

ZEST Task Group - Technical Working Group

Developing Net Zero Technical Solutions for Scotland’s Future Mass Retrofit Housing Programme

Proposal Paper:

*Development of a **Housing Net Zero Technical Task Force** involving a steering group and supporting working groups to support the design, development, testing, evaluation and delivery of the technical solutions, training and low carbon energy efficiency outcomes.*

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Overview

The following paper presents a structured programme to identify, design, develop and install retrofit solutions to support Scotland's net-zero ambitions for future mass roll out across the social housing, private rented and owner occupier housing stock. The process provides a feedback loop and key stages to track archetype solutions, performance and emissions reductions assessments both forecasted and delivered.

Whilst the focus on the immediate programme is towards the social housing stock involving Housing Associations and Local Authorities the technical evidence, performance data and other aspects gathered during the first phase would also provide useful information to support the private rented and owner occupier housing stock.

Scotland has over 2.5 million homes and has the highest flats/apartments proportion of the four UK nations at 38% (England 18%; Wales and N. Ireland approximately 10-12% each). This may lead to other complexities of varying tenancies over such a large proportion of homes which may impede uniform approaches to retrofitting whole blocks.

Over the last 20 years there have been a range of retrofit projects involving a wide range of house types trialling new fabric solutions and energy systems. However, the data and information is often isolated in separate domains and may also not include key parametric data for comparable analysis.

To meet the oncoming challenge but also the opportunity of the 'net zero economy' and mass retrofit required, it is recommended that a structured programme of robust archetype technical solutions is developed involving a wide range of stakeholders. These archetype solutions would then provide a standardised approach not only incorporating targeted energy saving measures, but also reductions in energy bill costs, tackling fuel poverty, whilst supporting more options for households to utilise their disposable incomes' and supporting wider health benefits. A key factor of such an approach is to increase the 'productivity' and flow through of retrofit projects where the housing and construction retrofit sector moves in unison to deliver and meet the immense task ahead.

Additional large scale benefits would include:

- Pan Scotland multi-sector housing and industry synergetic approaches
- Mapping and planning of mass upskill and training to install such solutions,
- Economic benefits pan-Scotland for installation and construction workers,
- Economic benefits for manufacturers and material product supply chains,
- Development and/or testing of existing and new innovative solutions both for fabric and energy systems (e.g. heat)
- Additional measures for health and safety which could be incorporated at the same time, such as improved fire resistance measures
- Alignment with other upgrading works to properties such as bathroom and kitchen installations.

1.0 Introduction

The paper is divided into several sections outlining a suggested structure and journey path for the development of standardised “archetype” retrofit solutions for the existing housing stock.

Whilst this does not preclude the new build housing stock, as some fabric and energy system ‘existing stock’ solutions may transfer into the new build sector, the predominance of the existing housing stock’s contribution to the net-zero target is significant. As such this paper focuses solely on the retrofit sector for net zero for the existing Scottish housing stock.

By 2045 the target year for Scotland’s net zero delivery, the new housing (if built annually at 25,000 units) would only account for approximately 0.9% per annum to Scotland’s stock profile. As such the total housing stock by 2045 will be composed of the 81% of existing housing stock built up to 2021 and 19% (new homes built 2021-2045).

Furthermore given the reduced energy requirements, running costs and emissions of new build housing built over the next 24 years versus the average existing housing stock, the operational emissions contributions of future new housing built is likely to be 10%, and may with further new technology improvements be less than 10%. As such at least 90% of the housing GHG emissions in 2045 may relate to existing stock built pre 2021.

2.0 Scale of Task Ahead

With approximately 2.6 Million homes in Scotland, which will require some form of retrofit of fabric solutions (new or upgraded) and energy system installation (given the future reduction in gas) and net zero targets, the scale of the task ahead is immense. It is important to also consider other pressures on market supply of low carbon material solutions, skills and energy systems in the UK and Europe, with 26 million and 330 million existing homes respectively. Both these large market sectors will require similar delivery of net zero retrofit measures over future timelines, as will other countries and continents.

Taking a normal year of 365 days and removing weekends, holidays and occasional delays due to bad weather it is likely that the working ‘calendar’ year would be approximately 230 days. Over 23 years (2022-2045) and the target year of 2045 for net zero outcomes this would require **113,000 homes** to be retrofitted per year, or **490** homes per day. Given the approximate 75:25 splits between privately owned (75%) and the combined RSL and LA housing stock (25%) this would equate to the number of homes being retrofitted per day as 368 private sector and 122 for RSL/LA. The UK as a whole would require to retrofit over 850,000 homes per annum and Europe over 11.5 million per annum.

