

**Housing Archetype Identification and  
Heating Flow Temperature Modelling Report**

**Community Heat Development Unit (CHDU) Project.**

**Funded by Energy Redress**

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on behalf of Shareenergy**

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## **Context**

Sharenergy commissioned Marches Energy Agency to undertake this housing archetype identification and modelling work to feed into the Community Heat Development Unit (CHDU) project that they are delivering on behalf of Energy Redress.

This project seeks to establish the feasibility of setting up district heating schemes powered by renewable energy technologies.

## **Purpose of this work**

1. Assess the feasibility of heating homes, within selected study areas, with a heating system flow temperature of 55°C in contrast to a base case of a 65°C. This factor underpins the financial viability of the District Heating scheme.
2. Identify the extent and costs of insulation works that would be necessary to make this flow temperature feasible.
3. Identify the extent and costs of upgrading radiators to K3 specification (triple panel) that would be necessary to make this temperature feasible.

## **The Study Areas**

### **Study Areas Selection**

Four study areas have been considered in this report:

- Maesrhandir and Trehafren areas of western Newport in Powys
- Attock Park area, Barkerend, eastern Bradford
- West End, Morecambe
- Jackmans estate, Letchworth

Sharenergy identified these areas as having heat network potential during the modelling and site selection stages of the CHDU project. Both sites include a range of different domestic building archetypes that may be well suited to connect to a heat network which also supplies nearby anchor loads. More information about the CHDU site selection process is available here:

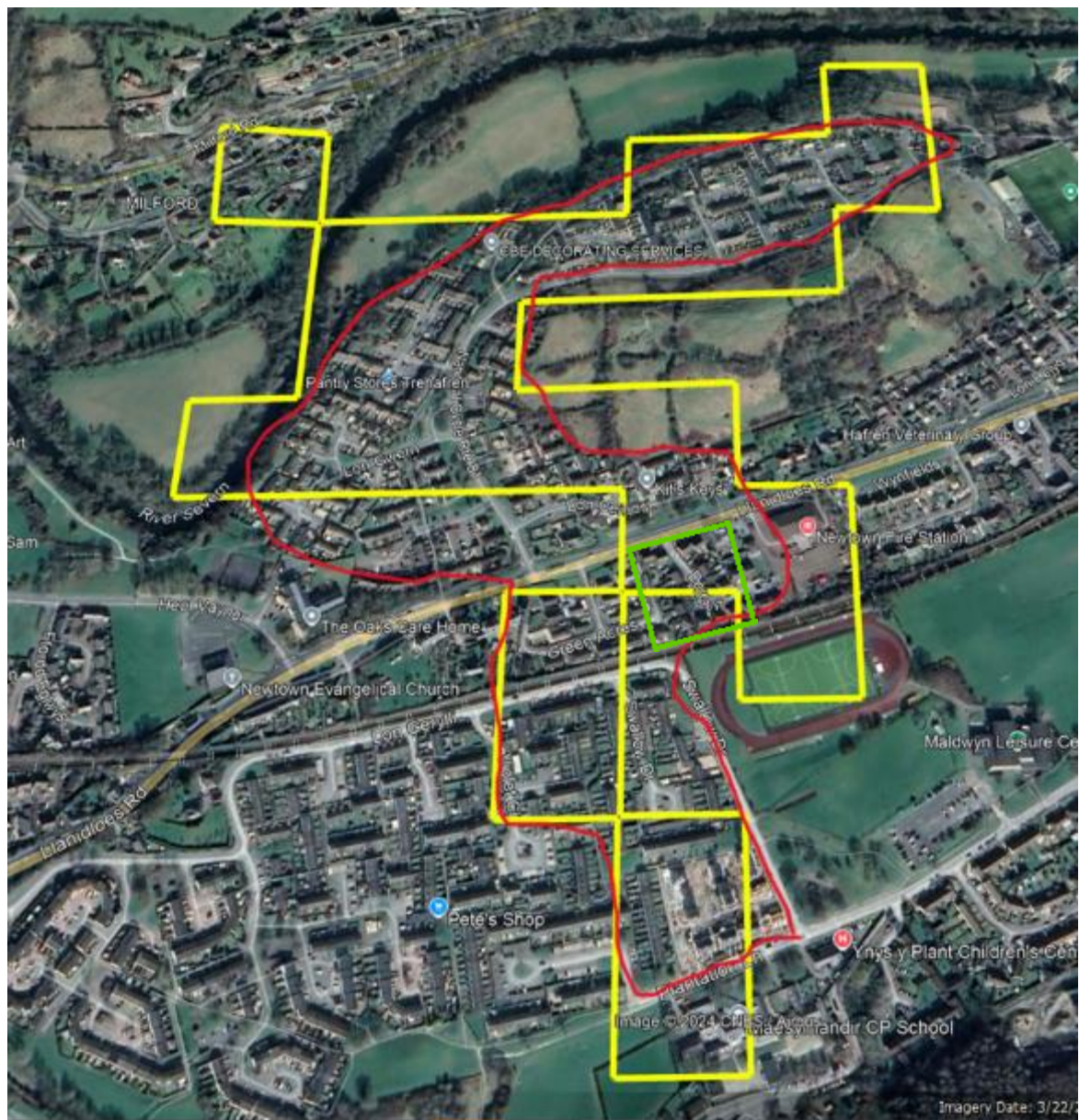
<https://www.communityheat.org.uk/interactive-map>.

## Study Area 1: Maesrhandir and Trehafren areas of western Newport in Powys

The housing aspects of this study area are characterised by the 1970s social housing estates of Maesrhandir, to the south, and Trehafren, to the north of the Llanidloes Road and the railway line. These homes form archetype N1 – outlined in red.

The small estates of Dolgoch and Green Acres lie between these two housing areas. Dolfach forms archetype N2. We were not able to model Green Acres due to lack of available EPC and online floorplan data.

The study area also contains the Newport Fire Station and is adjacent to the Maldwyn Leisure Centre.

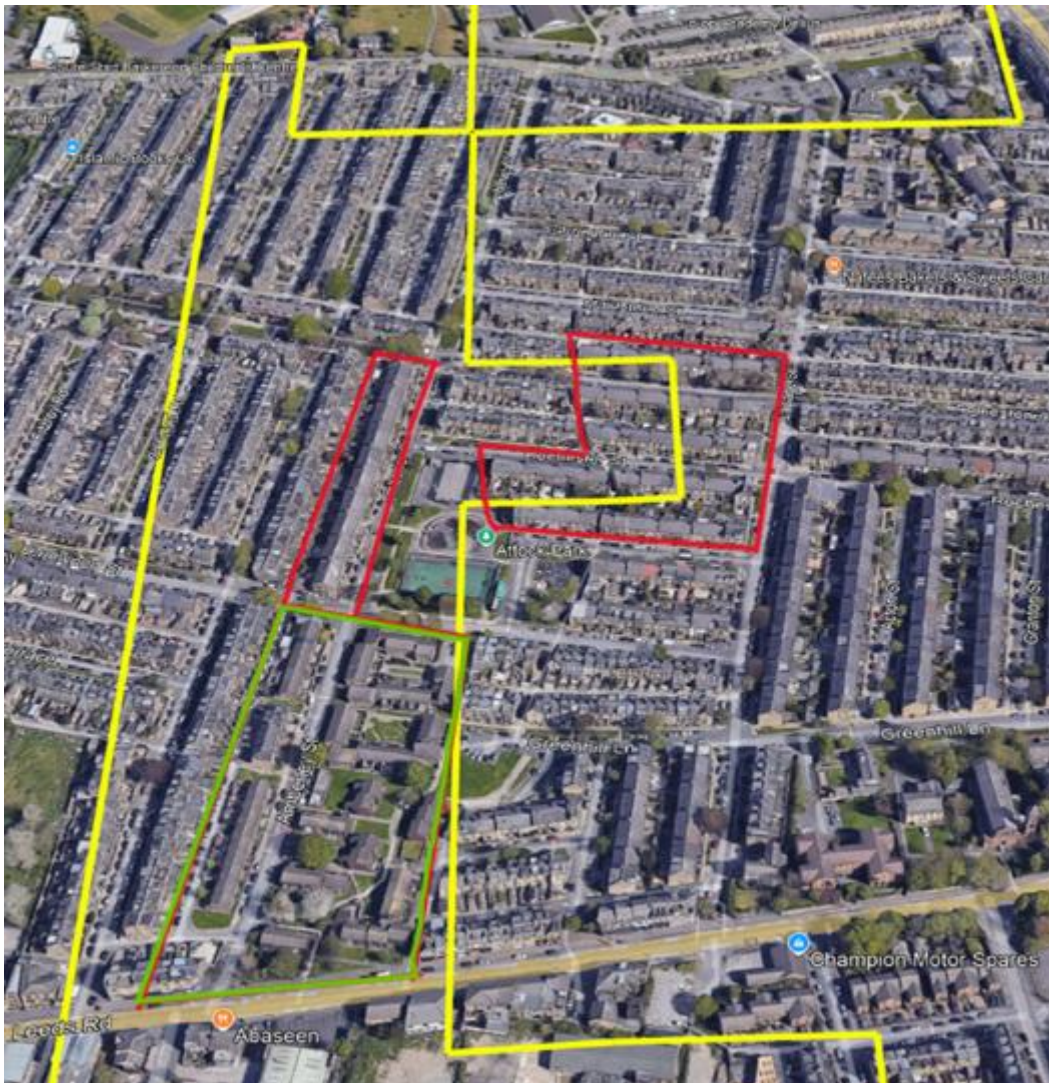


## Study Area 2: Attock Park area, Barkerend, eastern Bradford.

The Bradford study area incorporates light industrial areas to the north and south. The housing aspects of this study area are characterised by the terraces of solid wall victorian terraces lying between the Leeds Road and the Barkerend Road.

The archetype range was greater in this area, namely:

- Long terraces of ‘back to back’, indicated outlined in red below constitute Archetype B1 – outlined in red.
- The 1970s short terraces and flats outlined in green constitute Archetype B3 and B4 – outlined in green.
- The remainder of the area is formed of narrow fronted long terraces, the majority of which have room in the roof (RiR) accommodation in the lofts. These constitute archetype B2.





