Agenda Item No. 7(b)

South Ayrshire Council

Report by Depute Chief Executive and Director of Housing, Operations and Development to Cabinet of 23 September 2025

Subject: Ayrshire Energy Masterplan

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1. Purpose

1.1 The purpose of this report is to provide an update on the progress of the Ayrshire Energy Masterplan, agreed at a meeting of South Ayrshire Council on 23 November 2021; note the final strategy report; and inform Cabinet as to the next steps that the Council will take to support the implementation of the plan.

2. Recommendation

2.1 It is recommended that the Cabinet:

2.1.1 notes the contents of the Ayrshire Energy Masterplan final report and that the development of the high level plan is now complete; and

2.1.2 notes and approves that Council officers will work to support the implementation of the plan in partnership through participation in the Clean Growth workstream of the Ayrshire Growth Deal and the Energy sub group of the Sustainability Strategic Delivery Partnership (SDP) of the South Ayrshire Community Planning Partnership (CPP). Recommendations within the AEM which accord with South Ayrshire Council's LHEES will be progressed through the LHEES. Housing Services will continue to progress energy efficiency improvements to the Council's domestic portfolio.

3. Background

3.1 The requirement for an Ayrshire Energy Masterplan was identified by the Clean Growth workstream of the Ayrshire Growth Deal and subsequently embedded in the Ayrshire Regional Economic Strategy. At its meeting on 23 November 2021, the Council agreed a funding contribution of up to £30,000 to allow the development of the Ayrshire Energy Masterplan and that officer support was required to develop and implement this work. In January 2022 a meeting was held to establish a working group of officers from South Ayrshire Council, East Ayrshire Council, North Ayrshire Council, Scottish Enterprise and University of the West of Scotland to help deliver this strategy. This officer group developed the tender specification and consultants Atkins Realis were appointed to support the creation of the masterplan. Officers worked with Atkins Realis to develop this strategy culminating in the final strategy being completed in March 2025. A copy of the final document is attached as Appendix 1.

3.2 The key objectives of the masterplan are to firstly present a pathway to net zero energy use that maximises socio-economic benefits for Ayrshire, secondly act as a framework to be a catalyst for investment in energy infrastructure and thirdly shape intervention strategies and pathways to ensure a just transition to net zero. The masterplan focusses on achieving reductions in energy use and the decarbonisation of energy sources that will support our target of net zero emissions by 2045.

3.3 Whilst providing a direction of travel across the three Ayrshire's the Ayrshire Energy Masterplan has implications for work in South Ayrshire. Firstly, officers will pursue the overarching objectives through the Regional Economic Strategy and Ayrshire Growth Deal and the South Ayrshire Local Outcome Agreement, in particular the Energy and Travel priorities. Secondly, Asset Management will continue to deliver property interventions (to include management, generation, retrofit, behavioural and rationalisation) across the built estate. Thirdly Housing Services will continue to deliver energy efficiency and net zero interventions in the Councils domestic portfolio and ensure that new-builds meet all relevant standards. Fourthly, the masterplan contains recommendations to be progressed alongside our Local Heat and Energy Efficiency Strategy (LHEES) especially with regard to heat networks and heat network zoning.

4. Proposals

4.1 Members are asked to:

4.1.1 note the contents of the Ayrshire Energy Masterplan final report (see Appendix 1) and that this plan has now been developed and finalised; and

4.1.2 note and approve the ongoing work of officers through the LHEES, Housing Services and partnership working to support the implementation of the plan.

5. Legal and Procurement Implications

5.1 The recommendations in this report are consistent with legal requirements.

5.2 The recommendations in this report are consistent with procurement requirements.

6. Financial Implications

6.1 There is an approximate project underspend of £15,000 with a share of this to be returned to the Council.

7. Human Resources Implications

7.1 Report recommendations will be delivered through existing resources.

8. Risk

8.1 ***Risk Implications of Adopting the Recommendations***

8.1.1 There are no risks associated with adopting the recommendation.

8.2 ***Risk Implications of Rejecting the Recommendations***

8.2.1 Rejecting the recommendation may increase the risk that the Council will not meet its statutory obligation for net zero by 2045.

9. Integrated Impact Assessment (incorporating Equalities)

9.1 There are no significant potential positive or negative equality impacts of agreeing the recommendations therefore there is no requirement to carry out an Integrated Impact Assessment.

10. Sustainable Development Implications

10.1 **Considering Strategic Environmental Assessment (SEA)** - This report does not propose or seek approval for a plan, policy, programme or strategy or document otherwise described which could be considered to constitute a plan, programme, policy or strategy.

11. Options Appraisal

11.1 An options appraisal has not been carried out in relation to the subject matter of this report.

12. Link to Council Plan

12.1 The matters referred to in this report contribute to Priorities 1, 2 and 3 of the Council Plan: Spaces and Places/ Moving around and the environment (Outcome 1), Live, Work, Learn (Outcome 2) and Civic and Community Pride (Outcome 3).