This is on the basis that each home only needed to be visited once during the 23 years and all works could be undertaken in a day. This is of course unrealistic and it is also highly likely that as new energy technologies develop for hydrogen, or future advanced air source heat

pumps or new electric generating heating systems (e.g. microwave) come onto the market, the housing stock may require two or three waves of retrofit activity over the next 23 years.

Note: This is also in line with the strategy being put forward by RIAS in relation to 'wave' approaches to retrofitting the housing stock.

In addition, the non-domestic sector (which is more bespoke) will require a significant mass retrofit programme and this will place significant pressures and demands on available supplies of skills, materials and energy heating systems over this same period.

Furthermore, the growth required in electric vehicle charging point installations, electrification of other transport (shift from diesel for trains) and general growth in electric based systems will place further pressures on skills supply over the coming decade. The degassing of the grid and shift towards hydrogen (even for commercial and industrial process sites alone) may also create pinch points in workforce supply.

These areas also create many job opportunities and economic growth potential, however, if housing retrofit is undertaken with a bespoke and sporadic approach then this lowers productivity, increases potential for bottlenecks on skills supply given the range of diverse sectors competing for similar workforce skills sets.

Thus a standardised archetype approach to retrofit with forward pre-planning through tested solutions and pre-emptive readiness, common technical handbook of solutions and a matrix approach to assisting in choosing future energy systems with archetypes, provides possibly the best pathway to deliver net zero outcomes for all parts of Scotland, both urban and rural.

Through such an approach the industry, public sector, landlords and occupants can have greater certainty in delivery and performance outcomes. It also provides an opportunity for the whole housing, retrofit design and contractors sector to work with LABSS (Local Authority Building Standards Scotland) to have verified type approval retrofit archetype processes accepted pan Scotland, significantly improving productivity and delivery.

3.0 Structured Delivery and Oversight of Net Zero Outcomes for Housing

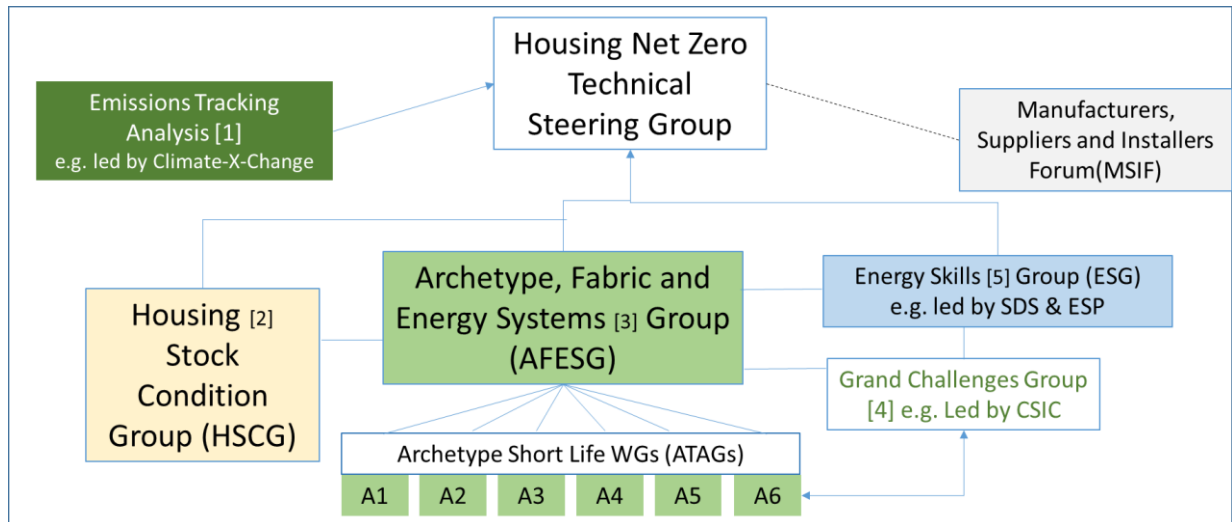
There have been a number of projects in Scotland involving test and development and the fitting of fabric energy efficiency improvements. However, some of the previous studies on energy retrofit have been sporadic and not centralised in terms of data collection, analysis and also in relation to independent third party scrutiny or not subject to post occupancy evaluations.