#### Study Area 4: Jackmans Estate, Letchworth Garden City

With this study area our attention is focussed on four blocks of 1960's low-rise flats located within the Jackmans estate, to the south-east of the town.

These buildings were constructed with brick 'skins' and mostly with flat roofs. Some of the four archetypes are seen repeated nearby.

The respective flats were modelled by floor level and whether mid or end terrace. Low levels of insulation were assumed based on epc data and no evident major fabric improvement programmes apart from pvc double glazing.



Blocks of Flats:

1. Radburn way - 20 x 2 bed maisonettes
2. Ivel Court - 32 Flats (4 floors above shops)
3. Lannock - 18 flats (6 central 2 beds & 12 end 3 beds)
4. Kyrkeby – 32 flats 2 bed flats (4 floors )

## **Methodology**

The housing archetypes were identified and modelled by way of desk based research, namely:

- Housing archetypes were identified via google maps on the basis of built form morphology. Street View enable identification of building types and variations.
- Construction age bands were identified by way of local authority planning registers, local history archives and old maps.

Old maps of the UK - See National Archive of Scotland -

<https://maps.nls.uk/geo/find/#zoom=16.6&lat=52.69684&lon=-2.52168&layers=30&b=10&z=0&point=52.90228,-2.51257>

- Building fabric types and floor areas were informed using the Energy Performance Certificate register:

<https://www.gov.uk/find-energy-certificate>

- House floor plans with room sizes were available online via Right Move/Sold House Prices:

<https://www.rightmove.co.uk/house-prices.html>

- Additional information regarding aspects such as proportion of social housing were available via Street Check.

<https://www.streetcheck.co.uk/> and <https://www.checkmystreet.co.uk/>

The Microgeneration Certification Scheme Heat Pump sizing tool was used to model the building archetypes under varying fabric insulation conditions and with heating system flow temperatures of 65°C and then at 55°C.

Identification of room by room heat losses under different conditions enabled the estimation of radiator sizes required.

This involved detailing the estimated:

- U-values for all building fabric elements (floors, walls, ceilings, doors, windows etc) and changing them in accordance with the varying insulation profiles.
- Dimensions for all building fabric elements room by room.

This generates room by room heat losses incurred by keeping the building heated to standard temperatures of:

- Bathroom - 22°C.
- Living rooms – 21°C.
- Other rooms – 18°C.

Base case radiator sizing for the archetypes was predicated on meeting the heat loss demands of the unimproved house at a 65°C flow temperature and what was considered to be typical for the size of the room. Thus a flow temperature of 65°C would not require insulation and radiator upgrades.

The table below, pertaining to archetype B2 demonstrates the reduction in building heat loss with improvements in building fabric insulation along with the corresponding reductions in radiator sizes.

Conditions	Heat Loss (kWhs)	min rad type at 55°C	Comment	min rad type at 65°C	Comment
Solid Wall, RIR, no Loft Insulation	6646	K2 & K3	K3 - RiR, Kitchen, Bath & Bed 2.	K2	All rooms
Solid Wall, no Loft Insulation	5021	K2 & K3	K3 - Bath & Landing	K1 & K2	K2 - Lounge, Kitchen, Bath & Landing
Solid Wall, 300mm Loft Insulation	4441	K1, K2 & K3	K3 - Bath & Landing	K1 & K2	K2 - Lounge, Kitchen, Bath & Landing
Solid Wall, External Wall Insulation, 300mm Loft Insulation	3072	K1 & K2	K2 - Lounge, Kitchen & Bath	K1	All rooms

The baseline or current condition of building fabric insulation was estimated on the basis of the following assumptions:

- The current level of social ownership on the Newtown estates is a valid indicator of the numbers of homes with external wall insulation, given that this was a housing association improvement programme. Information obtained via census data.
- Levels of loft and cavity wall insulation reflect relevant current national government statistics. (CWI – 70% & LI – 67%).

See – Energy Efficiency of UK Homes, House of Commons Library -

<https://researchbriefings.files.parliament.uk/documents/CBP-9889/CBP-9889.pdf>

- 95% of archetype B2 in Bradford have living accommodation in the loft space based on the presence of multiple skylights or dormers. It was estimated that 33% of these were uninsulated in line with loft insulation levels nationally. This is a critical assumption in the costing of this archetype given the very high levels of RiR accommodation indicated.

Costings of insulation works are based on the assumptions that:

- Loft, Room in Roof and Cavity wall insulation works will be completed before homes are connected to the heat network.
- Room in Roof insulation would cost £2,000.
- Installation of loft insulation would cost £1,000.
- Installation of cavity wall insulation would cost £1,500.

Insulation cost estimates are based on consideration of the following sources:

- Energy Saving Trust - <https://energysavingtrust.org.uk/energy-at-home/reducing-home-heat-loss/>
- Retrofit Academy – Retrofit design tools
- Marches Energy Agency – Recent contracts

Necessary upgrading of radiators to K3 (triple panel with 2 sets of convector fins) works are costed on the basis:

- Current K3 radiator prices. See – <https://www.bestheating.com/> and <https://www.justradiators.co.uk/radiators/compact-radiators/type-33-k3>
- Each K3 radiator replacement would require 2 heating engineers at an overall cost of £100 per radiator.

#### Wet Heat Distribution Systems:

- In Morecambe West there were 213 homes without central heating. These would require the installation of a wet heat distribution systems.
- Given the vey high incidence of flats and maisonettes in the area (72%) the costs of undertaking this work were estimated on the 'per floor' basis, with a 25% discount being applied for multiple floors.
- Cost per floor or flat was estimated as £1,500 on the basis of 6 radiators, TRV and associated pipework.

## **Study1: Newtown**

Archetype N1 - Maesrhandir and Trehafren Estates (n=499)

We believe these homes were built in the 1970s. They have brick cavity gable walls and ground floor elevations. The first floor front and rear elevations were constructed with timber frames and hung with tiles. It is assumed that they were built with minimal insulation.

Although there initially appeared to be considerable variety within the housing stock, with features such as flat, mono and dual pitched roofs, we recognised that there were fundamentally two sub archetypes characterised by floor areas of 72m<sup>2</sup> and 84m<sup>2</sup>. Both of these types appeared to have 2 and 3 bedroom variants.

These homes were configured mainly as short terraces with evidently different heat loss profiles between mid and end of terrace homes. These four variants were modelled separately.

There is evidence of a high proportion of these homes having been retrofitted with external wall insulation. We believe it is safe to assume that these homes were in social ownership at the time of these works and that a high proportion of them remain so.

This archetype was modelled in 4 scenarios:

1. As Built – No Cavity Wall Insulation (CWI) & no Loft Insulation(LI)
2. CWI & 300mm LI
3. EWI (no CWI) & 300mm LI
4. EWI, CWI & 300mm LI

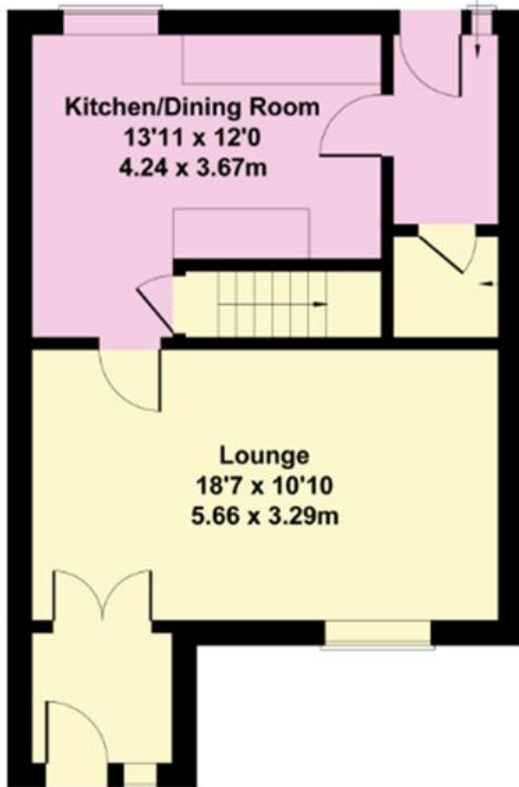




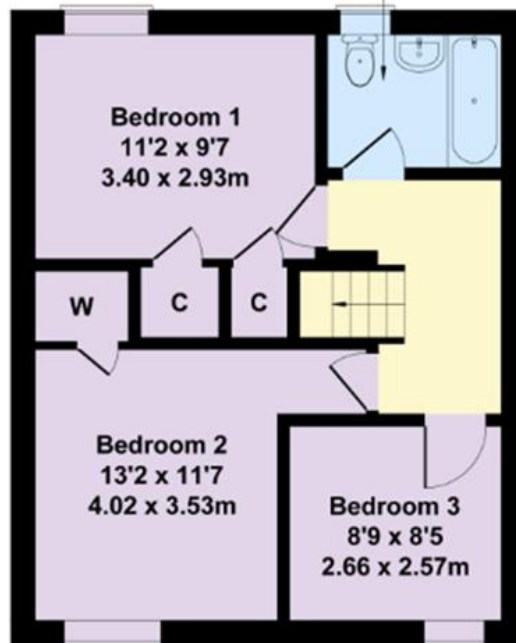
**Utility** 7'10 x 4'2  
 2.38 x 1.27m

**Store** 4'3 x 4'0  
 1.30 x 1.22m

**Bathroom** 7'2 x 5'5  
 2.19 x 1.66m



**GROUND FLOOR**



**FIRST FLOOR**

### **Newtown: Archetype N2 – Dolfach Estate (n=38)**

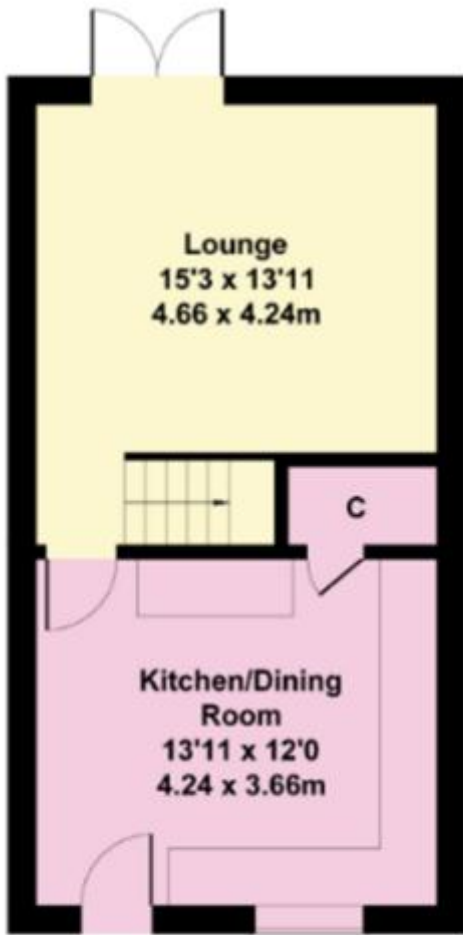
These two storey 3 bedroom, semi-detached homes were built around 1990. They are constructed with insulated cavity brick walls, tiled pitched roofs and double glazing. Total floor area is approximately 71 m<sup>2</sup>.

