External Lighting

Points available for the indicator: 2 points

Aim: To recognise the presence and specification of energy-efficient light fittings for external areas of the estate.

Indicator	Points available	Method of Evaluation
Lamp efficacy greater than 45 lumens per circuit-watt (The Scottish Government, 2015). OR Lamp capacity should not exceed 100 lamp-watts per light fitting.	1 point	Lighting specifications
External light fittings are controlled through a time switch, or daylight sensor, to prevent operation during daylight hours (BRE, 2013). OR Occupancy sensors to switch off external lighting when the area becomes	1 point	

unoccupied (The Scottish Government, 2015).		

4.7.2.2. Internal Lighting

Points available for the indicator: 4 points

Aim: To recognise the presence and specification of energy-efficient light fittings for internal lightings within the apartments.

Indicator	Points available	Method of Evaluation
At least 75% of the fixed light fittings in a building should be installed with low energy light fittings (The Scottish Government, 2015).	1 point	Lighting specifications
Low energy light fittings should have lamps with a luminous efficacy greater than 45 lamp lumens per circuit-watt and a total output greater than 400 lamp lumens (The Scottish Government, 2015).	1 point	
Internal lighting that does not exceed the maximum average wattage across the total floor area - 9 W/m2 (BRE, 2012).	1 point	
Internal light fittings are controlled through daylight sensors, to prevent operation during daylight hours. OR Occupancy sensors to switch off lighting when the area becomes unoccupied (The Scottish Government, 2015)	1 point	

4.7.3. Feasibility study

Points available for the indicator: 3 points

Aim: To verify whether a feasibility study has been carried out by the co-operative to evaluate various low carbon technology options.

Indicator	Points available	Method of Evaluation
Feasibility study carried out by an energy specialist company to establish the most appropriate renewable energy source. The study should cover a minimum (BRE, 2013): • Energy generated per year • Carbon emission reduction and life cycle impact • Land use • Payback period • Available grants • All technologies that could be implemented on site and that could meet the energy demand • Reasons for excluding other technologies OR The co-operative has a contract set in place with an energy supplier to provide electricity from a 100% renewable source.	3 points	Literature review and staff interviews.

The advantage of investing in a feasibility study would allow co-operatives to focus only on a limited number of suitable technologies, which also makes their job of sustainability reporting easier.

4.7.4. On-site Renewable Energy Generation

Points available for the indicator: 6 points

Aim: To encourage co-operatives to meet a proportion of their energy demand through renewable sources in order to reduce the environmental impacts associated with fossil fuel energy production.

Indicator	Points available	Method of Evaluation
On-site incorporation of non-polluting renewable energy generation producing a proportion of (U.S. Green Building Council, 2014): The electrical energy demand: • >5% • >12.5% • >20% AND The thermal energy demand: • >5% • >12.5% • >20%	1 point or 2 points or 3 points 1 point or 2 points or 3 points	Assessment of meter readings.

4.7.5. District Heating

Points available for the indicator: 12

Aim: To encourage employing district heating or cooling solutions for space heating and/or water heating that help reduce energy use, and reduce environmental impacts.

In the UK, most of the energy consumed in mainly for heat, that is generally obtained by burning fossil fuels (predominantly gas). However, in many parts of the world, heat networks are installed to transport heat to consumers through a series of insulated pipes, such that the source of heat generation is not within individual buildings, but present on a larger scale. The Government believes that heat networks can play a major role in low carbon heating, depending upon the source that supplies the heat into the pipes (DECC, 2013).

A major barrier for implementation of district heating networks is funding. It is essential for co-operatives to obtain funding for major infrastructure projects. There are a number of policies in place to promote the development of heat networks. Some of the most significant ones are (DECC, 2013):

- Renewable Heat Incentive (RHI)
- The Energy Company Obligation (ECO)
- various building regulations and planning policy aimed to setting building standards
- Specific policies targeting Combined Heat & Power (CHP) installations

An important barrier to be considered is the heat losses in distribution. This depends on the length and material of the pipes and also the insulation. The distribution heat losses can be assessed using the Ofgem Heat Loss Assessment tool. This tool allows the users to assess what portion of their pipework is properly insulated and provides a simplified methodology to estimate annual heat losses from both the insulated pipe lengths and the non-insulated pipe lengths (Ofgem, 2015). In case the average percentage heat loss from all individual pipe lengths exceeds a certain limit, the tool suggests the installation of additional heat meters for better monitoring.

Further indicators highlighted are based on CIBSE Heat Networks Guide which indicate the best practice for district heating systems.

Indicator	Points available	Method of Evaluation
External Pipework: Pre-insulated pipe network complies with EN253 and associated EN standards (CIBSE, 2014). Average annual heat losses from 'properly insulated' external pipework should be < 3% (Ofgem Heat Loss Assessment). Average annual heat losses from 'non properly insulated' external pipework and storage tanks should be < 6% (Ofgem Heat Loss Assessment). Total annual heat loss from the network up to the point of connection to each building should not exceed a certain proportion of the sum of the estimated annual heat consumption of all of the buildings connected: • <40% • <30% • <20% • <10% Primary low carbon heat source delivers a high proportion of the annual heat demand: • >50 • >60% • >70% • >85%	1 point 1 point 1 point 1 point or 2 points or 3 points or 4 points 1 point or 2 points or 3 points or 4 points	Assessment done using Ofgem Heat Loss Assessment Tool and Heat Meter Readings.

Implementation of Combined Heat & Power (CHP) scheme to meet a proportion of the electrical demand.	1 point	

4.8 Innovation

Points available for the indicator: 2

Aim: Creation or set up of an innovative technology or facility that would benefit the society either economically, socially or environmentally.

Indicator	Points available	Method of Evaluation
Description of the innovative technology or facility and justify its benefit to the community	2 points	Evaluating this category is more of a subjective judgement depending on whether it has bought considerable benefit to the people.

Chapter 5. Case Study: West Whitlawburn Housing Co-operative

Now, the assessment criteria described in Chapter 4 was applied to West Whitlawburn Housing Co-operative. Given below is the boundary considered for West Whitlawburn, highlighted in red.

The 100 new build homes have currently not been considered for reporting as they were not yet connected to the district heating system, so no meter readings were available. Also flats were of different configuration and different energy sources were used compared to the other flats. For example, some flats had solar thermal system installed to provide hot water. As individual flats could not be evaluated, only the six tower blocks, 5 low rise buildings, concierge station and community centre was evaluated.

It is important to highlight that when the co-operative invests in reporting, all the flats must be considered to provide a complete picture.

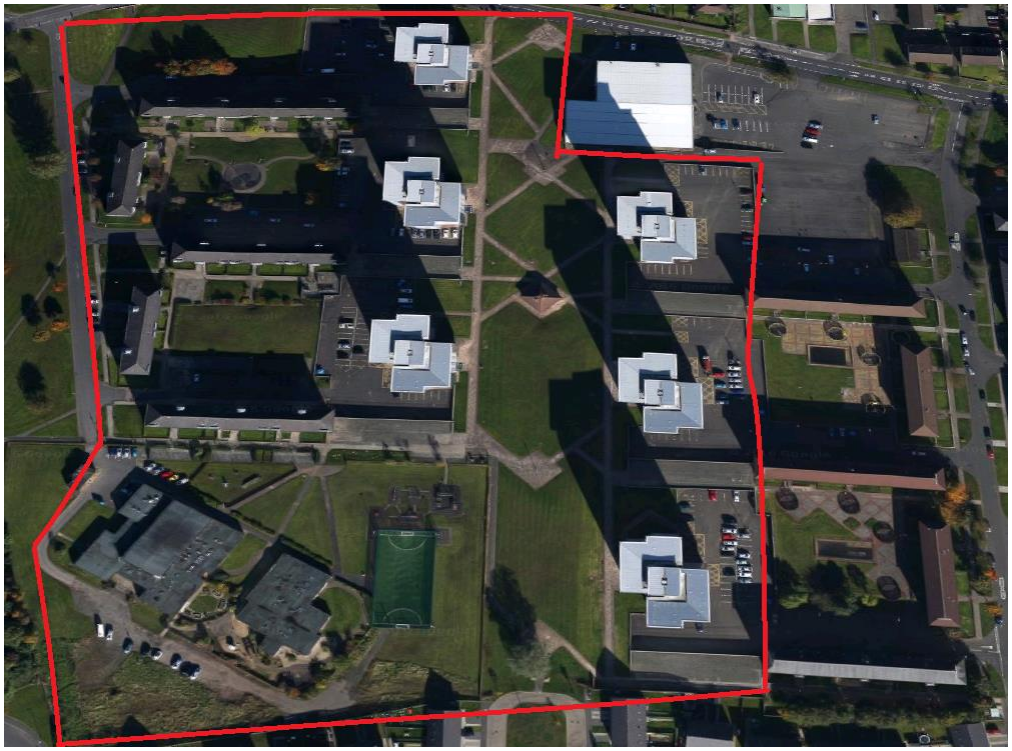

Figure 9: Site boundaries for WWHC, highlighted in red (Google Maps)

5.1 Governance

5.1.1. Governance Structure and Composition

The Co-operative structure consists of a Management Committee that is entirely made up of local tenant members who are direct recipients of the Co-operative's housing services. These unpaid voluntary members are elected in by members of the Co-operative. All Management Committee members receive a comprehensive induction and on-going training.

The Management Committee has complete power relating to all affairs of WWHC in line with the rules, all applicable legislation and guidance from appropriate bodies (West Whitlawburn Housing Co-operative, 2009).

Various tasks run by the Management Committee are divided into sub committees that are responsible for different services that West Whitlawburn undertakes.

The Co-operative also consists of paid staff members who are responsible for carrying out decisions of the Management Committee and run the day-to-day business of the Co-operative. The staff members are also divided into different areas of functioning as seen in the chart below.