13. Link to Shaping Our Future Council **Yes ☑** **No ☐**

13.1 The matters referred to in this report contribute to the Council's transformation priority area(s): our assets and our delivery model, supporting energy efficiency, net zero targets, maximising asset use, sustainable development, and data and analytics development.

14. Results of Consultation

14.1 There has been no public consultation on the contents of this report.

14.2 Consultation has taken place with Councillor Martin Kilbride, Portfolio Holder for Buildings, Housing and Environment, and the contents of this report reflect any feedback provided.

15. Next Steps for Decision Tracking Purposes

15.1 If the recommendations above are approved by Members, the Depute Chief Executive and Director of Housing, Operations and Development will ensure that all necessary steps are taken to ensure full implementation of the decision within the following timescales, with the completion status reported to the Cabinet in the 'Council and Cabinet Decision Log' at each of its meetings until such time as the decision is fully implemented:

Implementation	Due date	Managed by

Support the implementation of the plan with recommendations within the AEM which accord with South Ayrshire Council's LHEES to be progressed through the LHEES	31 September 2026	Service Lead – Asset Management and Community Asset Transfer

Background Papers **Report to Leadership Panel of 23 November 2021 - Ayrshire Energy Masterplan**

Ayrshire Energy Masterplan Website

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Date: 3 September 2025

Appendix 1

AtkinsRéalis

Final Report

East Ayrshire Council, North Ayrshire Council, South Ayrshire Council, Scottish Enterprise, & The University of the West of Scotland

March 2025

Ayrshire Energy Masterplan

AtkinsRéalis - Baseline / Référence

Notice

This document and its contents have been prepared and are intended solely as information for East Ayrshire Council, North Ayrshire Council, South Ayrshire Council, Scottish Enterprise, & The University of the West of Scotland and use in relation to present evidence, considerations, and recommendations for the finalisation of the Ayrshire Energy Masterplan.

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This document has 84 pages including the cover.

Document history

Document title: Final Report

Document reference: EAC AEM Final Report

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for Review – Sections:	UM	WW	DL	DL	19/02/2024
2.0	Revised draft following feedback and incorporation of Work Package 4	UM	WW	DL	DL	17/05/2024
3.0	Revised draft following further feedback	UM	WW	WW	DL	05/09/2024
4.0	Final Version	WW	UM	DL	DL	05/11/2024
5.0	Formal Issue	UM	WW	DL	DL	10/03/2025

Client signoff

Client	East Ayrshire Council (Procuring Authority), North Ayrshire Council, South Ayrshire Council, Scottish Enterprise, & The University of the West of Scotland
Project	Ayrshire Energy Masterplan
Job number	5220472
Client signature/date	

Tables

Figures

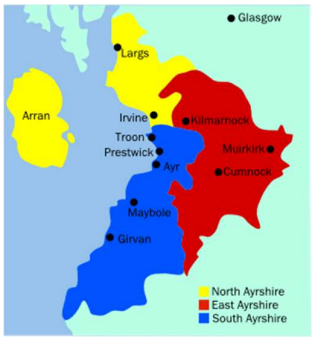
Executive Summary

Forming a crescent shaped wedge in the Southwest of Scotland, Ayrshire includes three council areas of East Ayrshire, North Ayrshire and South Ayrshire, including the Isle of Arran, Great Cumbrae and Little Cumbrae.

With a population of approximately 370,000, covering an area of 1,301 square miles, the region is known for its spectacular coastlines, fertile farmlands, tourism, renowned golf courses and the birthplace of Robert Burns.

With a wealth of natural resources and an ambition to implement a pathway to net zero, this report sets out key activities Ayrshire Councils will undertake to face climate change head on.

(Image Source: Regions in Scotland: A Simple Guide | Wayfaring Kiwi)



(Image Source: MapOfAyrshire - Ayrshire - Wikipedia

Working with key partners Scottish Enterprise and University of West of Scotland, the Ayrshire Councils set out key objectives for the Ayrshire Energy Masterplan to:

- Present a **pathway to net zero energy use** that **maximises socio-economic benefits for Ayrshire.**
- Act as a framework to be a **catalyst for investment in energy infrastructure.**
- Shape intervention strategies and pathways to ensure a **just transition** to net zero.

Focusing on Heat, Transport and Power, the recommendations and action plan set out in this document set the framework to support a just and equitable transition to net zero for Ayrshire, providing guidance, direction and focus for communities, businesses and stakeholders on our journey to net zero and face the challenges of the climate emergency.

A review of energy use in the region assessed **Ayrshire's greenhouse gas emissions associated with energy use are estimated to be 2.23 $MtCO_2e$/year** however, 83% of this comes from transport, domestic and non-domestic gas use. The majority is from Transport.

(Image Source: Gas Flame | Quick shot of my gas cooker. | Thomas | Flickr by @ARRGch)

Significant steps have already been made in reducing carbon emissions associated with electricity production and it is recognised that more needs to be done to ensure that the electricity infrastructure is prepared to allow for increased electricity production from renewable sources and getting this energy to where it can be used, supporting

both low carbon transport and heating solutions. The overall target adopted by the AEM is for Ayrshire to achieve **net zero emissions by 2045** in line with Scottish Government targets.