These have been modelled in 3 scenarios:

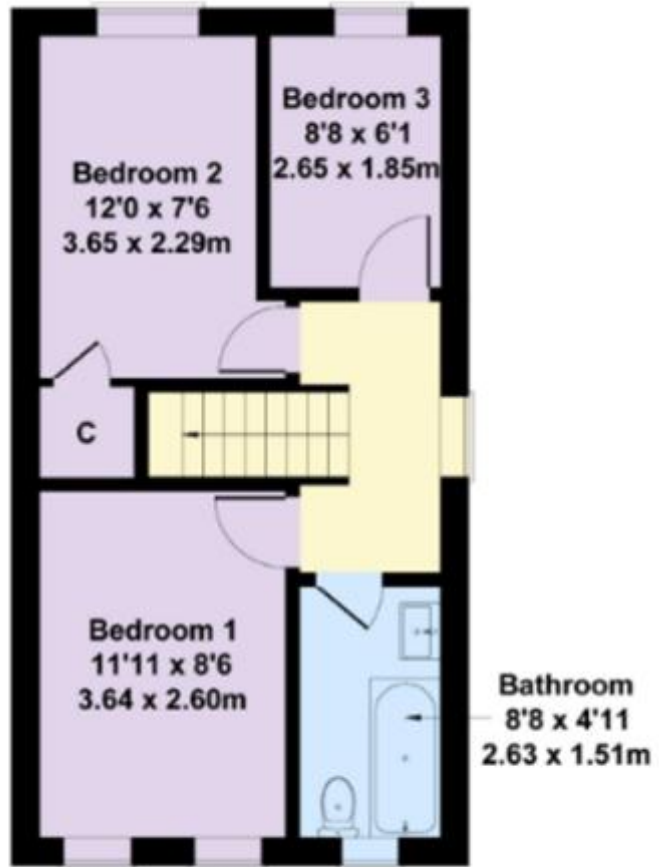
1. As built – filled cavity and 100mm LI.
2. Filled Cavity and 300mm LI.
3. EWI, CWI and 300mm LI.



Newtown. Archetype N2 – Floor Plan



**GROUND FLOOR**



**FIRST FLOOR**

## **Newtown Findings**

### Heating Circuit Flow Temperatures

A flow temperature of 65°C modelled as sufficient to heat all the archetypes without needing insulation or the installation of K3 radiators.

An additional sensitivity analysis was run at Newtown using a flow temperature of 45°C. This was found to be unfeasible even for with homes with external wall insulation (EWI) and 300mm of loft insulation (LI) needing more than K3 radiator upgrades in order to meet heat loss demands.

### K3 Radiator and Fabric Insulation Upgrade Requirements

A flow temperature of 55°C proved to be feasible with upgrading elements of fabric insulation and specific radiators to K3 (triple panel with two sets of convector fins).

At this temperature we gained the following insights:

#### Archetype N1:

- With no LI and no CWI present (estimated at 33%) K3 radiator upgrades would be needed in multiple rooms in both end and mid terrace and in both footprint sizes.
- With LI and CWI (estimated at 67%) present K3 radiator upgrades would be needed only in some bathrooms.
- With EWI and LI present (estimated at 68% in line with social ownership) K3 radiator upgrades would not be required.

#### Archetype N2:

- K3 radiator upgrades in the kitchen and lounge would be needed in all modelled scenarios.

### Newtown: Radiator and Fabric Insulation Upgrade Costs

Radiator upgrade costs have been estimated on the basis of the cost of required radiators plus £100 labour costs per radiator.

The specification of radiator upgrades assumes that loft and cavity wall insulation have been undertaken in line with national statistics for these measures, namely 67%. Thus leaving 33% needing to be insulated.

These factors were applied to 160 (32%) of the 499 homes in archetype N1 which are estimated to be privately owned. It was assumed that the social housing stock was all retrofitted with external wall insulation and loft insulation. This was informed by epc data and street view survey.

The costs of these fabric upgrade works have also been estimated on the basis of recent experience of purchasing similar measures within MEA and also cross referenced with Retrofit Academy and Energy Saving Trust.

Headline costs at 55°C flow temperature are presented in the table below.

Archetype	No. of Homes	Radiator Upgrade costs	Insulation Costs	Comment
1	499	£7,231	£131,736	LI & CWI in non-social homes n=160
2	38	£39,900	£12,540	LI in 33% of homes
Totals		£47,131	£144,276	

Average Costs per home if the upgrade costs were spread across all homes in the study area equate to:

- Radiator upgrades - £88/home
- Insulation upgrades - £269/home

Average Costs per home if the costs were only spread across homes requiring upgrades equate to:

- Radiator upgrades - £1,152/home
- Insulation upgrades - £2,000/home

### Upgrade Costs Details

Archetype	N1a (72m <sup>2</sup> )	N1b (84m <sup>2</sup> )	N2	Totals	Average Cost/ Home
Number (no. of homes)	250	249	38	537	
No LI <100mm (no. of homes)	26.4	26.3	12.54	0	
No CWI (no. of homes)	26.4	26.3	0	0	
Insulation Costs	£66,000	£65,736	£12,540	£144,276	Cost/Home in Study = £269
K3 costs (post insulation)	£7,231	0	£39,900	£47,131	Cost/Home in Study = £88
Insulation Costs/ Home Insulated	£2,500	£2,500	£1,000	£6,000	£2,000
K3 costs/ Home upgraded	£274	£0	£3,182	£3,456	£1,728

### **Newtown Conclusions**

This study area is characterised by a high proportion of improved social housing with external wall insulation (estimated at 68% of these estates). This has led to relatively low overall insulation and radiator upgrade costs.

At an average of £88 per home, the indicated radiator upgrade costs associated with running the heating system at 55°C is likely to be feasible.

## **Study 2: Bradford:**

Archetype B1 (n=166)

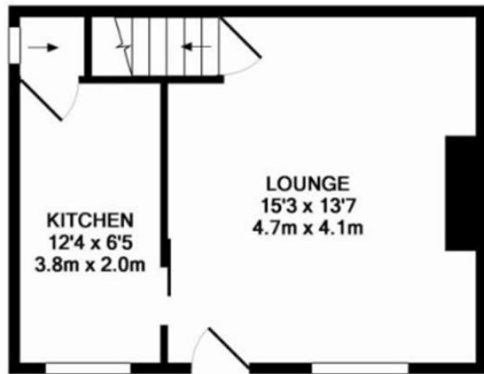
These Victorian houses are built with stone walls and slate roofs. An unusual characteristic is their configuration as 'back-to-back' terraces, with window and door openings only on one side. The rear facing 'frontages' are accessed via a passageway. The bedroom above the passage belongs to only one of the houses. This leads to neighbouring homes having different floor areas (58m<sup>2</sup> or 67m<sup>2</sup>), both configured as 2 bedroom homes, but with different size bathrooms. These constitute sub-archetypes 3A and 3B.

These have been modelled in 3 scenarios:

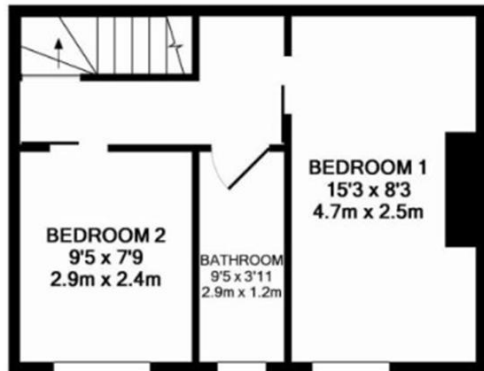
1. solid wall and no loft insulation
2. solid wall and 300mm of loft insulation
3. solid wall with external wall insulation and 300mm of loft insulation



Bradford: Archetype B1a – 58m<sup>2</sup>



GROUND FLOOR

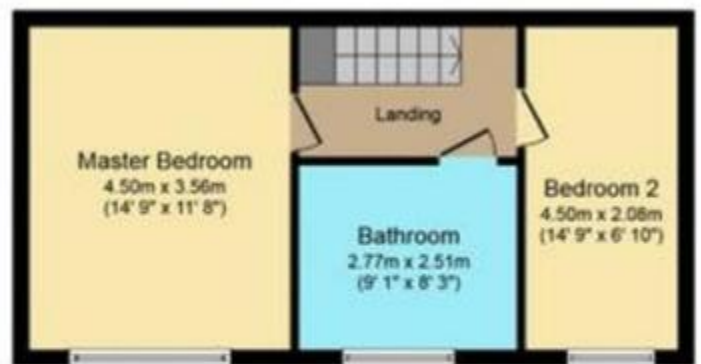


Bradford: Archetype B1b – 67m<sup>2</sup>



**Ground Floor**

Floor area 27.0 sq. m. (291 sq. ft.) approx



**First Floor**

Floor area 39.0 sq. m. (420 sq. ft.) approx

### **Bradford: Archetype B2 (n=511)**

These Victorian terraced houses, built with stone walls and slate roofs have dual front and rear aspects. The typical configuration is 2 bedrooms with an upstairs bathroom with a floor area of 56m<sup>2</sup>.