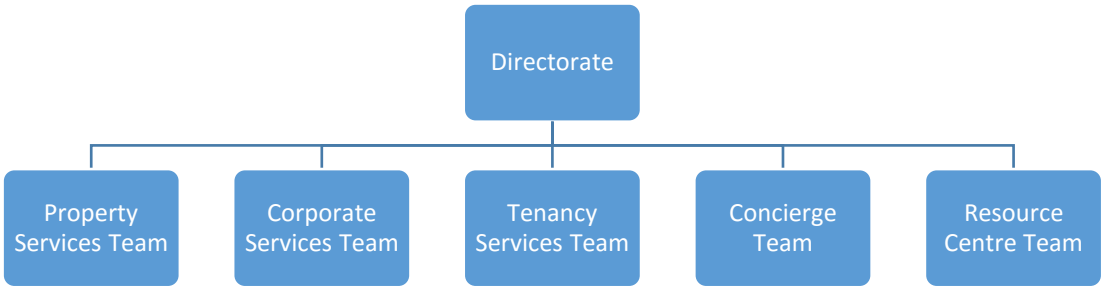

Figure 10: Governance structure of staff members

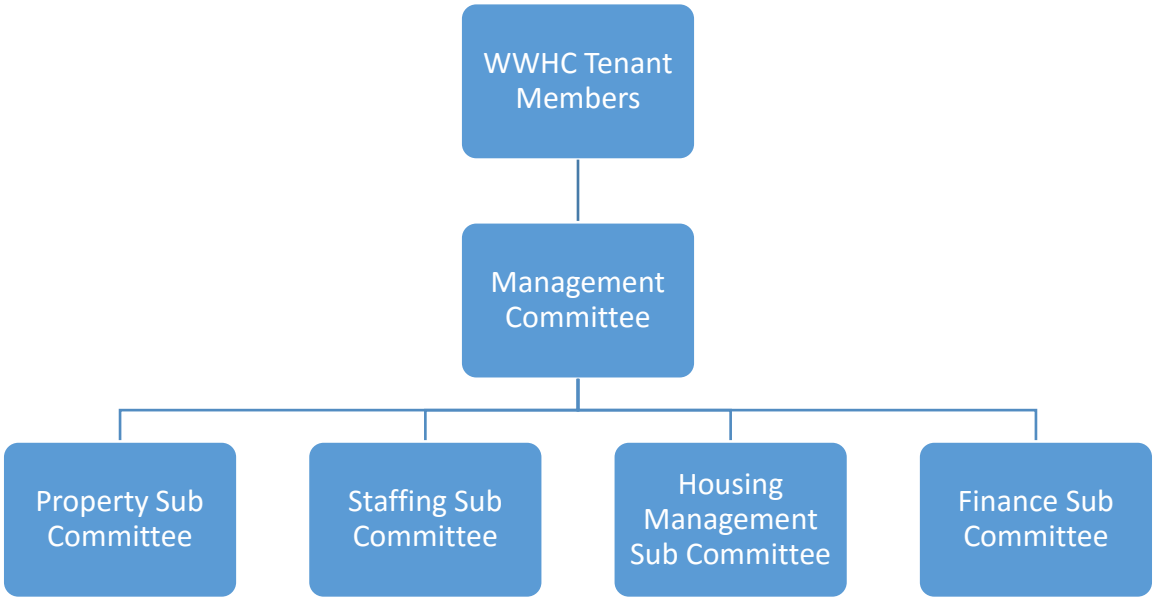

Figure 11: Governance structure of management committee

Points awarded to indicator: 4/4

5.1.2. Sustainability Action Plan

West Whitlawburn has drawn a Sustainability Policy with three main objectives to ensure future sustainability:

- Sustainable Properties
- Sustainable Communities
- Sustainability in the Workplace

They expect to review their policy and action plan on a 3 yearly basis. The policy currently does not indicate any targets or benchmarks to be reached. Also, a dedicated working group is yet to be set up to deal on sustainability issues.

Points awarded to indicator: 2/4

5.1.3. Annual General Meeting

The Annual General Meeting was held on the 7th September 2015. Out of a possible 654 members, 24 members (4% of members) attended.

This can be regarded as a very low attendance. However, the other aspect of a low attendance can be the fact that people are satisfied with the work put in by the co-operative's staff and management, and have no issues to be resolved. So a low attendance can also be indicated as a sign of smooth functioning of a co-operative.

Points awarded to indicator: 0/1

5.1.4. Earning Differentials

The wage ratio of the highest paid full-time employee to the lowest paid full-time employee is 3:1.

Points awarded to indicator: 1/1

5.1.5. Gender Equality

The Management Committee currently comprises of 13 unpaid tenant volunteers, of which 11 employees are female and 2 are female.

WWHC employs 40 paid staff members, of which 22 are female and 18 are male.

Points awarded to indicator: 2/2

5.2 Community Development

West Whitlawburn is fully committed to community development along with providing affordable quality housing. For this reason, the Whitlawburn Community Resource Centre was set up to provide educational, social, health related facilities to enhance community development. The number of participants in various services run by the Resource Centre are provided in Appendix 3.

5.2.1. Social Facilities

The Resource Centre houses a Whitlawburn Community Café for people to gather around and socialise. It also houses a room for professional meetings, conferences and classes.

Points awarded to indicator: 2/2

5.2.2. Recreational Facilities

The Whitlawburn Community Resource Centre is a great place for recreation as it contains gym and exercise facilities, various recreational services indicated in Appendix 3, and a large hall that could be rented out to members for special occasions.

Points awarded to indicator: 5/5

5.2.3. Educational and Employment Facilities

In order to provide access for educational and employment opportunities to people, Whitlawburn Community Resource Centre has partnered with a number of voluntary and statutory organisations such as:

- Routes to Work South
- JobCentre plus
- South Lanarkshire College
- Universal Connections

In terms of employment opportunities, the Out of School Care focuses on providing high quality childcare in the area, buy employing local people to contribute to the development of the area. The co-operative also looked into the Working with West Whitlawburn Project, to provide training and employment from the local people in the construction industry.

Points awarded to indicator: 4/4

5.3 Health and Social Wellbeing

West Whitlawburn have put into place a concierge service to ensure the safety of the people from crime and other anti-social behaviour. However, their job is not limited to that. The concierge service ensures people's wellbeing in terms of health and any other problems that people might experience.

5.3.1. Safety

The concierge service monitors the CCTV that have been installed across the entire estate and the buildings. There are also secure doors in to each building and into each landing, so that only those people who reside in the building are permitted free access.

Points awarded to indicator: 4/4

5.3.2. Health

The Community Resource Centre conducts various fitness related activities for members of all ages to promote healthy living. The various services offered and the attendance figures are provided in Appendix 3.

Fire alarms are present in every flat and are monitored by the concierge service. Every alarm sounded is notified to the concierge who can themselves act or contact the necessary personnel.

Apart from fire alarms, the co-operative provides housing alarm services to tenants who suffer from any illness or disability. These alarms are present in homes with pull cords and also as pendants around the necks of the service users. Activating the alarm immediately contacts the concierge service, who will be of service at the flat within a few minutes (West Whitlawburn Housing Co-operative, 2009).

The total area within the estate considered for the scope of this project is 68000m^2. The total green space available within the estate is approximately 17500m^2 i.e. 26% of green space availability within the estate.

Figure 12: Presence of green space within the estate.

Points awarded to indicator: 5/6

5.3.3. Social Wellbeing

The Scottish Housing Regulator reports on WWHC's performance and the co-operative has performed very well in comparison to the Scottish average housing performance.

Table 4: WWHC report card from the Scottish Housing Regulator

Percentage of tenants satisfied by overall services	**95.70%**	88.10%
Tenant Satisfaction- keeping tenants informed about various services and outcomes	**97.70%**	89.30%
Percentage of tenants satisfied with their participation in decision making processes	**81.30%**	79.60%
Homes that meet Scottish Housing Quality Standard	**98.80%**	91.00%
Percentage of tenants satisfied by co-operative's repair and maintenance services	**94.50%**	89.30%
Resolving anti-social behaviour within target timescales	**89.10%**	83.20%
Percentage of tenants satisfied by rents	**97.50%**	90.00%

Points awarded to indicator: 7/7

5.4 Food and Water

5.4.1. Accessibility to Sustainable Food

All housing stocks at WWHC are within 300 metres of Nisa Extra, belonging to a family of independently owned retail outlets across the UK.

In order to promoting the value ‘Cooperation among Co-operatives’, WWHC collaborates with the Food Co-operative to supply fresh food to the tenants. The Food co-op sets up shop every Thursday & Friday to provide supplies like fresh fruits and vegetables. It benefits people who have no vehicular access and also benefits old aged and disabled people. Also, providing fruits and vegetables in single quantities rather than a pack makes it affordable for tenants to purchase.

West Whitlawburn also collaborates with Rutherglen & Cambuslang Foodbank, who set up satellite offices in vulnerable areas where people cannot afford to buy food due to

various circumstances. It is volunteer run, and food distribution packs are made available every Tuesday for free for people in need.

No portion of the land is currently used for urban food growing. The green space should be investigated further for food growing opportunities.

Points awarded to indicator: 2/3

5.4.2. Water consumption

Currently water sub-metering is not being done at WWHC. Hence no points can be awarded under this indicator.

Points awarded to indicator: 0/4

5.4.3. Rain Water Harvesting

No rain water harvesting strategies have been applied at WWHC until now. So no points can be awarded under this indicator.

Points awarded to indicator: 0/1

5.5 Transport

5.5.1. Public Transport Facilities

For transport via bus to the city centre was assessed by calculating distances from each building to the bus stop. The buildings considered in scope include the 6 towers and the 5 low rise buildings. The average distance measured was 330 metres. The bus station is highlighted by the red blip in the figure.

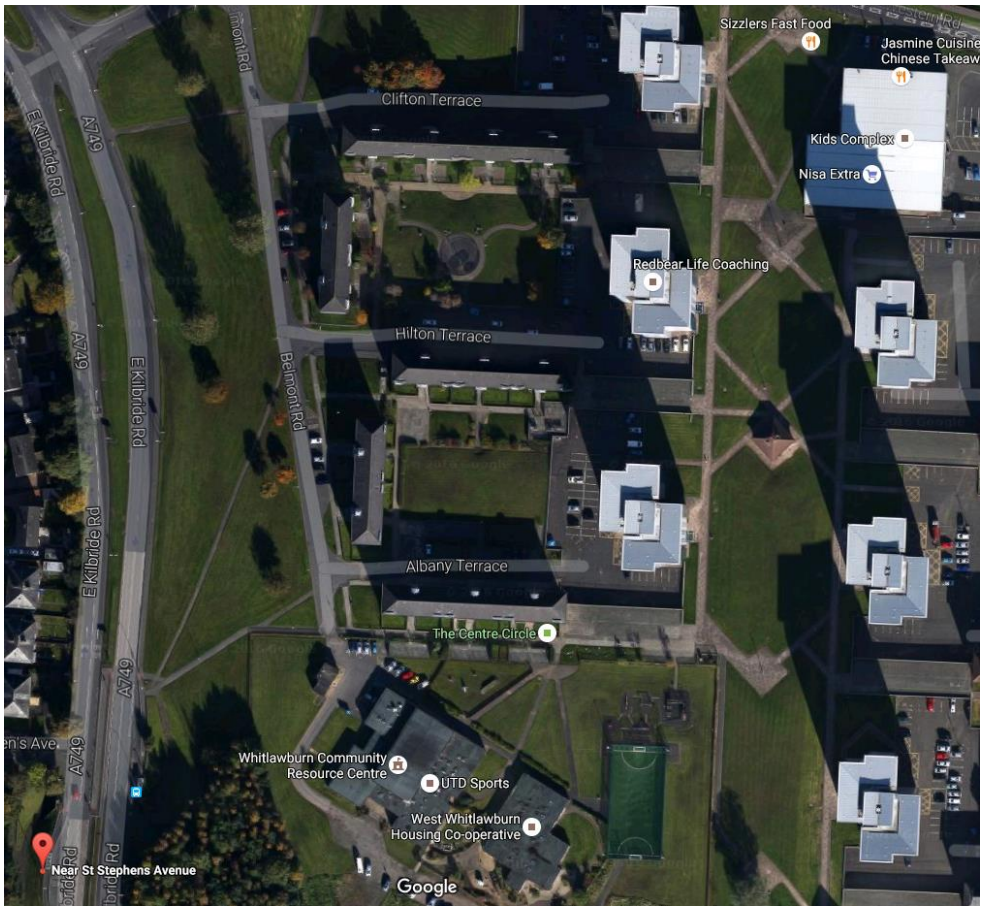

Figure 13: Proximity of the nearest bus station facilitating public transport to the city centre

Points awarded to indicator: 4/4

5.5.2. Bicycle Facilities

Each flat has its own storage spot on the ground floor of the building, where bicycles could be stored. However, there are no storage facilities within the flats.