Given the scale of the task in delivery of net zero, complexity of diverse build types, the need for sector wide 'roll-outs' required of accepted technical solutions and the acceleration of skills and industry readiness, it is recommended that a specific programme is commenced which interlinks all of the various needs to deliver the required outcomes.

Specifically this paper recommends for the:

- Establishment of a **Net Zero Technical Task Force for Housing** to start as soon as possible
- The task force would be led by a **NZ Steering Group** involving officials from Scottish Government, Energy Efficiency Experts, Local Authorities, Housing Associations, Architects, Architectural Technologists, Academic's with strong experience of retrofit assessment, and Industry Retrofit Sector representatives and FE Skills & Training. Advisory roles from building control and planning would also be members of the steering group to assist with fire safety expertise and other regulatory and technical standards compliance.
- A primary subgroup proposed would be the **Archetype Fabric and Energy Systems Group** (AFESG). This group would form a series of specific short life **Archetype Technical Advisory Working Groups** (ATAGs) aligned to each or range of archetypes where similar solutions could apply. The specific focus would be on fabric, construction, design detailing, fabric performance, supply chains and skills and training. The ATAGs would also include energy systems experts to review and assess a range of non-gas and heating products, systems and technologies both existing and future systems solutions coming to market.
- To address specific archetype '**grand challenges**' or where complex solutions are needed, which require innovation support and R&D assessment (e.g. timber frame retrofit solutions) it is suggested that these archetype solutions are led by CSIC.
- To address skills and training delivery an **Energy Skills Group** would be formed, or linked to an existing SDS Energy Retrofit Skills Group, to deliver the follow on training, short courses and certification (if required) for installation of the archetype solutions.
- To fully understand the "existing baseline" it is suggested that an in-depth and updated Housing Stock Condition Survey should be undertaken by HA's and LA's to assist in mapping their existing stock, build, adaptations, previous retrofit measures and quantification measures. This will assist in tracking and working with the future mass roll out of key retrofit archetype solutions. This would be led and managed by the **Housing Stock Condition Group**. This could also provide information and data of the existing stock energy performance for previous retrofit measures that have been undertaken. This data will be very helpful to assess the delivery and need of various archetype technical solutions which arise from the AFESG towards net zero.
- Given the delivery of a mass roll out technical solution programme for net zero and the strategic importance of **manufacturers, suppliers and installers** it is suggested there should be a **forum** for this group (**MSIF**). This could feed into the technical solutions, advise on installation, 'works time periods' involved and engage with the new skills, upskilling and training supporting jobs growth and employment opportunities pan Scotland. By reaching across the MSIF sectors through such a forum (which would include trade bodies) will enable a pan Scotland involvement of the SME sector enabling and the Net Zero programme development.

Figure 1 illustrates the potential composition and structure proposed. The proposed composition of the Net Zero Technical Steering Group is shown in Figure 2.



1. Emissions Analysis – to map the macro emissions outcomes for various retrofit scenarios (fabric & energy)
2. Home Condition Analysis – (RSLs / LAs) existing and new survey data enhances condition knowledge
3. AFESG – Co-ordinate and assess data capture on previous fabric case studies, new retrofit pilots and solutions (SRPe & ETP) and energy systems. ATAGs short life working groups for key major archetypes report to AFESG.
4. Grand Challenges – e.g. CSIC (e.g. Timber frame housing solutions and non standard archetypes)
5. Skills group to map upskilling, new skills and sector macro training needs and delivery with SDS and trade bodies

Figure 1 – Proposed structure of the Housing Net Zero Technical Task Force, with technical steering group and specific working groups and forums.