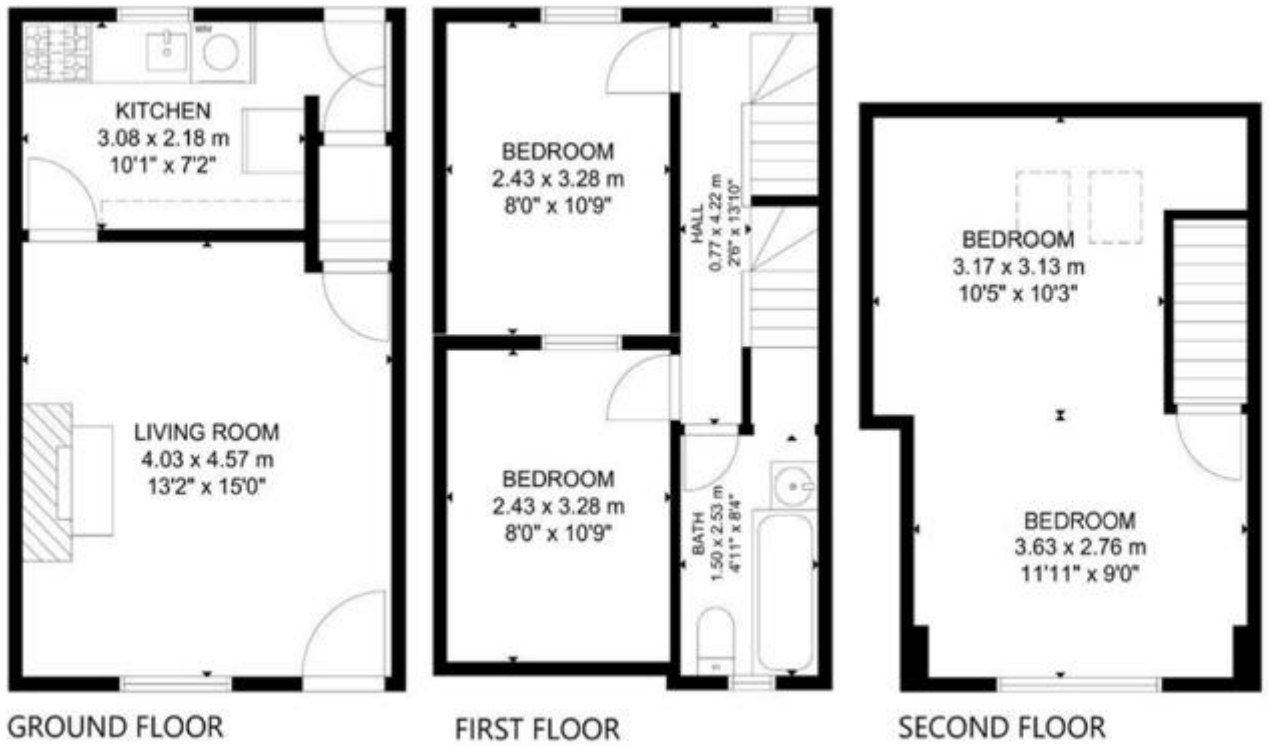
It appears that most of this archetype have some form of accommodation in the loft space. From the presence of box dormers and multiple sky lights it is estimated at 95% have some form of 'room in roof' (RiR).

These have been modelled in 4 scenarios:

1. solid wall with RiR and no loft insulation
2. solid wall and no loft insulation
3. solid wall and 300mm of loft insulation
4. solid wall with external wall insulation and 300mm of loft insulation



Bradford. Archetype B2 – Floor Plan



### **Bradford: Archetype B3 (n=86)**

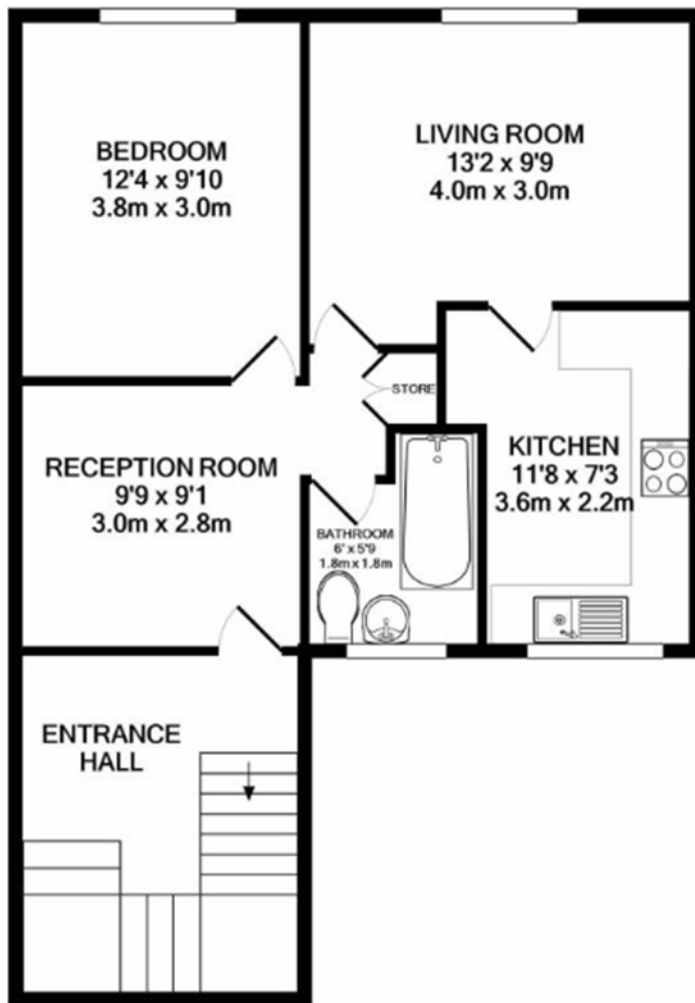
These 2-storey flats are built with brick cavity walls and tiled roofs, probably during the 1970s. They are configured as short terraces of 3 blocks. The top floor flat is accessed by an enclosed stairway to the rear elevation. The ground floor flat and the top floor flat constitute sub-archetypes B3a and B3b. Both have a floor area of 46m<sup>2</sup>.

These have been modelled in 3 scenarios:

1. Unfilled cavity wall and no loft insulation
2. Filled cavity wall and 300mm of loft insulation
3. Filled cavity wall, external wall insulation and 300mm of loft insulation



Bradford: Archetype B3 – Top Floor Flat



1ST FLOOR  
APPROX. FLOOR  
AREA 605 SQ.FT.  
(56.2 SQ.M.)

### Bradford: Archetype B4 (n=16)

These homes were probably built in the 1970/80s. They were constructed with brick cavity walls under tiled roofs. The cavities were probably uninsulated and lofts minimally so. The floor area is approximately 86m<sup>2</sup>.

These have been modelled in 3 scenarios:

1. Unfilled cavity wall and no loft insulation
2. Filled cavity wall and 300mm of loft insulation
3. Filled cavity wall, external wall insulation and 300mm of loft insulation



Bradford. Archetype B4 – Floor Plan.



## **Bradford Findings**

A flow temperature of 65°C was modelled as sufficient to heat all the archetypes without needing insulation or the installation of K3 radiators.

### K3 Radiator and Fabric Insulation Upgrade Requirements

A flow temperature of 55°C proved to be feasible with upgrading elements of fabric insulation and specific radiators to K3 (triple panel with two sets of convector fins).

At this temperature we gained the following insights:

#### Archetype B1a (67m<sup>2</sup>):

- Higher heat loss due to bedroom over passageway.
- Without LI these homes required K3 radiator upgrades in the kitchen, lounge and bathroom.
- With LI these homes required K3 radiator upgrades in the kitchen, bedroom 1 and bathroom.

#### Archetype B1b (58m<sup>2</sup>):

- With and without LI these homes required K3 radiator upgrades in the kitchen.

#### Archetype B2:

- With and without LI these homes required K3 radiator upgrades in the Bathroom and landing.
- With a RiR present these homes required K3 radiator upgrades in the attic rooms, Bed 2, Kitchen and Bathroom.

#### Archetype B3:

- Without LI or CWI both ground floor and first floor flats would require K3 radiator upgrades in the bedroom, diner and lounge.
- With LI and CWI the ground floor flats would require K3 radiator upgrades in the kitchen and lounge.

#### Archetype B4:

- Without LI or CWI these homes would require K3 radiator upgrades in the bathroom, landing, hall and lounge.
- With LI and CWI these homes would require K3 radiator upgrades in the hall and lounge.

### **Bradford: Radiator and Fabric Insulation Upgrade Costs**

The cost of possible heating system upgrades assumes that loft and cavity wall insulation have been undertaken in line with national statistics for these measures, namely 67%. Thus leaving 33% needing to be insulated. The costs of these fabric upgrade works have also been estimated.