Points awarded to indicator: 1/2

5.5.3. Local Parking

Each tower block has its own designated parking, sufficient for both tenants as well as visitors.

Due to the already present construction, underground parking is not feasible now.

Points awarded to indicator: 2/3

5.6 Waste

WWHC in partnership with South Lanarkshire Council introduced mini recycling units in the car parks of the 6 tower blocks. The recycling units are at a distance of 30 metres from each of the tower blocks. Tenants receive re-usable sacks that they fill with household wastes like paper, cardboards, cans and plastic bottles. These wastes are then emptied into the recycling units.

This has resulted in around half a tonne of household waste every fortnight being recycled rather than ending up in a landfill (West Whitlawburn Housing Co-operative, 2009).

Even though the results look positive, a lot more can be done to encourage people to recycle and minimise waste. People would still prefer to use the bin chute right outside their flat rather than empty their trash into recycling units.

Points awarded to indicator: 3/5

5.7 Energy

5.7.1. Building Energy Consumption

For modelling on building energy consumption, only the six tower blocks were considered, due to data availability.

Sub-metering for individual flats has been done only for the heating system. The energy meters were not installed till recently, due to which readings were only available for the past few months. Also sub-metering and recording of meter reading is only being done for heating, and not electricity. Metering services for heating are provided through the vPro Energy Metering System (vPro:ems). Information is supplied directly to the tenants through their vPro:ems In-Home Display that provides information regarding tarrifs, consumption profile and a lot of other useful information (Vital Energi, 2014).

Significant difference in flat by flat heat meter readings justified the need for theoretical modelling of the dwellings. This has been done to obtain an average figure for energy consumption. The modelling was done using the EDEM tool developed by the University of Strathclyde (Clarke, et al., 2008). Modelling was done choosing flats from the 6 tower blocks available. The flat being modelled is a two-bedroom flat for which building

drawings were made available. Two bedroom flats represent 93% of the housing stock. The U- values for the flats are indicated in Table 7.

Table 5: U-values for a tower block flat at West Whitlawburn

Section	U- value (W/m^2K)
External Walls	0.27
Floor	0.7
Windows	2.0
Roof	0.16

Further data assumed and inputted for modelling is shown in the table below.

Table 6: Input data for modelling using HEM

Air changes	standard
Hsys Fuel	wood/bio
Hsys type	boiler (high efficiency)
Renewables	none
Exposure	flat(g), flat(m), flat(t)
Climate	UK standard
Heating Demand	Scottish standard
Hot Water Demand	Scottish standard
Appliances	standard

The flats are modelled on three different floors due to the difference in heating demands for mid floor flats as compared to top and ground floor flats. From the available drawings, the floor area for the flat was calculated to be $70m^2$. The results for modelling are shown in the tables below.

Table 7: Energy Consumption for a ground floor flat

Demand type	kWh/m^2 per annum
Space Heating	109.4
Hot Water	62.0
Electricity (lighting and appliances)	33.8

Table 8: Energy Consumption for a mid-floor flat

Demand type	kWh/m^2 per annum
Space Heating	55.3
Hot Water	62.0
Electricity (lighting and appliances)	33.8

Table 9: Energy Consumption for a top floor flat

Demand type	kWh/m^2 per annum
Space Heating	84.6
Hot Water	62.0
Electricity (lighting and appliances)	33.8

By averaging the energy demand per flat for the entire building, the primary energy consumption is 180 kWh/m^2 per annum. The carbon emission estimation from this software would deviate to a large extent from the actual emissions as the software only allows the secondary heating system, which would be gas in our case, to supply 10% of the heating demand. However, on analysing the heat meter readings, gas boilers supply 39% of the heating demand on average in a year.

Points awarded to indicator: 7/11

5.7.2. Lighting

5.7.2.1 External Lighting

West Whitlawburn has recently upgraded their external light fittings to LED high power flood lights, which were energy efficient. However, no occupancy or daylight sensors were installed.

Table 10: Technical Specifications of LED high power flood lights (RoHS)

LED Luminous Flux	16500 lm
LED Wattage	2 x 70W
Luminous Efficacy	>110 lm/W
Power Factor	>0.90

Points awarded to indicator: 1/2

5.7.2.2 Internal Lighting

The choice of light fittings within the dwellings was given to the tenants and from the flats surveyed, flats had incandescent bulbs installed which were not energy efficient. Each two bedroom flat had around 7 light fittings. There are no daylight sensors installed in the flats. The lights are only controlled by manual switches.

As the choice was left to the tenants, no specifications on types of light fittings were available. The two flats that have been surveyed consisted of 40W incandescent light bulbs. Since incandescent light bulbs are fading out, the co-operative must encourage tenants to buy energy efficient light bulbs. This would help reduce their energy bills and also reduce carbon emissions.

For every flat that switches from incandescent light bulbs to equivalent wattage LED lamps, the savings are indicated below.

Table 11: Energy savings by switching to LED lamps in flats (RS Components, 2011)

Energy savings per flat	823 kWh/year
Cost Savings per flat	£ 114/year
Carbon savings per flat	380 kgCO_2e/year

Points awarded to indicator: 1/4

5.7.3. Feasibility Study

Previously, WWHC had electric heating systems to provide heating in buildings. In 2009, they commissioned RSP Consulting Engineers to prepare a feasibility study to identify possible upgrades to the heating system that would be both economical and environmentally beneficial. The requirements for the heating system as set by the co-operative were that it should

- reduce energy bills
- not take up additional space within the dwellings, due to space limitations
- allow independent metering and billing of each dwelling
- be easily manageable and controllable by the tenants

The study had considered solar thermal, heat pumps and modular CHP in each building. But due to specific site requirements, they were later discounted. The consultant report narrowed the choice down to two solutions; biomass district heating and gas-powered CHP district heating.

Finally, the path chosen by WWHC was to implement a district heating scheme powered by a biomass boiler. This was mainly due to biomass being considered as a renewable source to generate heat, and also the possibility of obtaining better funding. The project was jointly funded by the Warm Homes Loan, European Structural funding, and npower's Energy Company Obligation (ECO) scheme.

Points awarded to indicator: 3/3

5.7.4. On-Site Renewable Energy Generation

As explained in section 2.5.3, the heat demand on-site is met by a 740 kW biomass boiler and a 50,000 litre thermal store. Woodchips are supplied as fuel to the biomass boiler. It is also backed up by three 1300 kW low temperature gas boilers.

Biomass, although said to be a sustainable fuel, may not necessarily be one. When considering carbon emissions resulting from biomass combustion, we need to take into account not only the carbon emissions from burning the biomass fuel, but also consider carbon emissions resulting from preparation and transportation of the fuel to the site.

West Whitlawburn receives their supply of wood chip from RTS Ltd. based in Crieff. Regular supplies of high quality wood chip fuel (with less than 40% moisture content) is delivered from their storage facility in Perthshire. Approximately 30 tonnes of woodchip is supplied every week during the winters, and 15 tonnes of woodchip is supplied every week during the summer. The fuel requirement is almost double during the winter due to larger heating requirement in the dwellings.

The figure below depicts the Life Cycle Assessment of biomass production as published in the Scottish government website. The biomass process flow diagram below represents a small- scale production of woodchips from woodland management.

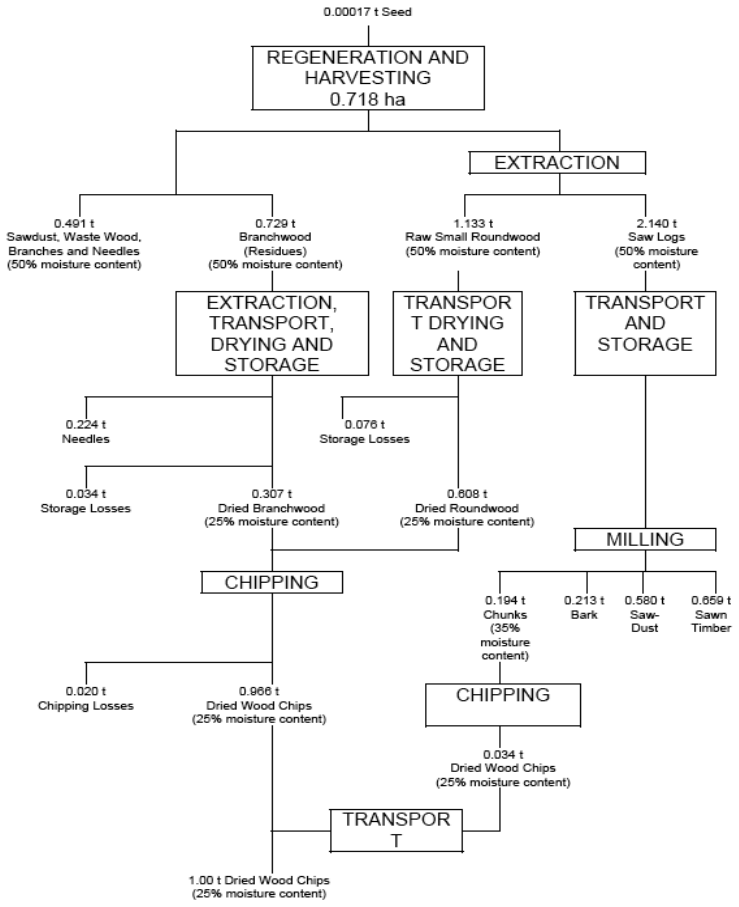

Figure 14: Biomass process flow diagram for small scale woodchip production (The Scottish Government, 2006)

DECC B2C2 is a tool that can be used to determine the carbon intensity of the biomass fuel (wood chips, pellets, biogas) before combustion, in units of $gCO_2e/MJ(fuel)$ or $kgCO_2e/t(fuel)$.