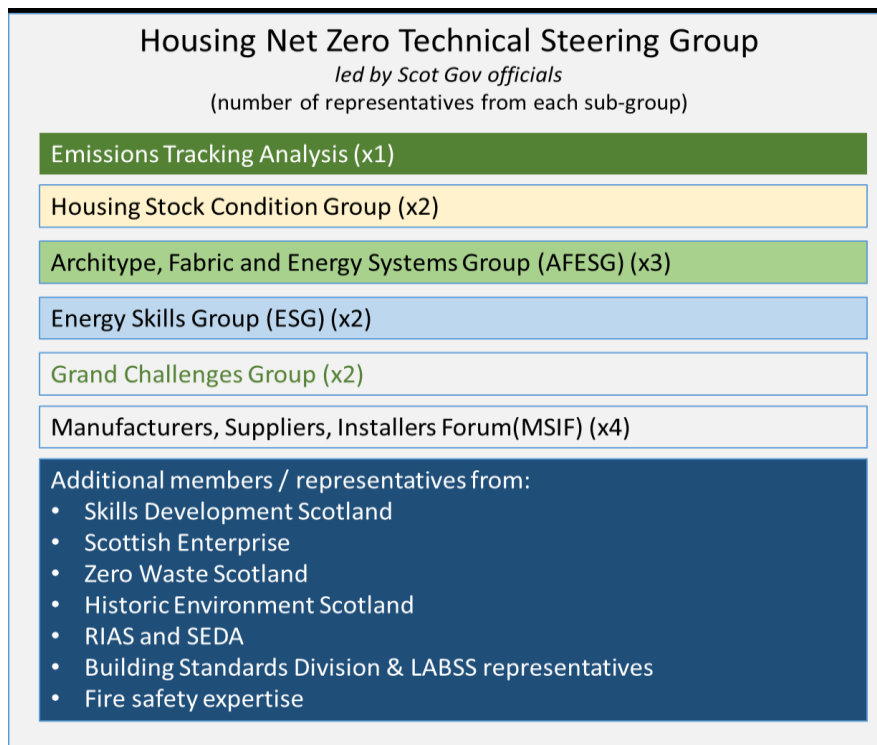


Figure 2 – Proposed composition of the Housing Net Zero Technical Steering Group, with members drawn from the various specific working groups, forum and public bodies.

4.0 Archetype Solutions

The programme would develop a series “archetype technical solutions” based on the core structural and external building materials and energy performance of specific existing housing types. Examples of the types of archetypes (and potential number of housing units involved in Scotland) are shown in Figure 3. It is likely that some of the archetype technical solutions for these build types could also be transferred into the non-domestic sector, such as offices located in pre-1919 build types. Archetype solutions would be evaluated and assessed for a number of factors, some examples of the areas to be considered are below:

- In-situ U-values
- Air tightness
- Workmanship factors, complexity of installation and installation time required
- Materials used and supply factors
- Ecology and Circular Economy
- Fire safety and parallel fire safety improvements during retrofit

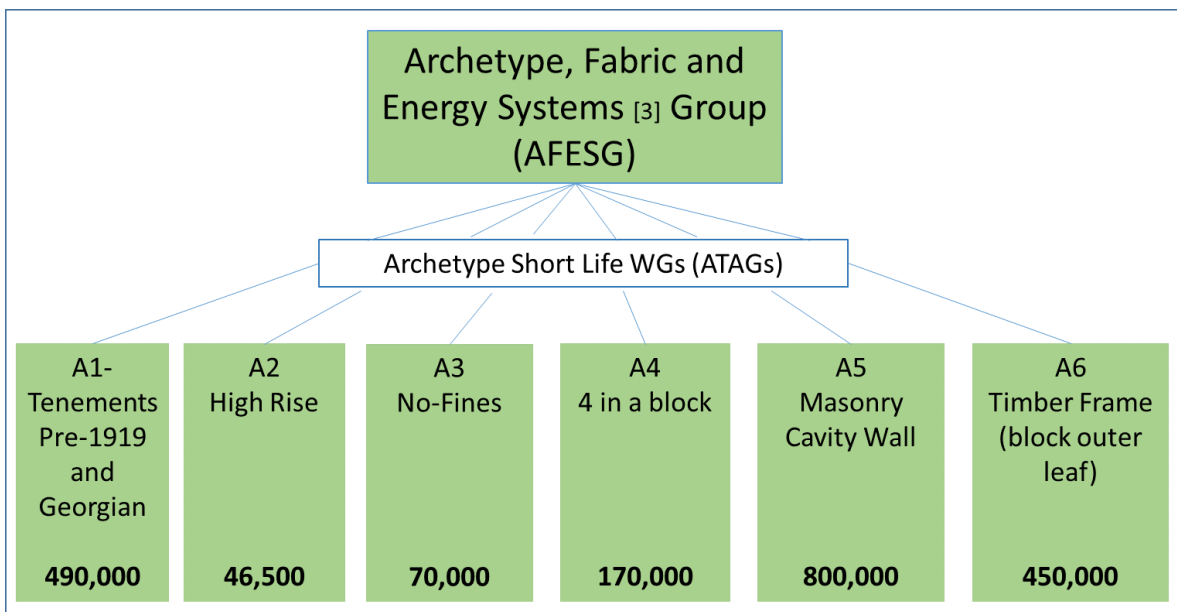


Figure 3 – Possible major “Archetype” groupings for fabric first assessment towards net zero delivery by the Archetype Short Life Working Groups (ATAGs).