Headline Radiator upgrade Costs:

- Total - £439,400 (£564/home)
- Total without RiR - £172,403 (c. £220/home)

Headline Insulation upgrade Costs:

- Total - £425,544 (c. £546/home)
- Total without RiR - £105,147 (c. £135/home)

Archetype	No. of Homes	Radiator Upgrade costs	Insulation Costs	Comment
B1a	83	£89,640	£27,390	Bedroom over passageway
B1b	83	£26,560	£27,390	
B2	26	£14,053	£8,432	LI in non RiR homes
B2 (RiR)	485	£266,998	£320,397	33% assumed uninsulated
B3	86	£26,230	£28,735	LI and CWI in flats
B4	16	£15,920	£13,200	LI & CWI in 33% of homes
Totals	779	£439,400	£425,544	
Totals w/o RiR	294	£172,403	£105,147	

Overview of Radiator and Fabric Insulation Upgrade Costs

Average Costs per home if the upgrade costs were spread across all homes in the study area equate to:

- Radiator upgrades - £564/home
- Insulation upgrades £546/home

Average Costs per home if the costs were only spread across homes requiring upgrades equate to:

- Radiator upgrades - £684/home upgraded
- Insulation upgrades - £1,361/home upgraded

## Upgrade Costs Details

Archetype	B1a (67m <sup>2</sup> )	B1b (58m <sup>2</sup> )	B2	B2(RiR)	B3a (GFF)	B3b (TFF)	B4	Total	Mean Costs/ Home
Number of homes	83	83	25.55	485.45	43	43	16	779	
No LI <100mm	27.4	27.4	8.4	0	0	14.2	5.3	82.7	
No CWI	0	0	0	0	14	15	0	29	
No RiR insulation	0	0	0	160	0	0	0	160	
Insulation Costs (£)	27,390	27,390	8,432	320,397	7,095	21,640	13,200	425,544	546
K3 costs (£)	89,640	26,560	14,053	266,998	26,230	0	15,920	439,400	564
Insulation Costs/ Home Insulated (£)	1,000	1,000	1,000	2,000	500	1,525	2,500	9,525	1,361
K3 Costs/Home Upgraded (£)	1,080	320	550	550	610	0	995	4,105	684

## **Bradford Conclusions**

This area of Bradford is characterised by high numbers of solid wall stone houses. These homes are hard to heat. This has led to relatively high radiator upgrade costs. External wall insulation has not been considered as part of this study due to the high costs involved.

The 'back to back' terraced nature of the Archetype B1 homes necessitates a through passageway. This brings in increased heat loss aspects particularly to the bedrooms above passageway. This is reflected in the higher radiator upgrade costs incurred in these homes.

Within Archetype B2 there are indications of high numbers of homes with lofts that are converted for living accommodation. This substantially increases insulation and radiator upgrade costs due to the high levels of heat loss often associated with this type of living space. Hence a 'saving' of £266,997 on radiator upgrades and £320,397 'saving' on insulation cost if RiR houses are removed from the programme. Our estimates assume that only 33% of these RiR conversions are uninsulated, whereas the number may actually be far higher.

### **Study 3: West End, Morecambe**

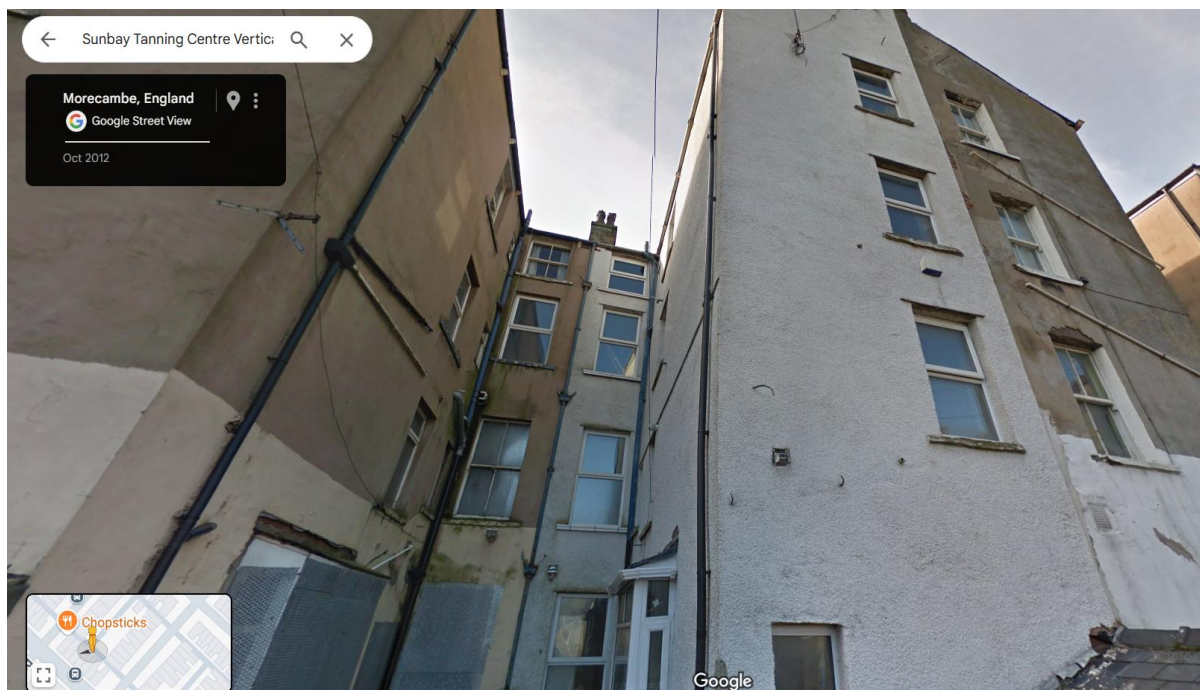
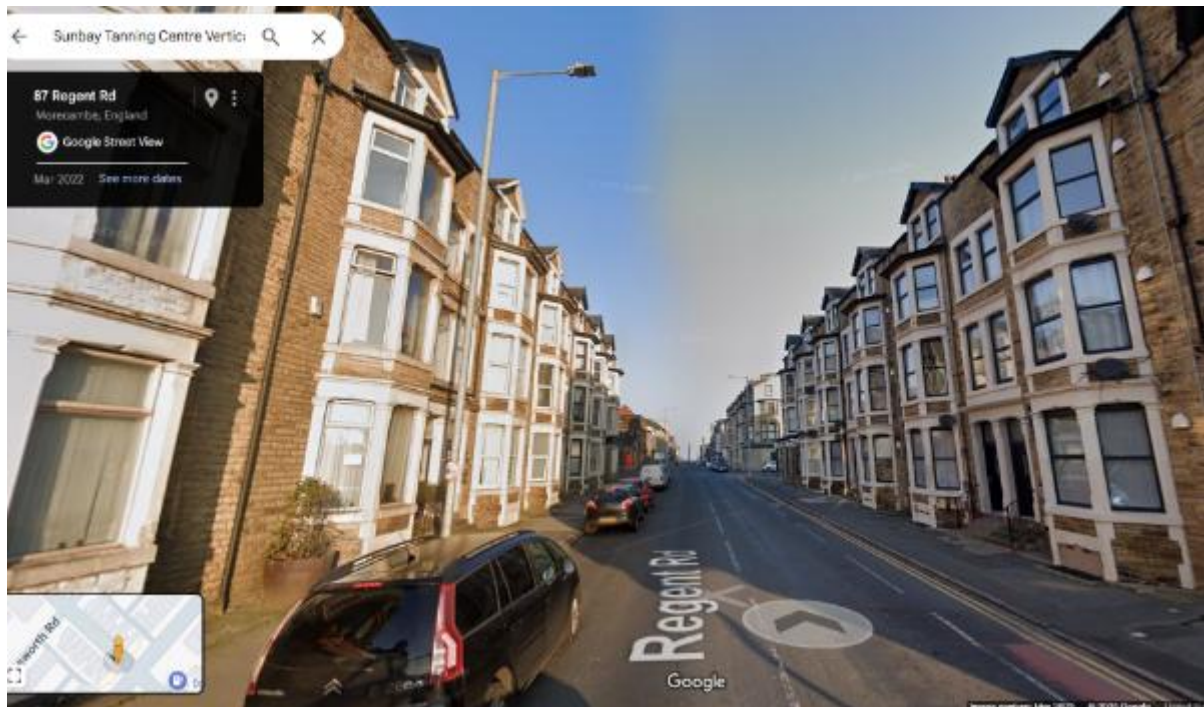
This area is characterised by large Victorian, terraced houses adjacent to the sea front in Morecambe, Lancashire. The buildings are 2, 3 or 4 storeys, constructed of brick under slate roofs. There are also many upper rooms with sloping ceilings and room-in-roof (RiR) rooms. The area is built to a high density with small rear yards and back lanes.

Built as single homes, many of these buildings have been subdivided into flats. The EPC data indicates that flats constitute 62% of the homes in the area, with 10% as maisonettes and 28% as whole houses. The sample includes 407 buildings configured as 787 homes.

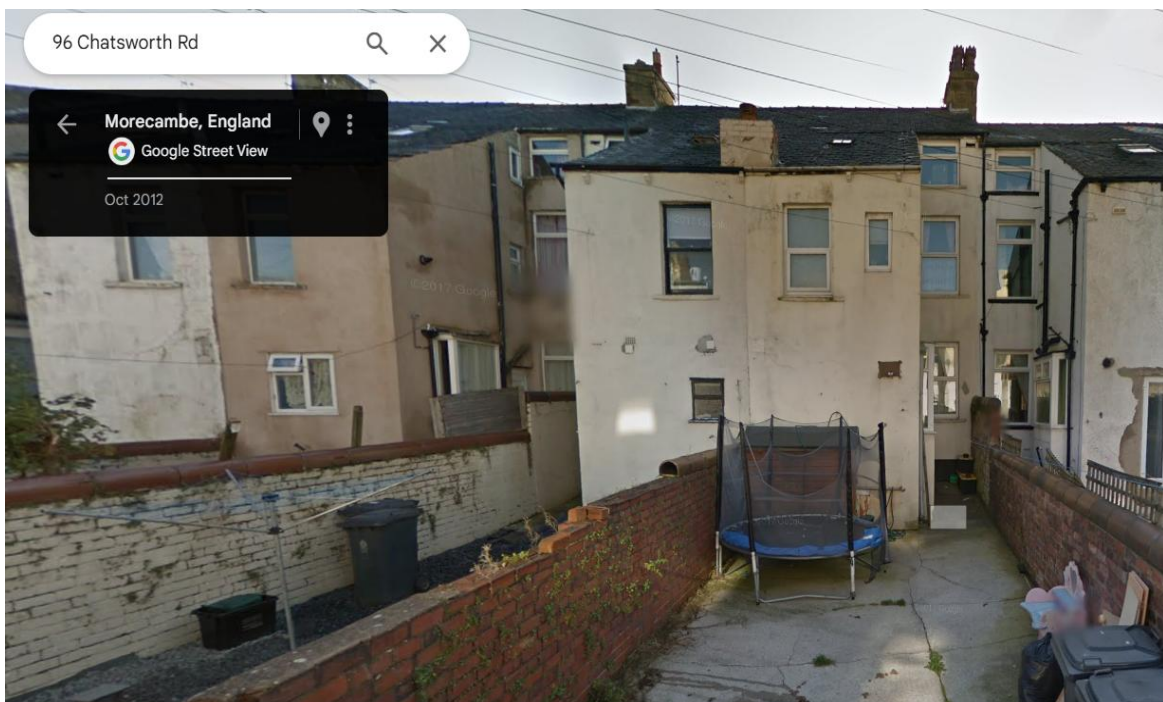
Given the complexity of the area and the high level of subdivision it was decided for the purposes of heat loss and fabric upgrade estimation modelling to treat each floor of each building as a flat. This modular approach then enabled us to construct the other housing forms from amalgamation of Ground floor, mid-floor and top floor flats. The nominal floor area was taken to be 49m<sup>2</sup>.