A fuel chain is entered into the Biomass Carbon Calculator, which comprises of various stages of the fuel production and usage (e.g. harvesting, transporting distances, storage, heat production). The tool then provides us the total greenhouse gas (GHG) emissions for each stage and the total GHG emissions produced at the end of the fuel chain.

A default fuel chain was taken which would include the carbon footprint calculation from six stages of the life cycle- Primary harvested product from which the biomass feedstock used in the power plant derives; On-farm use of fuels such as diesel in vehicles used for harvesting and extraction; Transport of product from extraction site to the chipping facility; Fuel and electricity used to transform the feedstock into the final product i.e. woodchips; Feed transport from storage facility to the site where energy is generated; Power plant which generates heat and/or electricity.

For the Biomass Carbon Calculator, the main timber transport activity was assumed to be a round trip distance of 90 km (56 miles). The transport from the storage facility to the Energy Centre at West Whitlawburn was determined to be a round trip distance of 98 miles (from storage facility in Crieff to West Whitlawburn).

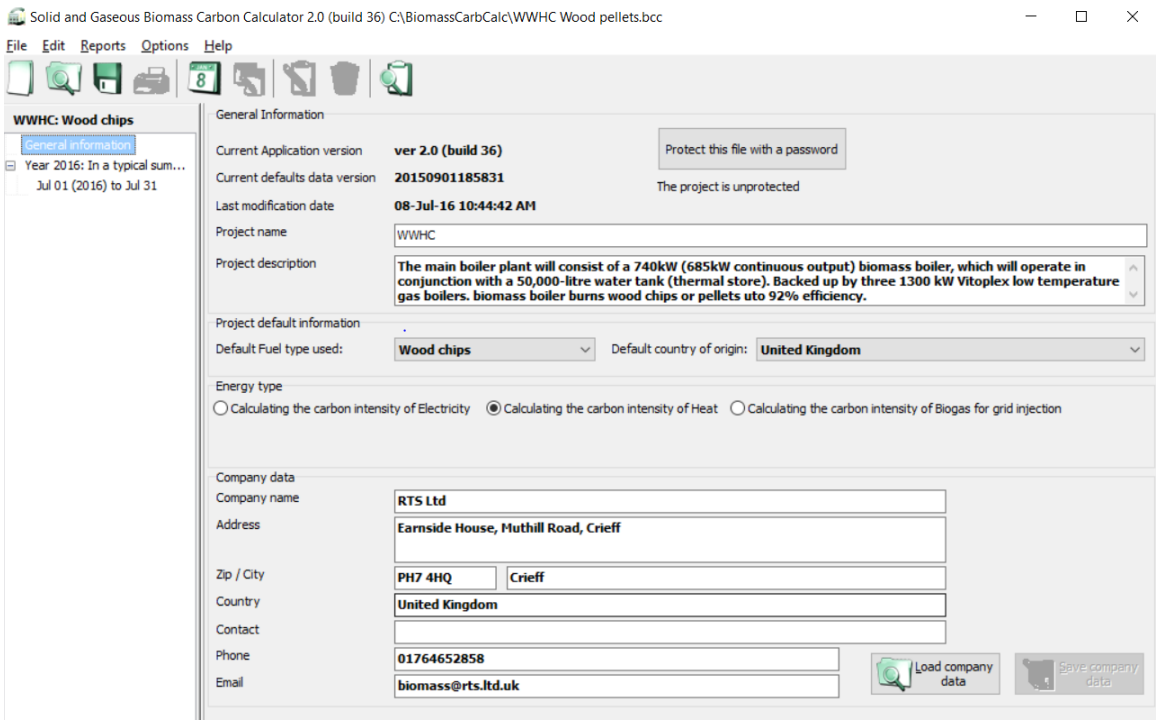

Figure 15: General description input to the Biomass Carbon Calculator.

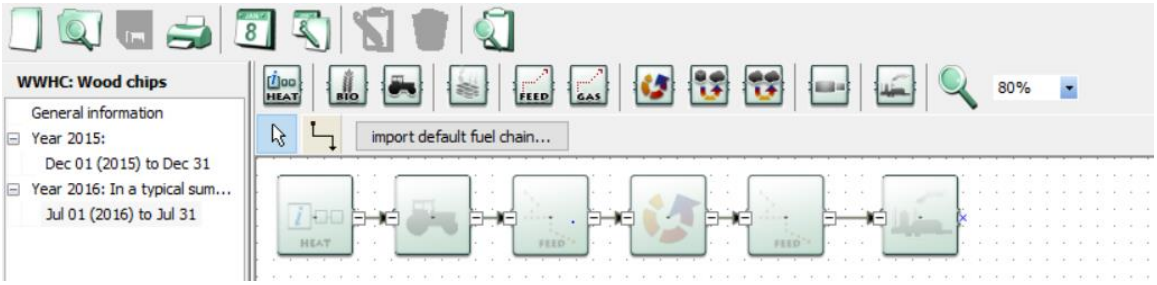

Figure 16: Fuel chain considered for carbon footprint calculations.

As monthly supply log was not available, the biomass supply was approximated through the meter readings provided by WWHC. Heat produced during the months of November-May was considerably higher than the production during June-October. It was assumed that 120 tonnes of woodchip would be supplied per month for 7 months of the year (November-May), and 60 tonnes of biomass would be supplied per month for the other 5 months. Therefore, a total of 1140 tonnes of woodchip supply would be required every year at an average moisture content of 34%. According to heat meter readings, the biomass boiler meets 61% of the heat demand on average throughout the year (explained in section 5.7.5).

The carbon footprint calculated from the Biomass Carbon Calculator was 36,036 kgCO2e/year.

West Whitlawburn currently purchases electricity from the grid and no provisions have been made to meet the electricity demand through renewable energy. Through the feasibility study conducted, no renewable source (producing electricity) was deemed ideal for implementation within the estate. Apart from the biomass boiler, gas-CHP was the only other solution that existed.

Points awarded to indicator: 3/6

5.7.5. District Heating

The district heating network at West Whitlawburn is connected to 543 flats distributed across 13 separate buildings: Benmore Tower, Kintore Tower, Arran Tower, Ailsa Tower, Bute Tower, Roslin Tower, Albany Terrace, Belmont Road 1, Hilton Terrace, Clifton Terrace, Belmont Road 2, along with the Concierge Station and the Community Centre.

The district heating pipework is valved at the bottom of the riser for every tower. The pipework rises up through the bin room through the riser to feed each floor. Each flat has a Heat Interface Unit (HIU) installed. The flats are connected to the primary heating network indirectly via a plate heat exchanger that provides a physical barrier to the water. A circulation pump and pressurisation unit are to circulate the space heating water through the radiator (Vital Energi, 2014). Indirect HIU's are relevant as they prevent any water leakage due to separated hydraulic systems and also have a lesser change of water contamination due to separate primary and secondary networks, as compared to direct HIU's (CIBSE, 2014).

The calculation of external pipe heat losses using the Heat Loss Assessment tool indicates a 9.84% annual heat loss from all 'properly insulated' pipes which exceeds the benchmark of 3%. Annual heat loss from 'not properly insulated' pipes is about 18,042 kWh and from the storage tank is 11,777 kWh, which together accumulates to 0.8% of average annual heat losses compared to the plant's projected output.

The buried pipework is made from isoplus single series pipes of different lengths. The rigid steel pipes are insulated with Polyurethane-hardfoam (PUR) in accordance with BS EN 253 (2009) (isoplus Fernwärmetechnik Vertriebsgesellschaft mbH, 2012).

Results of heat loss calculation for 'properly insulated' pipe lengths >10m			
1	AUTOMATIC CALCULATION. Total calculated **average annual heat loss from all individual 'properly insulated' pipe lengths >10m** (kWhth).	354,010	Automatically populated upon completion of the "PI Calculator".
2	P**rojected annual heat output from the plant** (kWhth)	3,596,600	Automatically populated upon completion of the "PI Calculator".
3	AUTOMATIC CALCULATION. The **calculated %** of average annual heat loss from all individual 'properly insulated' pipe lengths >10m compared with the plant's projected annual heat output (kWhth):	9.84%	As the figure calculated is >3% you should note that these losses will be deducted from periodic support payments.
Heat Loss Assessment Results			
a	Average annual heat lost from 'Non Properly Insulated' pipe lengths (kWhth) and external storage tanks	29,820	For Example: '6058'. *NB - Do NOT type 'kWhth' after the number.*
b	Average annual heat loss from 'Properly Insulated' pipe lengths >10m (kWth)	354,010	For Example: '112603'. NB - Do NOT type 'kWhth' after the number.
c	Projected annual heat output (kWhth)	3,596,600	
d	Total average annual heat loss from all 'Non Properly Insulated' pipe lengths, 'Properly Insulated' pipe lengths >10m (kWth) and external storage tanks.	383,829	
e	AUTOMATIC CALCULATION. The calculated % of average annual heat loss from the Heat Loss Calculator for 'Non Properly Insulated' pipework compared with the plant's projected annual heat output (kWhth)	0.8%	This will automatically calcuate the percentage. If the figure calculated is >6% it will need an internal assessment by Ofgem.
f	Heat loss calculation	Approved	
g	AUTOMATIC CALCULATION. Quarterly heat loss figure (QHLF) (kWhth)	95957	Enter this figure into Question HH123-3 of the IT Register.

Figure 17: Heat loss results obtained from Ofgem Heat Loss Assessment tool

Individual heat meters in buildings were only installed very recently. On analysing the heat meter readings from the months of May, June and July, it is observed that the heat losses are more significant.

The readings recorded below have been noted over a course of 74 days, from 16th May 2016 (time: 16:00) to 29th July 2016 (time: 15:20).