Some of the key archetype existing housing systems with are:

External solid stone walls with lath and plaster finishes

- Pre-1919 Tenements, Pre-1919 houses, Pre-1919 terraced.
- Georgian buildings (some pre-1919 solutions may also be suitable for this build type)
- Some colony build types

- A-Listed buildings also of this same era and archetype but may have further restrictions on changes to cornices or other façade elements

Cavity block wall construction (or brick / block cavity walls) with plasterboard finishes

- Houses and Flats
- 4-in-a block
- 1930's to present day (houses and flats)

No Fines - cavity wall construction

- Some may be brick or standard block (with render) on external leaf or no fines both leafs with render

High Rise - precast or in-situ concrete slip form construction

- Variations in external wall compositions such as concrete panelised or hybrid panels
- Note: Currently due to ongoing fire safety upgrades on-going further more detailed information on each high rise systems builds may be available.

Timber frame (inner leafs) cavity wall – Using:

- Blockwork and render outer leafs, Brickwork outer leafs
- Houses and flats (typically max 3-4 storeys – although very few are 5 storeys)

Metal frame (inner leafs) cavity wall – Using:

- Blockwork and render outer leafs
- Brickwork outer leafs

(Note: some of the solutions developed for metal frame may align with timber frame)

Non Standard House Types

- Timber frame with timber cladding outer external wall linings
- Post war - prefabricated metal frame systems with variations in outer leafs

Defective House Types (PRC) in Scotland (10,400)

<i>Blackburn Orlit House</i>	<i>Boot House</i>	<i>Dorran House</i>	<i>Lileshall House</i>
<i>Lindsay House</i>	<i>Myton Clyde House</i>	<i>Orlit House</i>	<i>Tarran House</i>
<i>Tarran Clyde House</i>	<i>Tee Beam</i>	<i>Unitroy House</i>	
<i>Whitson Fairhurst House</i>	<i>Winget House</i>		

5.0 Development of Archetype Solutions

The development of the Archetype Net Zero Solutions would be led by ATAG short life working groups, brought forward via the Archetype Fabric and Energy Systems Group (which is composed of the chairs and co-chairs of each ATAG) for recommendation to the NZ steering group for future adoption and mass roll out. Such recommendations would be based on 'real' in-situ measured performance evidence of improvements and achieving the targets set by the NZ steering group. This could be key phases and approaches:

- Phase A – Fabric First
- Phase B – Energy solutions
- Phase A+B Partnership – Fabric First and Energy Solutions

Where insufficient or no energy efficiency measures have been installed it is recommended to focus on fabric first (Phase A). This will assist in reducing energy costs and reduce energy demand. This may also provide time to review for different energy systems options and a wider range to be considered and time to skill up the sector for installation of future energy system technologies 'at scale'.

Where fabric measures have already been applied and are sufficient then energy system solutions (Phase B) should be installed to reduce and replace existing fossil fuel energy heating sources.

Where possible, and to maintain the momentum of net zero outcomes both Fabric First and Energy Solutions could be developed in partnership. However, care should be taken given the advancements in heating and energy systems and the installation of heating systems too early may result in future deconstruction and replacement in later years. Also given the macro issues with gas, hydrogen and other energy supplies (which are outside the direct control of government) the primary initial focus is suggested to be aligned to fabric first relative to Archetype.

These 'evidence based approaches' for each ATAG could be drawn from **in-situ measured U-value changes AND air tightness testing evaluations**. These could be provided via:

- A. **Existing datasets** of energy efficiency performance improvements that have previously been undertaken

OR

- B. **New Pilot Project Data** over the coming 6-24 months which demonstrably achieves the performance improvements required. (Full details on data and measurements required would be set by the AFESG and Steering Group).

OR

- C. **Grand Challenge solutions**, where new innovative solutions are required and would involve a longer timeframe for assessment prior to mass roll out. It is suggested that the grand challenges solutions would be led by CSIC given the innovative solutions required.

Annex A, B and C (at end of this paper) outline the proposed pathways for all data, analysis, assessment and development for evidenced based approaches for A, B and C above.