Images of the different configurations and some indicative floorplans are set out in the following pages.

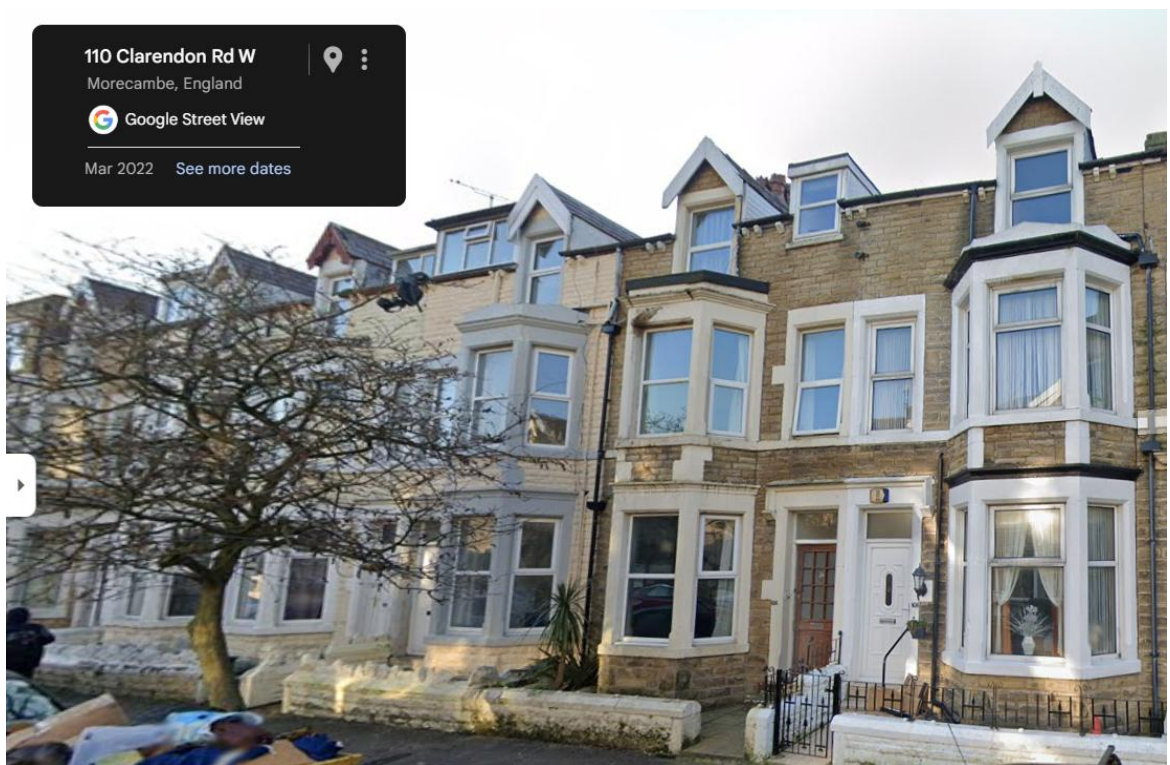
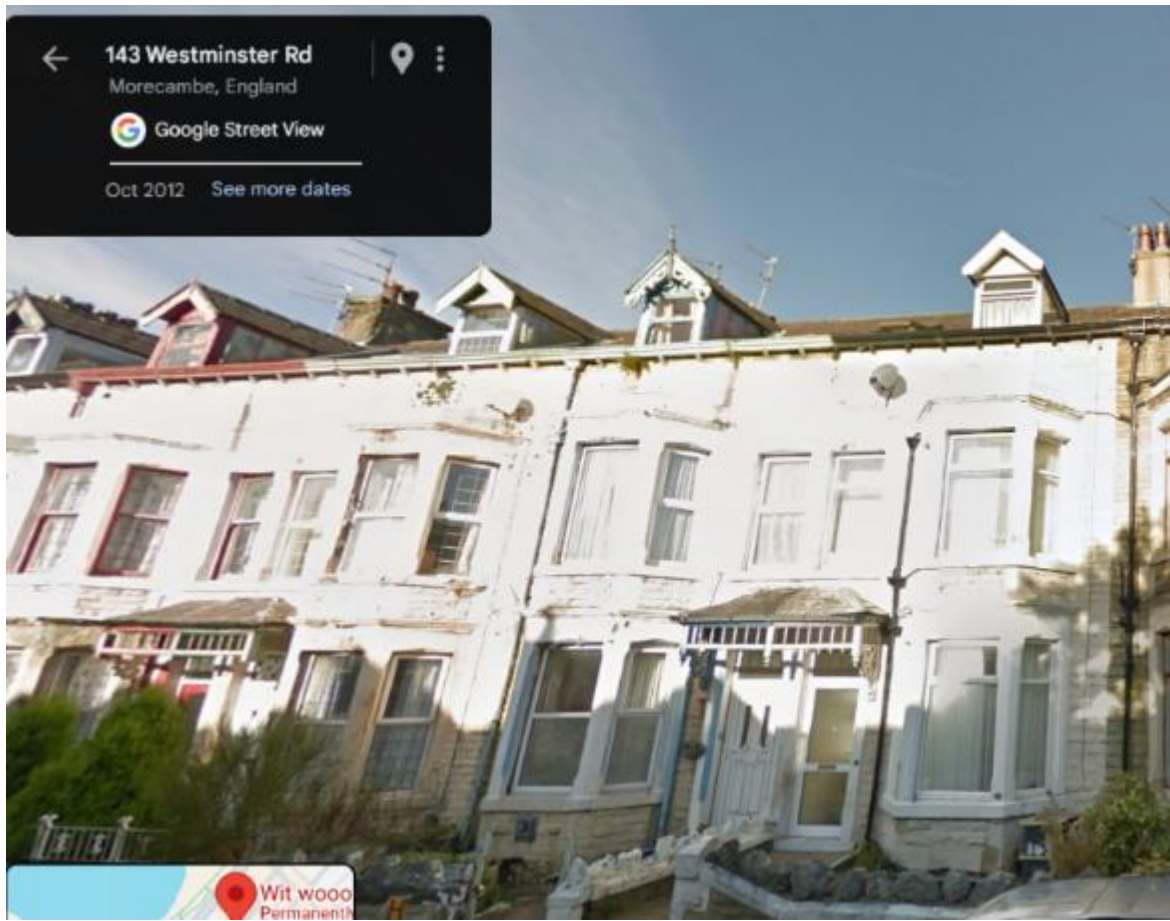
## Morecambe - Four Storey buildings



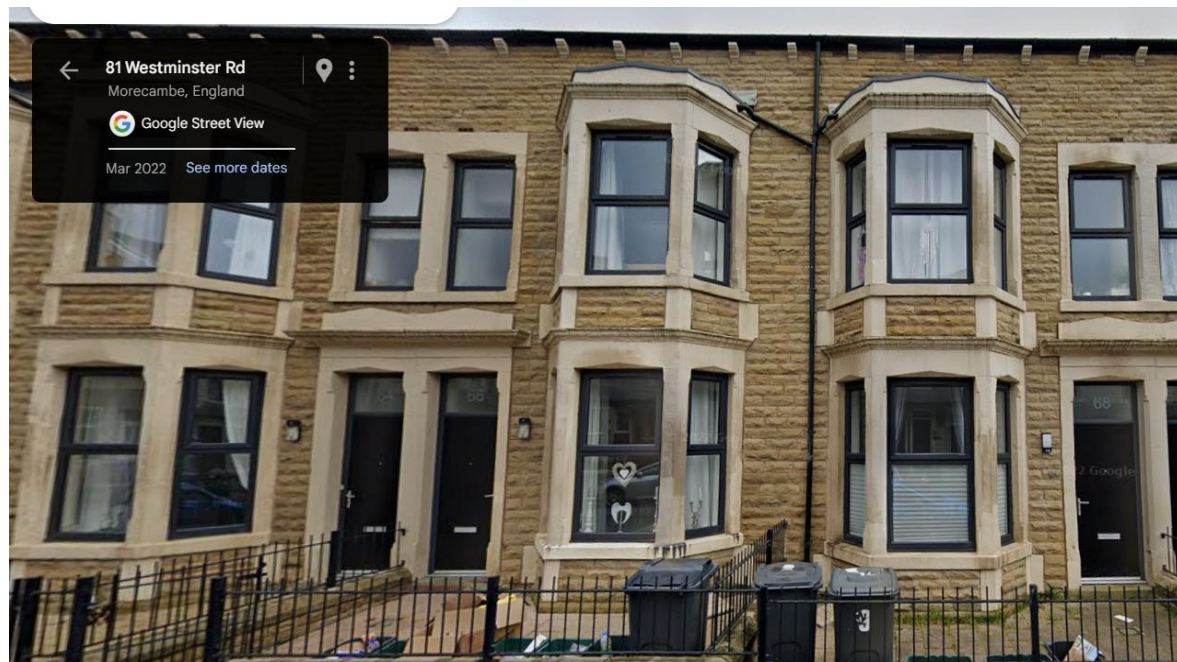
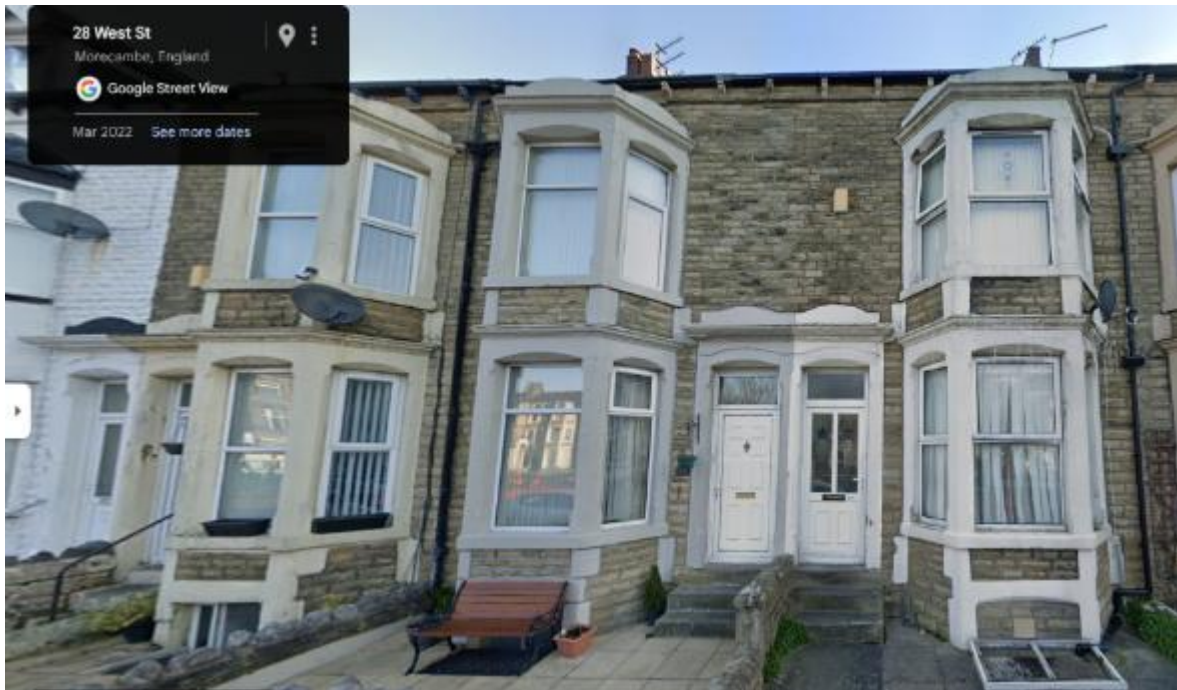
## Morecambe - Three Storey Buildings