Table 12: Meter readings obtained over a 74-day period (from 16 May 2016 to 29th July 2016)

Total Energy Output Reading (MWh) over the 74-day period						
Biomass Boiler		**Gas Boiler**		**District Heating**		
293.03		165.88		439.45		
Total Energy Input Heat Meter Reading (MWh) over the 74 day period						
1-27 Belmont Rd	**28-55 Belmont Rd**	**Albany Terrace**	**Hilton Terrace**	**Clifton Terrace**	**Alisa Tower**	**Arran Tower**
8.53	9.66	12.44	14.28	18.77	41.07	37.53
Bute Tower	**Benmore Tower**	**Kintore Tower**	**Rosling Tower**	**Concierge**	**Resource Centre**	**Energy Centre**
40.29	42.32	35.63	36.02	1.701	39.38	2.33

Results				
Total Energy (input) MWh	**Hours**	**Output/hr (MWh)**	**Input/hr (MWh)**	**Average heat loss %**
339.95	1775.3 (1775 hours and 20 minutes)	0.24	0.19	22.2%

The meter readings indicate an overall heat loss of 22.2%. The heat losses have gone as high as 33% and as low as 9%. This indicates that losses from the heat network is not just dependent on the buried network between any residential blocks but also the pipework from any block entry point up to each dwelling. It is indeed the latter portion of the pipework which contributes to greater heat losses and poor design can lead to not only significant heat losses but also over-heating of corridors/common areas (CIBSE, 2014).

The biomass heat source delivers around 66% of the heat demand during the summers, while during the winters it delivers around 59% of the heat demand of the estate. The rest of the heat demand is supplied by the back-up gas boilers. The proportion of heat demand satisfied by gas supply is higher during the winters due to a greater peak demands to be met during the season.

Over the entire year, the back-up gas boilers produce 39% of the heat that is supplied to the buildings. By analysing results from the monthly heat meter readings and the Ofgem Heat Loss Assessment Tool, the annual heat output produced from the district heating system is 42,77,688 kWh. So the proportion of annual heat produced by gas boilers 1,668,298 kWh. The carbon footprint from the gas boilers is 306,967 $kgCO_2e$/year (carbon intensity of gas is equal to 0.184 $kgCO_2e$/kWh according to DEFRA conversion factors for greenhouse gas reporting).

The total carbon footprint from the district heating system is 343,003 $kgCO_2e$/year.

Points awarded to indicator: 7/12

5.8 Innovation

5.8.1. Whitcomm

WWHC facilitated an innovative communication technology project that aimed at social regeneration by setting up a new Community Communications Co-operative, Whitcomm, within West Whitlawburn.

58% of the residents had identified themselves as being digitally excluded (having no broadband access) (Whitcomm Co-operative Ltd., 2012). Whitcomm was seen as a solution to provide a digitally excluded community with triple-play communication services at rates lower than what is provided by national communications services. This innovative service has found tenants using the service for a variety of things such as online banking, gaming, video streaming and also for children's homework (WWHC Cambuslang, 2013).

Points awarded to indicator: 2/2

Chapter 6. Discussion

From this report, numerous lessons were learnt regarding West Whitlawburn Housing Co-operative. The final score achieved by West Whitlawburn Housing Co-operative was **71.93**. The scoring has been provided in Appendix 1.

The scoring helps clearly indicate the gaps that need to be covered by the co-operative to become more sustainable. Firstly, the co-operative must put its sustainability plan into action and strive towards greater goals. A committee must be set up solely responsible for recording and reporting on data that can help build and improve the community. The co-operative has aimed to review its sustainability plan every 3 years. However, a two-year period seems more reasonable for refreshing the plan, due to the regular frequency of national policy changes. The co-operative has excelled in the fields of community development and social wellbeing, that shows its commitment towards their members. The various resources provided are highlighted in Appendix 3.

Resource usage described in Appendix 3 shows the various activities conducted by the Whitlawburn Community Resource Centre. The various services are part of a multiple categories such as Community Development, and Health and Social Wellbeing. All the resources together promote social networking, physical activity, and most importantly, civic engagement.

Accessibility to food has been made convenient through co-operation with various institutes. However, the large green space available suggests that there is potential for food growing space within and around the estate boundaries. So, local gardens need to be investigated for potential of growing herbs, trees etc.

Also, the co-operative should try to monitor water consumption and raise awareness to reduce the use of water. This would not only make tenants aware of their water use and but also help save on bills. Waterwise (2007) prepared a report for the Greater London Authority, which indicated positive and negative impacts of water sub-metering. The most positive impact was the percentage reduction in water demand. The additional metering would also allow water companies to manage their assets better, in instances such as identification of leaks. The negative side, however, is the increase in capital cost for low-

income families living in the co-operative. One solution could be to provide subsidies to tenants to encourage installation of sub-metering.

In terms of transport, the indicators were limited to site surveys, where indicators were judged based on proximity and location. There is a possibility to go a step further and monitor what percentage of the tenants and staff own private vehicles. Although it may be difficult to monitor tenants' transport emissions, it would be easier to monitor transport emissions by staff members, with regards to their daily travel to work. Staff members must be encouraged to use public transport to travel to work. Another aspect that can be monitored is the number of staff members that are hired locally. This would not only increase local employment opportunities around the housing co-operative, but also indirectly help reduce transport emissions due to reduced travel distances.

For parking facilities, the consideration made was to provide adequate parking for all residents along with visitors. Another scenario could possibly be to reduce the parking footprint and keep it to as low as possible. Co-operatives with limited land cannot afford to invest in providing parking space for everyone as other amenities may be more necessary to satisfy first. In this case underground parking or multi floor parking will help create more open streets and footpaths. The lesser parking spaces however, could indirectly encourage more people to use bicycle and public transport facilities. This negative aspect of excess parking space has not been considered in this thesis.

Even though recycling strategies have been implemented in all the blocks, their usage is not very common. Provisions should be made for collection of recyclable household wastes from houses that are rented by old aged or disabled people who can't afford to come downstairs every time they need to throw their wastes. Also, waste for this reporting was only considered to be household waste. However, considering housing co-operatives are always looking for improvements in their building construction, it is important to consider effective management of construction site waste. Key refurbishment and demolition materials should be identified and should be reused or recycled wherever possible.

In terms of indoor lighting, tenants must be encouraged to purchase energy efficient lights in order to reduce their energy bills and also the carbon emissions produced.

In terms of building energy consumption, electricity meter readings were not available. Flats had to be modelled on HEM based on the building plan available, and so the consumption may not be accurate. Also, building plans were only available for one type of housing stock. Even though the plan constituted a high proportion of the housing stock, other types of houses would have different energy consumption. The energy consumption of high rise buildings is very different from low-rise buildings, and this would be needed to be taken into consideration while reporting for the whole estate. The availability of the 'Dual Fuel' option provided in the vPro:ems could solve the problem for metering of both heating as well as electricity.

Now that the heat metering in completely in place, it is essential to keep record of day-to-day monitoring, so that comparisons can be made every year to help monitor building energy consumption and try reducing it.

In a lot of these above suggestions, it is clear that behavioural changes in the community is key. Communities should better understand and be made better aware of the benefits of sustainable living. This would not just make it easier to implement more sustainable resources, but would also automatically help make the community more sustainable just by the way every person thinks and functions.

As the site cannot accommodate any renewable sources for generating electricity, the carbon emissions from the grid are bound to remain constant, depending on the grid carbon intensity. One solution to increasing the percentage of electricity supplied by renewable sources is through 'community ownership'. The Scottish Government defines 'community and locally owned renewable energy' as renewable technologies producing heat and/or electricity, where the owners of the installation are either the community, local Scottish businesses, housing associations, public bodies or charity groups (Energy Savings Trust, 2015). Ownership is not only restricted to the co-operative owning the entire renewable installation but can also involve co-operatives paying a part of the development of the renewable installation in return for some benefit, such as share in the income generated. An example for this case is the Fintry Development Trust which 'owns' a wind turbine, that is part of the larger Earlsburn Wind Farm. The Fintry owned turbine is of a capacity

of 2.5MWe, which was the 15th wind turbine although the full capacity of the Earlsburn Wind Farm is around 35MW (Energy Savings Trust, 2015).

It is also important to note that the scoring depends upon the indicator weight. The indicator weight for this assessment is very subjective, and can be changed depending upon the importance of the indicator on a local and a national scale. For example, water metering is not currently being strictly imposed in Scotland, and is more of the tenant's decision to invest in metering rather than a policy. So almost all co-operatives are bound to lose points in that sector. This is why it is given a lower indicator weightage than food, which is being measured on a completely different metric, but is more likely to affect people as compared to water usage. Availability of affordable food is a larger problem as compared to water availability. However, if this scenario is applied to the Eastern world, the case is bound to be different as tap water is not fit to drink and people need to pay for potable water. Also water resources are more scarce in relation to their population. So, in that case, water resource would have a higher weighting in those sections of the world as compared to Scotland.

Similarly, in terms of other social categories, Community development and Health and Social Wellbeing have a greater weighting as compared to Governance. This weighting is also very subjective. A housing co-operative or any similar development mainly works to promote community development and wellbeing, while governance helps in promoting those aspects. Since the aim of housing co-operatives is to serve its members, the weighting is justified.

For the additional category i.e., innovation, which is more of an additional category can have a varied weightage. The degree to how 'innovative' a technology or plan can be highly subjective. On one hand, an innovation can bring great economic gains to the co-operative, and on the other, an innovation can bring great happiness to the tenants of the co-operative. Some innovative projects might be targeted specifically towards gains of the co-operative's members, while others might target growth of the entire region where the project is situated. There is also a possibility to score a co-operative greater than the total range of 100 points, by awarding extra points for projects that are of significant financial or social

important to the people in the region. How many people need to be influenced or how much profit should be gained, are things that cannot be benchmarked at this moment.

Chapter 7. Conclusion

The objective of developing an assessment tool is to spread awareness among members, staff members and other stakeholders of housing co-operatives, of factors that they can improve to progress towards a more sustainable living. Co-operatives, in general, play an important role to the country's economy, and implementing a similar assessment tool across all types of co-operatives could help improve people's lives economically and socially, and also have a positive impact on the carbon footprint.

The use of this assessment tool was shown through its implementation on West Whitlawburn Housing Co-operative. It provided an indication on various elements that the co-operative could improve on. The entire estate of West Whitlawburn could not be taken into account. However, when sustainability reporting is done over a year's time, the entire housing stock that will be taken into consideration would result in a different final score. This would be done by awarding points separately for different housing stock depending upon their levels of implementation and then finally, aggregating the points to produce a final score.

Trends keep changing, and so can the assessment tool. The subjective nature of the tool allows for a significant degree of variation depending upon what is the 'need of the hour'. Also, the addition of more categories that the co-operative can benchmark allows them to add more features to its co-operative model. Another aspect is to combine this environmental and social reporting along with the economic parameters that are generally published in annual reports of all co-operatives. Appropriate benchmarks will need to be set for that as well.

The scoring has only been done based on the current year's assessment. However, co-operatives investing in such a reporting framework could benefit by evaluating their status every year or once every two years. This gives them an opportunity to improve on the previous year's figures for every category and this benchmarking could assist them in setting new aims and objectives as the years roll by.