This would provide the platform and approach to determine whether the solutions were compliant with the target performance levels, and if successful provide useful insights for development of:

- Standard Technical Details which could be provided via an online handbook for archetype solutions,
- Benchmark data for analysis with further interim Post Occupancy Evaluation (POE) to track performance and emissions reductions per archetype,
- Skills and training knowledge which could be embedded into short courses for pan Scotland roll out,
- Underpinning technical and skills information for use in training animations,
- Guidance for home occupants of what to expect for the retrofit works being planned.

It is recommended that all data would require to be third party assessed and independent. Data solely from product manufacturers (without third party) would not be included.

Data would be required to be based on testing in real buildings and not only modelling or laboratory testing for thermal changes. The exception being unless there was a specific "benchmark" test process which could provide 'top-up data' to support further assumptions (used in conjunction with field tested data submitted).

The NZ Steering group would request that each ATAG for the development of archetype solutions ensures that they are being assessed to be effective for the **whole portfolio archetype** for that specific existing housing stock (where possible).

6.0 Assessment, Development and Installation of Energy Solutions (heating)

To support the roll out of non-gas heating systems, renewable generated energy technologies and future innovations the energy technologies, the AFESG will include specialist experts in energy and heating systems to assess and review data on a range of alternative heating systems involving:

- existing energy systems data
- new energy systems data

All data submitted would require to be assessed by a third party. Solely product manufacturer data would not be accepted. The AFESG would then provide recommendations to the NZ Steering Group.

7.0 Whole systems development to support mass roll out

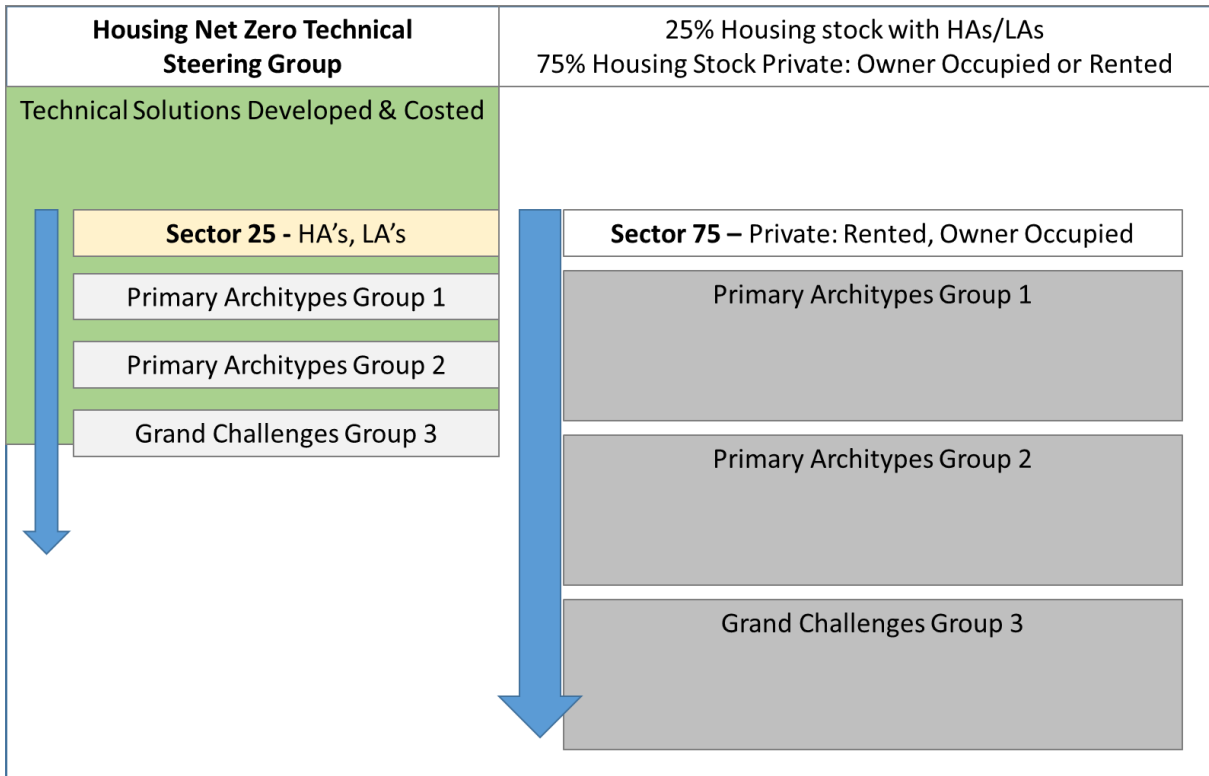
As solutions both in fabric first and energy systems come forward the intention would be to:

- publish such systems on a NZ Task Force website,
- provide technical specifications, design details and robust construction guidance supporting building owners, managers and the industry product manufacturers, suppliers and installers,
- use digital animations to support skills training (assisting pan-Scotland reach) and embed short courses, both as standalone for the industry but also within existing FE course programmes (where relevant),
- provide benchmark data to allow HA's and LAs the opportunity to assess their installations and programme of works and track their delivery and emissions reductions,
- provide regular forecasting on expected total emissions reductions, comparing also pre and post works emissions reductions estimates per archetype.