Morecambe - Three Storey including Room-in-Roof



## Morecambe - Two Storey Buildings



## Morecambe - Indicative Floorplans for Modular Flat Layout



Total floor area 142.2 m<sup>2</sup> (1,531 sq.ft.) approx

This floor plan is for illustrative purposes only. It is not drawn to scale. Any measurements, floor areas (including any total floor area), openings and orientation are approximate. Details are guaranteed, they cannot be relied upon for any purpose and they do not form part of any agreement. No liability is taken for any error, omission or misstatement must rely upon its own inspection(s). Powered by [www.focalagent.com](http://www.focalagent.com)

### **West End, Morecambe Findings**

A flow temperature of 65°C was modelled as sufficient to heat all three levels of flats without needing insulation or the installation of K3 radiators. This enabled the profiling of the radiator sizing for the respective flats. Profiles of top floor flat and room-in-Roof insulation were then also modelled.

The necessary K3 radiator upgrades were then modelled for a 55°C flow temperature. This process indicated that with varying radiator upgrades it would be feasible to heat these homes at the lower temperature.

The Ground floor flats displayed higher heat loss than the midfloor flats due to heat losses via the ground, with the latter also benefitting from heated homes below and above.

The top floor flats and the RiR flats were profiled as having relatively large radiator sizes due to their high heat loss profiles. Without insulation the top floor flats would need K3 upgrades in the Lounge, kitchen and bathroom.

Once these have been retrospectively insulated the improvement in thermal performance leads to a low level of need for upgrading to K3 radiators.

In the top floor a K3 upgrade would be needed in the kitchen and in the RiR flats K3 would not be required.

The EPC heating and fuel profile for the area indicated that 213 homes did not have central heating and therefore could be without a wet heat distribution network. If these homes were to be connected to a district heating network this would need to be remedied. These would not include a boiler and ancillary plant such as a circulation pump, as these would be installed as part of the district heating HIU.

Wet heat distribution system installation costs were estimated, based on meta epc data for main heating fuel and heating type, which indicated that it would be required in 213 homes.

### West End, Morecambe: Fabric Insulation and Heating System Upgrade Costs

Improvements to upper floor insulation have been modelled in line with national rates of uninsulated lofts (33%) and to a standard of 300mm on flat ceilings and an equivalent of 100mm on all elements of RiR.

The estimated insulation costs totalling £71,990:

- Top floor flats ceilings (41 flats) - £41,630
- RiR (15 flats) – £30,360

The K3 radiator upgrade costs without insulation were £518,086:

- Radiators – £339,021
- Installation - £179,065

The K3 radiator upgrade costs with prior insulation works were £387,333:

- Radiators – £255,313
- Installation - £132,020

Wet heat distribution system installation costs were estimated to be £371,738 for the 213 homes (£1,500 per floor/flat, with a 25% discount for subsequent floors).

<b>Costs</b>	<b>Without Insulation</b>	<b>With Insulation</b>
Insulation TFF		£41,630
Insulation RiR		£30,360
K3 rads	£339,021	£255,313
K3 install	£179,065	£132,020
Wet Heat System (213 homes/flats)	£371,738	£371,738
<b>Totals</b>	<b>£889,825</b>	<b>£831,060</b>
mean cost/home	£1,130.65	£1,055.99

### Morecambe West End: Conclusions

This area, being characterised by substantial and tall solid wall, Victorian houses with a high proportion subsequently sub-divided into flats, has led to a relatively high potential cost profile when considering converting the area to low temperature district heating.

#### **Study 4: Jackmans Estate, Letchworth Garden City**

With this study area our attention is focussed on four blocks of 1960's low-rise flats located within the Jackmans estate, to the south-east of the town.

These buildings were constructed with brick 'skins' and mostly with flat roofs. Some of the four archetypes are seen repeated nearby.

The respective flats were modelled by floor level and whether mid or end terrace. Low levels of insulation were assumed based on epc data and no evident major fabric improvement programmes apart from pvc double glazing.

The blocks of flats modelled were:

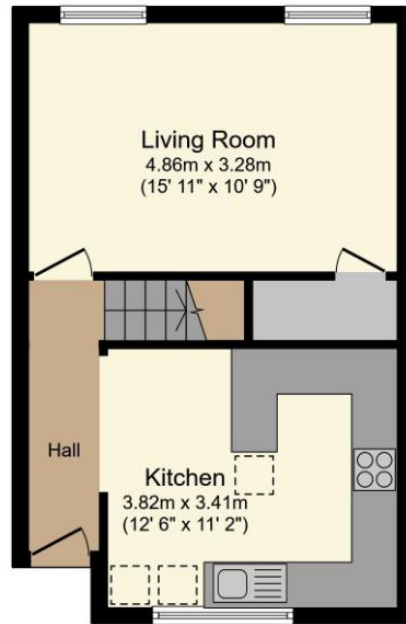
1. Radburn way - 20 x 2 bed maisonettes
2. Ivel Court - 32 Flats (4 floors above shops)
3. Lannock - 18 flats (6 central 2 beds & 12 end 3 beds)
4. Kyrkeby – 32 flats 2 bed flats (4 floors )

These are illustrated in the images and indicative floor plans set out in the following pages.

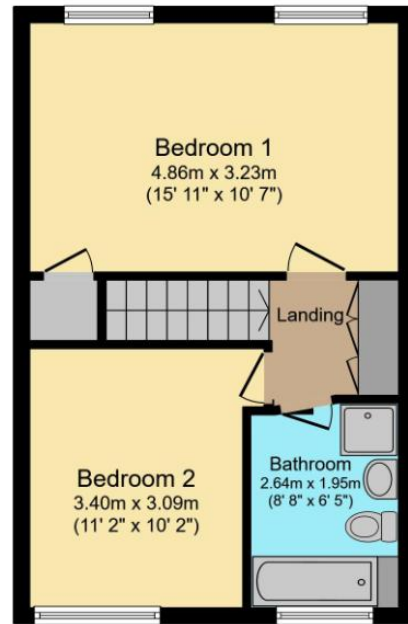
1. Radburn Way - 20 x 2 bed maisonettes



# Radburn Way - Indicative Floorplans



**Ground Floor**



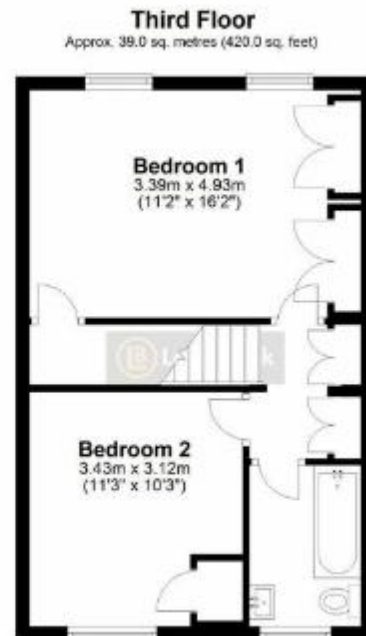
**First Floor**

Total floor area 74.0 sq.m. (796 sq.ft.) approx



**Second Floor**

Approx. 38.6 sq. metres (415.3 sq. feet)



**Third Floor**

Approx. 39.0 sq. metres (420.0 sq. feet)

Total area: approx. 77.6 sq. metres (835.3 sq. feet)

2. Ivel Court – 32 Flats (4 floors above shops)



Level Court - Indicative Floorplans

Ground Floor



TOTAL APPROX. FLOOR AREA 48.6 SQ.M. (523 SQ.FT.)