The assessment tool has been made publicly available and can be used by different housing co-operatives, communities, or individuals who wish to use this tool for their respective

organisations. As mentioned before, various categories can be added or removed, and the weightings can be varied to address the important issues at hand.

References

[1] CCH Confederation of Co-operative Housing, 2009. *Bringing Democracy Home,* Commission on Co-operative and Mutual Housing.

[2] Co-operative Heritage Trust, 2013. *Our Story: Rochdale Pioneers Museum,* Oldham: RAP Spiderweb.

[3] Agricultural Cooperative Service, 1992. *Organizing and Conducting Cooperatives' Annual Meetings.*

[4] *Housing Association Act 1985, Chapter 69,* London: The Stationery Office Limited.

[5] *Housing (Scotland) Act 2010 (asp 17),* London: The Stationery Office Limited.

[6] *Co-operative and Community Benefit Societies Act 2014,* London: The Stationery Office.

[7] Beaubien, L., 2011. Co-operative Accounting: Disclosing Redemption Contingencies for Member Shares. *Journal of Co-operative Studies,* August, 44(2), pp. 38-44.

[8] Bioregional, 2015. *WGV by LandCorp- One Planet Action Plan.*

[9] Birchall, J., 2004. *Cooperatives and the Millennium Development Goals,* Geneva: International Labour Office.

[10] Birchall, J., 2005. Co-operative Principles Ten Years On. *Review of International Co-operation,* 98(2), pp. 45-63.

[11] Boston University, 2012. *LED Lighting Retrofits.* [Online]. Available at: http://www.bu.edu/sustainability/what-were-doing/energy/led-lighting-retrofits/ [Accessed 06 July 2016].

[12] BRE, 2012. *BREEAM Communities Manual.* [pdf]. Available at: http://www.breeam.com/bre_PrintOutput/BREEAM_Communities_0_1.pdf

[13] BRE, 2012. *BREEAM Refurbishment – Domestic Buildings.* [pdf]. Available at: http://www.breeam.com/bre_PrintOutput/BREEAM_Domestic_refurb_manual_2012.pdf

[14] BRE, 2013. *BREEAM -SE English Manual for New Construction and Refurbishment,* Sundbyberg: Sweden Green Building Council.

[15] BRE, 2016. *BREEAM In-Use International.* [pdf]. Available at: http://www.breeam.com/filelibrary/Technical%20Manuals/SD221_BIU_International_2015_Re-issue_V2.0.pdf [Accessed 05 July 2016].

[16] CIBSE, 2008. *Energy Benchmarks*, Norwich: CIBSE Publications.

[17] CIBSE, 2014. *Heat Networks: Code of Practice for the UK.*

[18] Clarke, J. A. et al., 2008. *The EDEM methodology for housing upgrade analysis, carbon and energy labelling and national policy development.* Quebec, Canada.

[19] Cooperative Development Scotland, 2009. *A comparative analysis of co-operative sectors in Scotland, Finland, Sweden and Switzerland.*

[20] Cooperative Grocer, 2013. *Sustainability Scorecard.* [excel]. Available at: http://www.grocer.coop/system/files/legacy_files/sustainablescorecard_0.xls [Accessed 04 July 2016].

[21] Co-operatives UK, 2004. *Key Social and Co-operative Performance Indicators.*

[22] Co-operatives UK, 2013. *Simply Performance A guide to creating member value by aligning co-operative strategy, performance measurement and reporting.* [pdf]. Available at: https://www.uk.coop/sites/default/files/uploads/attachments/simply_performance_0.pdf [Accessed 24 June 2016].

[23] Co-operatives UK, 2015. *The UK co-operative story.* [Online]. Available at: http://www.uk.coop/about/uk-co-operative-story [Accessed 10 June 2016].

[24] Co-operatives UK, 2016. *The co-operative economy report.* [Online]. Available at: http://reports.uk.coop/economy2016/ [Accessed 10 June 2016].

[25] Cornwall Council, 2013. *An Assessment of the Renewable Energy Resource Potential in Cornwall.*

[26] D&B Facades, 2013. *Why High-Quality Overcladding?.* [pdf]. Available at: http://www.cihhousing.com/__media/libraries/pdf-catalogues/Why-High-Quality-Overcladding.pdf [Accessed 10 July 2016].

[27] DECC, 2013. *The Future of Heating: Meeting the challenge,* London.

[28] DEFRA, 2015. *Statistics on waste managed by local authorities in England in 2014-2015*, National Statistics.

[29] Dyllick, T. & Hockerts, K., 2002. Beyond the Business Case for Corporate Sustainability. *Business Strategy and the Environment,* Volume 11, pp. 130-141.

[30] Edinburgh Community Solar Co-operative (ECSC), 2015. *How it works.* [Online]. Available at: http://www.edinburghsolar.coop/projects/how-the-co-op-works/ [Accessed 10 June 2016].

[31] Elkington, J., 1997. *Cannibals with forks – Triple bottom line of 21st century business.,* Stoney Creek, CT: New Society Publishers.

[32] Energy Savings Trust, 2015. *Community and locally owned renewable energy in Scotland at September 2015.*

[33] Ernst & Young, 2012. *Enlightened co-operative governance.* [pdf]. Available at: http://www.ey.com/Publication/vwLUAssets/Enlightened_co-operative_governance/$FILE/Enlightened%20co-operative%20governance_EN.pdf

[34] EY, 2014. *Sustainability reporting — the time is now*.

[35] Fife Council, 2010. *Creating Sustainable Communities and Buildings.* [pdf]. Available at: http://admin.1fife.org.uk/uploadfiles/publications/c64_SustainabilityChecklist.pdf

[36] Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), World Food Programme (WFD), 2012. *Agricultural cooperatives: paving the way for food security and rural development*.

[37] Forrest, N. & Wiek, A., 2014. Learning from success—Toward evidence-informed sustainability transitions in communities. *Environmental Innovation and Societal Transitions,* Volume 12, pp. 66-68.

[38] Global Ecovillage Network, 2015. *Community Sustainability Assessment (CSA).*

[39] Global Reporting Initiative, 2011. *Sustainability Reporting.* [Online]. Available at: https://www.globalreporting.org/information/sustainability-reporting

[40] Greencity Wholefoods, 2016. *About us.* [Online]. Available at: http://www.greencity.coop/about-us/ [Accessed 10 June 2016].

[41] GRI, UN Global Compact, WBSCD, 2015. *SDG Compass.* [Online]. Available at: http://sdgcompass.org/

[42] GRI, 2015. *G4 Sustainability Reporting Guidelines.* [zip]. Available at: https://www.globalreporting.org/resourcelibrary/G4-Package.zip [Accessed 04 July 2016].

[43] Herbert, Y., 2015. Leadership in Hegemony: Sustainability Reporting and Co-operatives. In: *Co-operatives for Sustainable Communities: Tools to Measure Co-operative Impact and Performance.* Manitoba: pp. 294-310.

[44] International Chamber of Commerce (ICC), December 2015. *Sustainability reporting – future directions.*

[45] International Cooperative Alliance (ICA), 2007. *Factsheet: Differences between Co-operatives, Corporations and Non-Profit Organizations.*. [pdf]. Available at: http://ica.coop/sites/default/files/Factsheet%20-%20Differences%20between%20Coops%20Corps%20and%20NFPs%20-%20US%20OCDC%20-%202007.pdf.

[46] International Cooperative Alliance (ICA), 2013. *Blueprint for a Co-operative Decade.* [pdf]. Available at: https://ica.coop/sites/default/files/media_items/ICA%20Blueprint%20-%20Final%20version%20issued%207%20Feb%2013.pdf

[47] International Co-operative Alliance (ICA), 2014. *Co-operative identity, values & principles.* [Online]. Available at: http://ica.coop/en/whats-co-op/co-operative-identity-values-principles [Accessed 4 June 2016].

[48] International Co-operative Alliance, 2016. *Sustainability Reporting for Co-operatives: A Guidebook.* [pdf]. Available at: https://ica.coop/sites/default/files/media_items/ICA%20Sustainability%20Reporting%20Guidebook.pdf

[49] International Labour Organization, 2011. *Promoting Co-operatives, A guide to ILO Recommendation 193.* [pdf]. Available at: http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---coop/documents/instructionalmaterial/wcms_160221.pdf

[50] Ioannou, I. & Serafeim, G., 2014. *The Consequences of Mandatory Corporate Sustainability Reporting: Evidence from Four Countries.*

[51] isoplus Fernwärmetechnik Vertriebsgesellschaft mbH, 2012. *isoplus Design Manual 2011*.

[52] Joint Research Centre, n.d. *Photovoltaic Geographical Information System (PVGIS).* [Online]. Available at: http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php# [Accessed 14 July 2016].

[53] KPMG, 2015. *The KPMG Survey of Corporate Responsibility Reporting 2015.* [pdf]. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/02/kpmg-international-survey-of-corporate-responsibility-reporting-2015.pdf

[54] LEED, 2016. *LEED v4 for Neighborhood Development.*

[55] Lozano, R., 2008. Envisioning sustainability three-dimensionally. *Journal of Cleaner Production,* 16(17), pp. 1838-1846.

[56] Lozano, R. & Huisingh, D., 2011. Inter-linking issues and dimensions in sustainability reporting. *Journal of Cleaner Production,* 19(2-3), pp. 99-107.

[57] Northwest Cooperative Development Center, 2006. *Types of Cooperatives*.

[58] Ofgem, 2015. *Heat Loss Assessment User Guide - Version 2.*

[59] Prakash, D., 2003. *The Principles of Cooperation- A Look at the ICA Cooperative Identity Statement,* Delhi.

[60] Radical Routes, 2004. *How to Set Up a Housing Co-operative, 5th Edition,* Leeds: Radical Routes Ltd..

[61] Radical Routes, 2010. *How to Set Up a Housing Co-operative,* Leeds: Radical Routes Ltd..

[62] Ragheb, M., 2014. *Wind Turbines in the Urban Environment*.

[63] RIAS, 2016. *West Whitlawburn MSF Overcladding.* [Online]. Available at: http://www.rias.org.uk/directory/practices/burnet-bell/west-whitlawburn-msf-overcladding/ [Accessed 25 July 2016].

[64] RS Components, 2011. *LED Reflector Lamps.* [Online]. Available at: http://uk.rs-online.com/web/p/led-reflector-lamps/9209253/ [Accessed 07 August 2016].

[65] Scottish Housing Regulator, 2012. *The Scottish Social Housing Charter.* [pdf]. Available at:

http://housingcharter.scotland.gov.uk/media/34241/the%20scottish%20social%20housing%20charter.pdf [Accessed 12 July 2016].