Given the range of existing archetype housing within HA and LA housing stocks, the prevalence of existing data and previous retrofit measures undertaken by this group (termed Sector 25) due to their management of approximately 25% of housing stock and the inclusive aim of supporting reductions in fuel poverty, the Sector 25 group are the potential key pathfinders in the development and first phase mass roll out of Archetype solutions.

This may provide a useful platform in staging the mass roll out of works across Scotland, providing a continuous program for employment, industry and delivery. This would assist material manufacturers, suppliers and installers to phase works over time in a structured pre-emptive planned approach for archetype solution delivery across all Scotland's housing stock.

Once the roll out program has commenced, which is likely to involve at least 2 primary "phases" for several key archetypes in each phase, and a grand challenges phase, this will provide in-depth data, costings and underpinning for future staggered roll outs for the Sector 75 group for the private owner occupied and rented sectors. In effect, given the Sector 75 group is 3 times the size of the Sector 25 group, the delivery of solutions derived from Sector 25 is fundamentally crucial to the successful future delivery and roll out for Sector 75.



8.0 Possible Next Stages

If such a proposal for moving forward was accepted the next stage would be the detailed breakdown of:

- Confirming composition of Steering Group,
- Suggested Composition of AFESG and the ATAG short life working groups for Archetypes,
- Discussions with SDS on composition of skills group to optimise delivery and reach,
- Remits and timelines for Steering group, AFESG, ATAGS and planned deliverables and reporting structures,
- Discussions with Climate-X-Change, ZWS, Scottish Enterprise, SDS and CSIC on roles, partnerships and inputs.

It is proposed that the NZ Task Force would report to the Climate Emergency Group at Scottish Government and provide regular updates to the industry leadership group (ILG) Construction Scotland, ILG Future Skills Group, SFHA and COSLA.

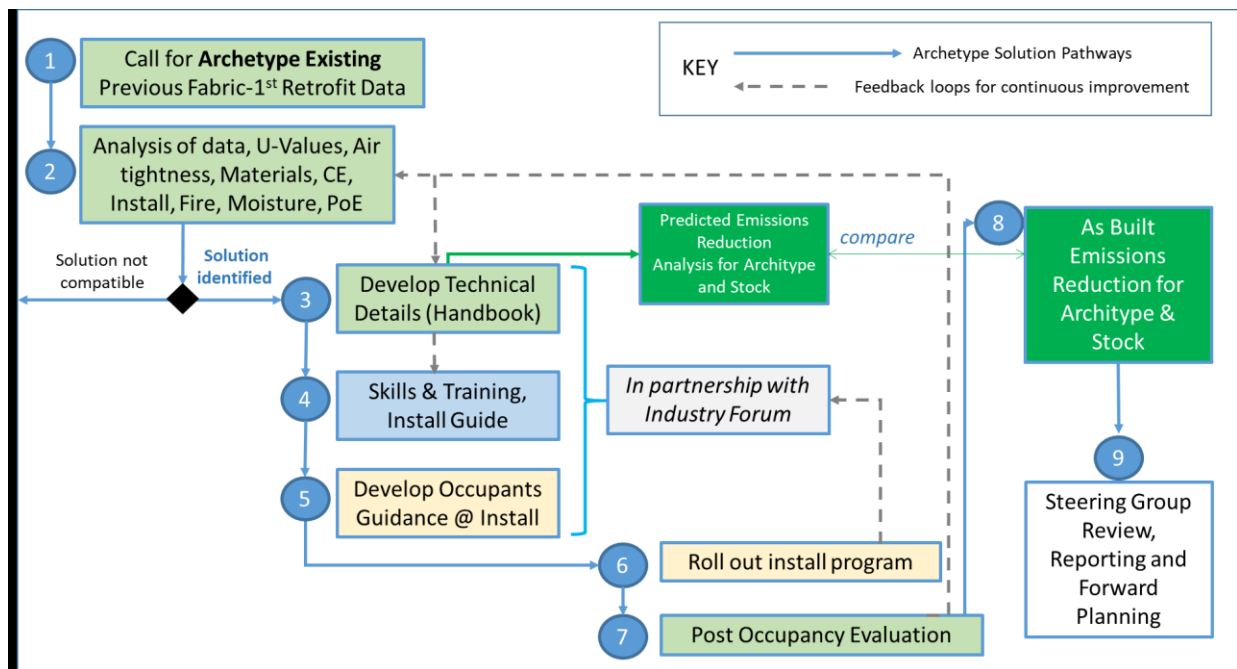
Key industry sector trade bodies to work with at early stages and in the formation of the Manufacturers, Suppliers and Installers would include SELECT, SNIPEF, Solar Trade Association, Federation of Master Buildings, Scottish Builders Federation and others.