3. Lannock - 18 flats – 6 central 2 beds & 12 end 3 beds

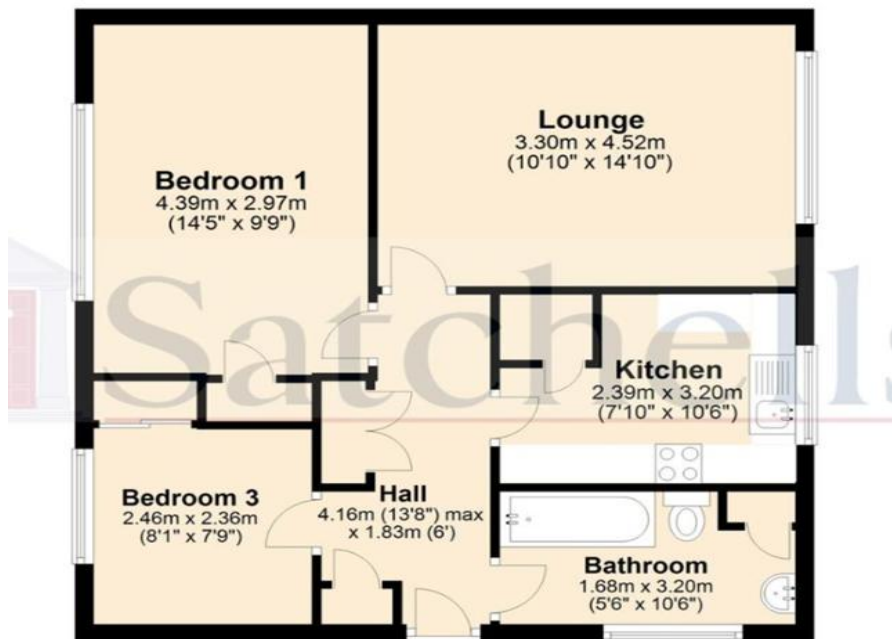


Lannock - Indicative Floorplans



TOTAL APPROX. FLOOR AREA 65.1 SQ.M. (701 SQ.FT.)

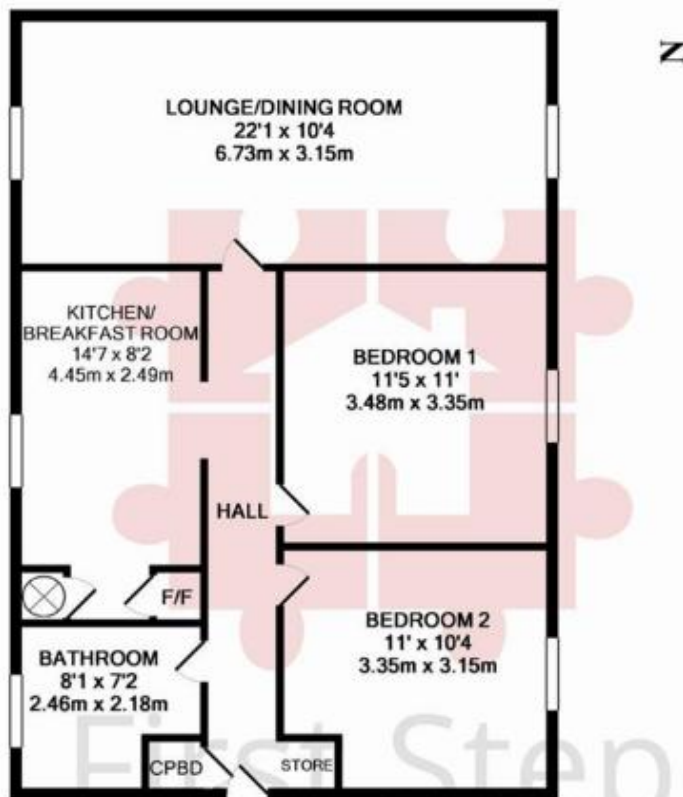
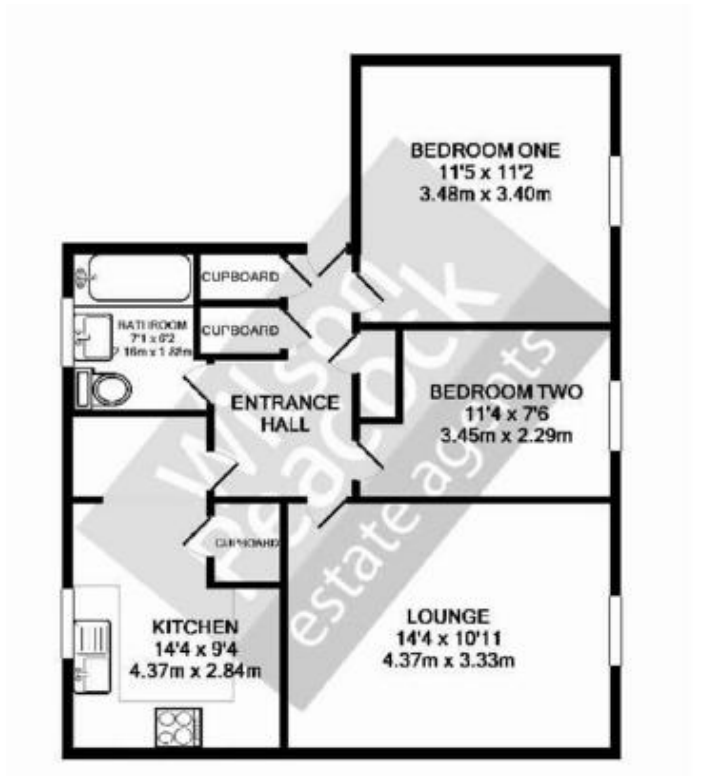
**First Floor**



4. Kyrkeby – 32 flats (4 floors )



Kyrkeby - Indicative Floorplans



LE084KB  
TOTAL APPROX. FLOOR AREA 706 SQ.FT. (65.6 SQ.M.)

### Jackman's estate, Letchworth: Findings

It has been assumed that cavity wall and flat roof insulation would not be installed as part of a district heating project given the level of co-ordination required to undertake this upgrade for a whole blocks of flats.

A flow temperature of 65°C was modelled with radiator sizes sufficient to heat all the flats without insulation or the installation of K3 radiators. This enabled the profiling of the radiator sizing for the respective flats. The necessary K3 radiator upgrades were then modelled for a 55°C flow temperature. This process indicated that it would be feasible to heat these homes at the lower temperature.

#### Radburn way - 20 x 2 bed maisonettes

Predictably the mid terrace homes were more thermally efficient than the end of terrace. The upper and lower maisonettes exhibited similar levels of performance with significant heat loss via the uninsulated roofs and also via the uninsulated concrete slab ground floor.

Upgrading the loft insulation to 300mm reduced the heat loss from the upper maisonette by around 20%.

The modelling indicated that K3 radiator upgrades would be required in the Lounge, kitchen, bedroom 1 and bathroom.

#### 2. Ivel Court - 32 Flats (4 floors above shops)

With the assumption of occupied space beneath the first floor flats, these performed better than the top floor and end terraced homes.

At a 55°C flow temperature, top floor flats would require K3 upgrades in all their rooms, whereas only Lounge and Kitchen upgrades would be needed in the mid-floor flats.

#### 3. Lannock - 18 flats (6 central 2 beds & 12 end 3 beds)

These flats follow an expected thermal profile with the uninsulated top floor flats (TFF) having about 25% more heat loss than the ground floor flats (GFF) and the mid-floor flats performing about 20% better than the GFF and 40% better than the TFF.

All the flats would need some level of K3 radiator upgrade, with the TFF needing upgrades in every room apart from the hall.

#### 4. Kyrkeby – 32 flats 2 bed flats (4 floors )

The heat loss profiles across the range of flat types modelled follows the pattern described above for Lannock. At the 55oC flow temperature the mid-terrace TFF would require upgrades in the lounge, kitchen, bathroom and bedroom 1, whereas the end terrace would need upgrades in all rooms.

#### **Jackman's estate, Letchworth: Fabric Insulation and Heating System Upgrade Costs**

The estimated loft insulation costs for the 10 upper maisonettes at Radburn way would be £10,000. The savings on radiator upgrades would be marginal however, due to overlapping heat output ranges.

The total K3 radiator upgrade costs for all the flats (102 homes) would be £91,140:

- Radiators – £59,940
- Installation - £31,200

The mean cost per home, without the cost of any loft insulation upgrades, would be £893.53.

#### **Jackman's estate, Letchworth: Conclusions**

In Letchworth, an area approach was not adopted. The cost of £893.53 per home reflects the hard to insulate nature of the buildings with all homes requiring some level of radiator upgrade.

## Overall Conclusions

Initial modelling indicated that a heating flow temperature of 65°C with typically sized radiators would be generally viable in most settings. This was then adopted as the base case for each archetype from which the viability of a 55°C flow temperature could be gauged.

Through detailed modelling it was established that a 55°C flow temperature would be adequate to heat a wide range of housing archetypes. This is predicated on the requisite upgrades to aspects of building fabric insulation and radiator profiles present.

The resultant cost per home varied considerably between areas. In Newtown it was low at £357 per home. This is due to the high proportion of homes (68%) that have been substantially improved by a social landlord with measures including external wall insulation and loft insulation.

In the Bradford it was high at £1,110 this is due to the high proportion of solid wall buildings with flats in uninsulated attic rooms.

At £1,055.99 per home, the profile in Morecambe was similar but with taller buildings and more mid floor flats. In addition there were 213 homes without central heating which would necessitate to installation of wet heat distribution systems.

In Letchworth, an area approach was not adopted. The cost of £893.53 per home reflects the hard to insulate nature of the buildings with all homes requiring some level of radiator upgrade.

Area	No. Homes	Mean cost/home	Comment
Newtown	537	£357	68% walls and roofs insulated by social landlord
Bradford	779	£1,110	Victorian solid wall with very high % of uninsulated RiR
Morecambe	787	£1,055.99	Victorian solid wall with high % of flats. Also homes without central heating.
Letchworth	102	£893.53	Non area focus with all homes being hard to insulate and requiring some radiator upgrading