[66] Scottish Housing Regulator, 2015. *Landlord Report.* [Online]. Available at: https://portal.scottishhousingregulator.gov.uk/interactive_multiyear/SLandlordReport.aspx?PSocialLandlord=236DA976-CFA9-E311-93F1-005056B555E6&year=2014/2015 [Accessed 25 July 2016].

[67] Shelter Scotland, 2008. *Housing cooperatives.* [Online]. Available at: http://scotland.shelter.org.uk/get_advice/advice_topics/finding_a_place_to_live/housing_cooperatives

[68] The Scottish Government, 2006. *Review of Greenhouse Gas Life Cycle Emissions, Air Pollution Impacts and Economics of Biomass Production and Consumption in Scotland.* [pdf]. Available at: http://www.gov.scot/Resource/Doc/149415/0039781.pdf [Accessed 09 August 2016].

[69] The Scottish Government, 2015. *Domestic Building Services Compliance Guide For Scotland.*

[70] TheGreenAge, 2014. *How many solar panels can I fit on my roof?.* [Online] Available at: http://www.thegreenage.co.uk/how-many-solar-panels-can-i-fit-on-my-roof/ [Accessed 19 July 2016].

[71] Thomas, H. & Logan, C., 1982. Distribution of Earnings and Surplus . In: *Mondragon: An Economic Analysis.* London: George Allen & Unwin (Publishers) Ltd., pp. 143-147.

[72] U.S. Green Building Council, 2013. *LEED v4 for Neighbourhood Development.*

[73] U.S. Green Building Council, 2014. *LEED 2009 for Neighborhood Development Rating System.* [pdf]. Available at: http://www.usgbc.org/sites/default/files/LEED%202009%20RS_ND_07.01.14_current%20version.pdf

[74] United Nations General Assembly, 2009. *Cooperatives in social development, A/RES/64/136.* [doc]. Available at: undocs.org/A/RES/64/136 [Accessed 14 June 2014].

[75] United Nations General Assembly, 2015. *Transforming our world: the 2030 Agenda for Sustainable Development, A/RES/70/1*. [doc]. Available at: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E [Accessed 27 June 2016].

[76] Viessman, 2010. *Veissman KOB Product Information.* [pdf]. Available at: http://acep.uaf.edu/media/62282/Viessman-KOB-Product-Information.pdf

[77] Viessmann, 2016. *Heating with wood.* [pdf]. Available at: http://www.viessmann.co.uk/content/dam/vi-brands/UK/PDFs/PressReleases/West%20Whitlawburn%20District%20Heating.pdf/_jcr_content/renditions/original.media_file.download_attachment.file/West%20Whitlawburn%20District%20Heating.pdf

[78] Vital Energi, 2014. *Indirect Heating Unit.* [Online]. Available at: https://www.vitalenergi.co.uk/technologies/indirect-heating-unit/ [Accessed 03 August 2016].

[79] Vital Energi, 2014. *vPro:ems Energy Metering Solution.* [Online]. Available at: https://www.vitalenergi.co.uk/technologies/smart-metering-vproems/ [Accessed 7 August 2016].

[80] Waterwise, 2007. International experiences of sub-metering. [pdf]. Available at: http://www.waterwise.org.uk/data/2007_Waterwise_submetering.pdf

[81] WCED, 1987. *Our Common Future,* Oxford: Oxford University Press.

[82] West Whitlawburn Housing Co-operative, Co-operative Housing in Scotland, 2008. *West Whitlawburn Housing Co-operative & Co-operative Housing in Scotland joint consultation response to 'Firm Foundations: the future of Housing in Scotland'*.

[83] West Whitlawburn Housing Co-operative, 2009. *West Whitlawburn Housing Co-operative Social Accounts 2008-2009.*

[84] Whitcomm Co-operative Ltd., 2012. *History.* [Online]. Available at: http://www.whitcomm.co.uk/about.html [Accessed 05 August 2016].

[85] World Business Council for Sustainable Development (WBCSD), 2002. *Sustainable Development Reporting: Striking the Balance.*

Chapter 8. Appendices

10.1 Appendix 1: Scoring for West Whitlawburn Housing Co-operative

Indicator	Points Achieved	Points Available	% of points received	Indicator weight	Indicator score	Total Category Score	Category Weighting
Governance							
Governance Structure and Composition	4	4	100%	2.20	2.20		
Sustainability Action Plan	2	4	50%	3.00	1.50	6.80	10.00
Annual General Meeting	0	1	0%	1.70	0.00		
Earning Differentials	1	1	100%	1.50	1.50		
Gender Diversity	2	2	100%	1.60	1.60		
Community Development							
Social Facilities	2	2	100%	5.00	5.00	15.00	15.00
Recreational Facilities	5	5	100%	5.00	5.00		
Educational and Employment Facilities	4	4	100%	5.00	5.00		
Health and Social Wellbeing							
Safety	4	4	100%	5.00	5.00	15.10	16.00
Health	5	6	83%	5.40	4.50		
Social Wellbeing	7	7	100%	5.60	5.60		
Food and Water							
Accessibility to Sustainable Food	2	3	67%	4.50	3.00	3.00	8.00
Water Consumption	0	4	0%	2.20	0.00		
Rain Water Harvesting	0	1	0%	1.30	0.00		
Transport							
Local Public Transport Accessibility	4	4	100%	4.00	4.00	6.33	8.00
Bicycle Facilities	1	2	50%	2.00	1.00		
Local Parking	2	3	67%	2.00	1.33		
Waste							
Accessibility of Waste bin	1	2	50%	1.00	0.50	2.50	4.00
Segregation of wastes	2	2	100%	2.00	2.00		
% waste recycled	0	1	0%	1.00	0.00		
Energy							
Building Energy Consumption	7	11	64%	6.00	3.82		
Lighting (external)	1	2	50%	2.50	1.25		
Lighting (internal)	1	4	25%	2.50	0.63	19.19	35.00
Feasibility Study	3	3	100%	6.00	6.00		
On-site Renewable Energy Generation	3	6	50%	8.00	4.00		
Distict Heating or Cooling	7	12	58%	6.00	3.50		
Innovation	2	2	100%	4.00	4.00	4.00	4.00
				FINAL SCORE		**71.93**	100.00

Figure 18: Final Score for West Whitlawburn Housing Co-operative

10.2 Appendix 2: WWHC aligning to the International Co-operative Alliance Principles

West Whitlawburn Housing Co-operative is guided by the seven Co-operative Principles, by which they put their co-operative values into practice:

Voluntary and Open Membership: Co-operatives are voluntary organizations, open to all people able to use its services and willing to accept the responsibilities of membership, without gender, social, racial, political or religious discrimination.

WWHC is a voluntary housing organisation that provides membership and occupancy to every individual over the age of 16 irrespective of their gender, race or disability.

Democratic Member Control: Co-operatives are democratic organizations controlled by their members—those who buy the goods or use the services of the co-operative—who actively participate in setting policies and making decisions.

WWHC is a democratic organisation that is entirely controlled by its members who are active participants in policy setting and decision-making process. It is governed by a Management Committee made up entirely of tenants, who employ staff members to ensure the smooth running of the co-operative.

Member's Economic Participation: Members contribute equally to, and democratically control, the capital of the co-operative. This benefits members in proportion to the business they conduct with the co-operative rather than on the capital invested.

All tenants in the co-operative own the same value (par value) of share, a nominal £1, which entitles them to vote and participate in decision-making. This share is not transferrable and a member cannot gain more than one share in the co-operative. This is kept in a separate bank account and can only be taken out if the co-operative is dissolving and those share funds would be the members' contribution to pay any debtors. The fully mutual and par value status ensures the shared ownership of the co-operative and keeps in line with the one member, one vote policy. The legislations that bound West Whitlawburn are the Co-operative and Community Benefits Society Act (2014) and the Housing (Scotland) Act (2010).

Autonomy and Independence: Co-operatives are autonomous, self-help organizations controlled by their members. Any agreements with other organizations or raises capital from external sources, it is done so based on terms that ensure democratic control by the members and maintains the co-operative's autonomy.

WWHC is an autonomous organisation that is controlled by its members. Any agreements with governmental or private organisations is made under terms that ensure complete democratic control of the members.

Education, Training, and Information: Co-operatives provide education and training for members, elected representatives, managers and employees so they can contribute effectively to the development of their co-operative.

WWHC provides education and training to its members by creation of the Community Resource Centre that runs support and advice services to enhance employment opportunities of its members.

Elected committee and staff members are also frequently provided training to ensure they can contribute to the co-operative on the highest level.

Cooperation among Co-operatives: Co-operatives serve their members most effectively and strengthen the co-operative movement by working together through local, national, regional and international structures.

WWHC is involved in a number of partnerships with other Co-operatives to provide various services that benefit mutually.

Concern for Community: Co-operatives work for the sustainable development of communities through policies and programs accepted by the members.

WWHC works to promote sustainable development that can be highlighted through the development of their biomass energy centre and district heating scheme. Efforts are also being put into recycling waste and other commodities.

10.3 Appendix 3: Annual Resource Usage Figure

Table 13: Annual usage figures of various resources provided by Whitlawburn Community Resource Centre

Group/Service	Category	Weekly Attendance	Annual Attendance
Yoga	Health & Fitness	15	750
Muay Thai	Health & Fitness	20	1000
FBX	Health & Fitness	10	500
Zumba	Health & Fitness	25	1250
Sequence Dancing	Health & Fitness	30	1500
Dance Class	Health & Fitness	45	2250
Body Blast	Health & Fitness	25	1250
Art Class	Learning	5	250
IT Drop-in Class	Learning	30	1500
Discovery Group	Learning	2	100
Men's Shed	Learning	12	600
Parent Café	Parent & Child	40	2000
Little Rascal Parent Group	Parent & Child	40	2000
Lego Class - Reach	Parent & Child	8	400
Sports Class - Reach	Parent & Child	8	400
Baby Massage	Parent & Child	10	500
Youth Club	Youth	10	500
Friday Night Football	Youth	40	2000
Soccer Tots	Youth	40	2000
Dance Tots	Youth	5	250
Cambuslang & Rutherglen Foodbank	Support Services	15	750
Richmond Fellowship	Support Services	15	750
Community Café	Tenants	150	7500
Out of School Care	Tenants	30	1500
Whitlawburn Community Project			
Citizens Advice Bureau	Support Service		477
Credit Union	Support Service		373
Digital Drop-in	Support Service		246
Whit Recycle	Support Service		50
Whit Football Holiday Camps	Youth		150
	Annual Total		**32796**

10.4 Appendix 4: Key Social and Co-operative Performance Indicators (KS&CPI) by Co-operatives UK.

In 2001, Co-operatives UK established the Key Social & Co-operative Performance Working Group in order to draw up a number of indicators that could be used by members of Cooperatives UK to measure their social, co-operative and environmental performance. The final 10 indicators that were agreed upon are:

- Member Economic Involvement
- Member Democratic Participation
- Participation of employees and members in training and education
- Staff injury and absentee rates
- Staff profile – gender and ethnicity
- Customer satisfaction
- Consideration of ethical issues in procurement and investment
- Investment in community and co-operative initiatives
- Net carbon dioxide omissions arising from operations
- Proportion of waste recycled/reused

The guidance document defined each of the indicators and also provided examples on how data could be collected for each indicator. Every indicator chosen was established based on its relationship to the Co-operative values and principles.