9.0 Summary

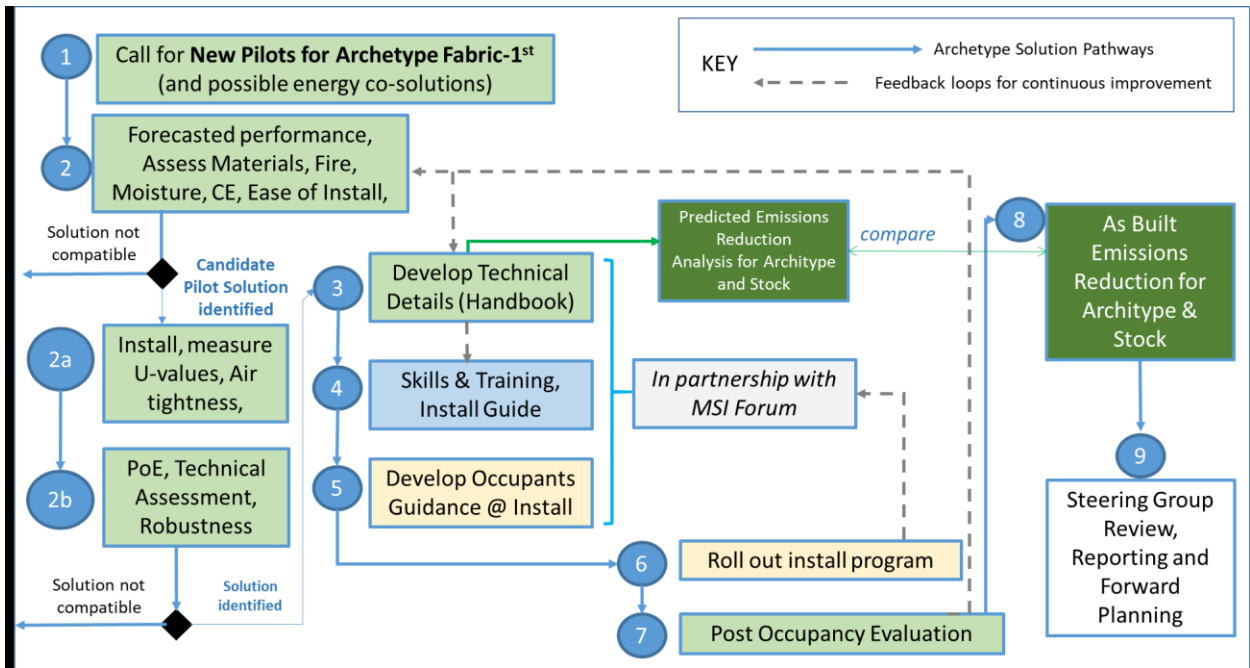
To achieve Net Zero outcomes over an entire sector of the built environment (such as existing housing) ultimately requires the whole sector to move in a solutions driven approach ‘as one’. By combining the very best of all skills, expertise, knowledge exchange and innovation this will underpin and enable the installation workforce to deliver ‘archetype’ repeatable solutions improving productivity, quality and reducing waste.

Time is now of the essence and it is recommended that if this proposal was accepted it would require a focused and rapid formation of the various Task Force groups, to enable the sector to maximise the pilot projects and opportunities for testing and assessment for the coming winter 2021-22.

ANNEX A – Using Existing Data Sets for Archetype Solutions



ANNEX B – New Pilot Projects for Archetype Solutions



ANNEX C – Grand Challenges Archetype Solutions