10.5 Appendix 5: One Planet Living (OPL) by Bioregional

One Planet Living is an initiative developed by Bioregional and WWF to achieve sustainable living throughout the world. The initiative mainly came into the spotlight based on Bioregional's work to build the BedZED eco-village in Hackbridge, London. Analysing the positive impacts that were achieved by working at BedZED, it became clear that sustainable living is not a result of only green and sustainable buildings, but should also include the wider infrastructure, products and services available to the community.

OPL is guided by 10 principles of sustainability that form the framework, which is indicated in their One Planet Action Plan.

One Planet Principle	Headline goals and targets
Health and Happiness	Foster a strong sense of community
	Foster a healthy community
Equity and Local Economy	Ensure a diversity of housing type and tenure
	Encourage residents to engage in fair trade and local economy programmes
Culture and Community	Create a culture of sustainability
	Create a culturally vibrant community
Land Use and Wildlife	Create two new habitats
	Contribute to an increase in biodiversity
Sustainable Water	Reduced potable water use by 75%
	Reduce flooding risk – 100% of stormwater treated onsite
Local and Sustainable Food	Access to food growing space (100% of dwellings)
	Edible landscaping (30% of landscape trees)
	Encourage sustainable and healthy purchasing habits
Sustainable Materials	Reduced embodied energy of construction
	Sustainable materials in operation
Sustainable Transport	Enable a sustainable transport carbon footprint
	Reduced private car ownership
Zero Waste	Maximise construction waste recycling (95%)
	Reduction in household waste in operation (30%)
	Recycling rate of household waste (70%)
Zero carbon	Maximise energy efficiency (34% reduction)
	Renewable energy generation (100% renewable energy)

Figure 19: One Planet Action Plan (Bioregional, 2015)

10.6 Appendix 6: Community Sustainability Assessment (CSA) by the Global Ecovillage Network

The CSA is a subjective tool developed to assist communities in assessing their performance towards sustainability. The CSA performs a balanced assessment against three aspects of the community: Ecological, Social and Spiritual. Communities are encouraged to rate various aspects based on the current actions rather than their intentions. It has been designed to be applied to a wide variety of communities. Each section has several checklists which are scored based on a questionnaire. In the end, points for each section are totaled up and a final score is calculated. The various checklists under each section are highlighted below.

Ecological Section:

- Sense of Place
- Food Availability, Production & Distribution
- Physical Infrastructure, Buildings & Transportation
- Consumption Patterns & Solid Waste Management
- Water - sources, quality & use patterns
- Waste Water & Water Pollution Management
- Energy Sources & Uses

Social Section:

- Openness, Trust & Safety; Communal Space
- Communication - the flow of ideas & information
- Networking Outreach & Services
- Social Sustainability
- Education
- Health Care
- Sustainable Economics - healthy local economy

Spiritual Section:

- Cultural Sustainability
- Arts & Leisure
- Spiritual Sustainability
- Community Glue
- Community Resilience
- A New Holographic, Circulatory World View
- Peace & Global Consciousness

10.7 Appendix 7: BREEAM Communities by BRE

BREEAM Communities is an independent, third party assessment and certification standard based on the established BREEAM methodology. The technical document considers issues and opportunities that affect sustainability at the project development phase. The document addresses environmental, social and economic sustainability objectives that have an impact on development projects.

The three steps involved in the assessment of sustainability are:

Step 1: Establishing the principle of development by emphasizing on the opportunities to improve sustainability at the site-wide level, such as community-scale energy generation, transport and amenity requirements.

Step 2: Determining the layout of the development which will include the requirements regarding how people will move around and through the site and where buildings and amenities will be situated.

Step 3: Detailed design of the development that will include specification of landscaping, sustainable drainage solutions, transport facilities and more detailed built design.

Issues in this document are grouped into five categories which are considered through appropriate criteria in Steps 1 to 3 described above. The five categories are: Governance, Social and economic wellbeing, Resources and energy, Land use and ecology, Transport and movement. An extra category is present to promote the adoption of innovative technologies and solutions. The issues in each category are depicted in the figure below.

Step 1	Step 2	Step 3
Governance		
GO 01 – Consultation plan	GO 02 – Consultation and engagement GO 03 – Design review	GO 04 – Community management of facilities
Social and economic wellbeing		
SE 01 – Economic impact SE 02 – Demographic needs and priorities SE 03 – Flood Risk Assessment SE 04 – Noise pollution	SE 05 – Housing provision SE 06 – Delivery of services, facilities and amenities SE 07 – Public realm SE 08 – Microclimate SE 09 – Utilities SE 10 – Adapting to climate change SE 11 – Green infrastructure SE 12 – Local parking SE 13 – Flood risk management	SE 14 – Local vernacular SE 15 – Inclusive design SE 16 – Light pollution SE 17 – Training and skills
Resources and energy		
RE 01 – Energy strategy RE 02 – Existing buildings and infrastructure RE 03 - Water strategy		RE 04 – Sustainable buildings RE 05 – Low impact materials RE 06 – Resource efficiency RE 07 – Transport carbon emissions
Land use and ecology		
LE 01 – Ecology strategy LE 02 – Land use	LE 03 – Water pollution LE 04 – Enhancement of ecological value LE 05 – Landscape	LE 06 – Rainwater harvesting
Transport and movement		
TM 01 – Transport assessment	TM 02 – Safe and appealing streets TM 03 – Cycling network TM 04 – Access to public transport	TM 05 – Cycling facilities TM 06 – Public transport facilities

Figure 20: BREEAM Communities steps, categories and assessment issues (BRE, 2012)

10.8 Appendix 8: LEED for Neighborhood Development (LEED ND) Rating System by U.S. Green Building Council

Various organisations that represent leading design professionals, builds and developers, and the environmental community came together to develop a rating system based on the principles of smart growth, new urbanism and green infrastructure and building. Unlike other LEED rating systems, which focus mainly on green building practices, LEED ND places emphasis on site selection, design and construction activities that brings infrastructure into a neighbourhood and relates the neighbourhood to its surrounding landscape.

LEED ND has three categories: Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. An additional category, Innovation and Design Process, addresses sustainable design and construction issues and measures not covered under the three categories.

The allocation of points among credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, and air and water pollutants. Social and public health benefits were added to the impact categories, and the impact categories were then applied at the neighborhood scale. Approaches such as energy modeling, life-cycle assessment, and transportation analysis are used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting. The project checklist illustrating the points in each category is shown below.

LEED v4 for Neighborhood Development Built Project
Project Checklist

Project Name:
Date:

Yes	?	No				
0	**0**	**0**	**Smart Location & Linkage**			**28**
Y			Prereq	Smart Location		Required
Y			Prereq	Imperiled Species and Ecological Communities		Required
Y			Prereq	WetlandS and Water Body Conservation		Required
Y			Prereq	Agricultural Land Conservation		Required
Y			Prereq	Floodplain Avoidance		Required
			Credit	Preferred Locations		10
			Credit	Brownfield Remediation		2
			Credit	Access to Quality Transit		7
			Credit	Bicycle Facilities		2
			Credit	Housing and Jobs Proximity		3
			Credit	Steep Slope Protection		1
			Credit	Site Design for Habitat or Wetland and Water Bc		1
			Credit	Restoration of Habitat or Wetlands and Water Bc		1
			Credit	Long-Term Conservation Management of Habitat or Wetlands and Water Bodies		1
0	**0**	**0**	**Neighborhood Pattern & Design**			**41**
Y			Prereq	Walkable Streets		Required
Y			Prereq	Compact Development		Required
Y			Prereq	Connected and Open Community		Required
			Credit	Walkable Streets		9
			Credit	Compact Development		6
			Credit	Mixed-Use Neighborhoods		4
			Credit	Housing Types and Affordability		7
			Credit	Reduced Parking Footprint		1
			Credit	Connected and Open Community		2
			Credit	Transit Facilities		1
			Credit	Transportation Demand Management		2
			Credit	Access to Civic & Public Space		1
			Credit	Access to Recreation Facilities		1
			Credit	Visitability and Universal Design		1
			Credit	Community Outreach and Involvement		2
			Credit	Local Food Production		1
			Credit	Tree-Lined and Shaded Streetscapes		2
			Credit	Neighborhood Schools		1

0	**0**	**0**	**Green Infrastructure & Buildings**		**31**
Y			Prereq	Certified Green Building	Required
Y			Prereq	Minimum Building Energy Performance	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Construction Activity Pollution Prevention	Required
			Credit	Certified Green Buildings	5
			Credit	Optimize Building Energy Performance	2
			Credit	Indoor Water Use Reduction	1
			Credit	Outdoor Water Use Reduction	2
			Credit	Building Reuse	1
			Credit	Historic Resource Preservation and Adaptive	2
			Credit	Minimized Site Disturbance	1
			Credit	Rainwater Management	4
			Credit	Heat Island Reduction	1
			Credit	Solar Orientation	1
			Credit	Renewable Energy Production	3
			Credit	District Heating and Cooling	2
			Credit	Infrastructure Energy Efficiency	1
			Credit	Wastewater Management	2
			Credit	Recycled and Reused Infrastructure	1
			Credit	Solid Waste Management	1
			Credit	Light Pollution Reduction	1
0	**0**	**0**	**Innovation & Design Process**		**6**
			Credit	Innovation	5
			Credit	LEED® Accredited Professional	1
0	**0**	**0**	**Regional Priority Credits**		**4**
			Credit	Regional Priority Credit: Region Defined	1
			Credit	Regional Priority Credit: Region Defined	1
			Credit	Regional Priority Credit: Region Defined	1
			Credit	Regional Priority Credit: Region Defined	1
0	**0**	**0**	**Project Totals (Certification estimates)**		110

Certified: 40-49 points, **Silver:** 50-59 points, **Gold:** 60-79 points, **Platinum:** 80+ points

Figure 21: LEED ND Project Checklist and Assessment.