Through the stakeholder engagement undertaken as part of this masterplan development process, it is clear that there is an appetite do more but there are barriers preventing this. It's a daunting task that will require all stakeholders to be brought on the journey to net zero. Ayrshire has incredible examples of community engagement especially in rural areas such as North Ayrshire's Green Island Programme, Isle of Arran and Isle of Cumbrae, and the Scottish Government Carbon Neutral Islands (CNI) Project, on the isle of Cumbrae.

The masterplan focuses on achieving reductions in energy use and decarbonisation of energy sources which contribute towards achieving net zero. To achieve net zero, whole life carbon and sequestration need to be accounted for, however these activities were not the focus of this masterplan and further work will be required.

Quantitative targets in relation to energy use were identified in line with the LHEES methodology. Other priorities and considerations were identified through the stakeholder survey and several follow-up interviews.

Heat network priority zones have been identified through the standard LHEES methodology and are set out in section 5, with opportunities to be investigated at Drongan, Cumnock, Kilmarnock, Ayr, and Irvine

Building efficiency options were modelled using dynamic simulation modelling to provide a snapshot of possible performance improvements for Ayrshire buildings.

Prioritisation dashboard tools were provided to each council.

The investments required to achieve targets whilst taking cognisance of priorities and considerations were identified with indicative costs estimated and socio-economic impacts modelled in terms of emissions reductions and employment estimates.

Finally, the actions required to continue the development of business cases for investment opportunities and fill remaining gaps in the data were collated.

The journey to net zero can seem a daunting task, especially on the scale of change required at Ayshire regional level; this will require a collaborative approach between Ayrshire Councils, the Scottish and National Governments, Energy Suppliers, Energy Network Operators to fully understand the needs of communities and customers. The eighteen recommended actions set out below highlight the key activities that the Ayrshire Councils will target over the next five years to drive the change required to support the energy transition to net Zero.

	Theme	Recommendation	Rational
1	**Cross authority working**	1. Review and update of masterplan every 5 years. Review actions when there are significant changes in legislation. 2. Establish a cross authority steering group to take forward the recommended actions from the masterplan; develop governance; delivery structure; roles and	Maintain impetus and react to changes in legislation. Formalise the masterplan and ensure its implementation.

	Theme	Recommendation	Rational
		responsibilities; management procedures; reporting structure; task/action working group scope and objectives; oversight to delivery.	Recognise the regional importance and cross authority opportunities
2	**Funding Environment & Carbon Assessment**	1. Ensure that costs are fully assessed against the long-term impacts for carbon, capital costs and operational costs for large scale Council projects. 2. Ensure that positive and negative impacts are assessed and presented in an open and transparent manner. 3. Set a carbon target for individual capital projects over £1m. Include for carbon reporting on capital projects at committee level. 4. As opportunities are developed through feasibility studies, ensure that a funding/development partner assessment is undertaken to assess private sector interest and delivery models. 5.As funding opportunities are identified, review recommendations and link to appropriate delivery actions and communication strategy. 6. Identify cross authority funding opportunities and collaborate to realise economies of scale, share resources and best practice.	Funding is a key restraint in the delivery of net zero. It is important to ensure that the economic impacts of the transition to net zero are sustainable and affordable to both the public and private sector.
3	**Stakeholder engagement**	1. Establish a working group through the Clean Growth Workstream to develop a cross-authority stakeholder engagement strategy. (For all sectors) 2. Stakeholders to be identified on an area, theme, and project basis to develop outcomes that support stakeholder. 3. Develop digital media packages for inclusion in the Ayrshire Regional Economic Strategy (ARES) portal, include links to best practice, case studies and key projects. 4. Ensure that stakeholder engagement is built into project deliverables and net zero strategies. 5. Investigate and understand opportunities for funding including private sector and developer led projects.	Build upon stakeholder engagement activities to fully understand each sector. Information is made available and actively marketed.

	Theme	Recommendation	Rational
4	**Communities**	1. Develop a cross-authority strategy for engaging with communities, linking to the stakeholder engagement plan area based targeted approach. Incorporate best practices from existing organisations and community groups i.e. those on isles of Arran and Cumbrae. 2. Ensure engagement actions are included during feasibility studies for local projects such as heat networks, LHEES roll out, new energy infrastructure. 3. Grant availability – consider an application process for groups within region.	Ensure that communities are brought on the journey to net zero, their voices and needs are heard and actively encouraged. Information is made available and actively marketed.
5	**Public buildings (including council non-domestic properties and NHS buildings)**	1. Identify funding and conduct energy audits to 50% of Council non-domestic properties to recognised standard such as BSEN 16247. Include for Building Assessment Reports for suitability to connect to heat networks. 2. Review carbon liabilities and develop decarbonisation plans for Council stock. 3. Commit to undertake all activities where a payback is financially viable. 4. Repeat every 5 years.	The region has a rich architectural heritage, especially in public buildings. Understanding their energy use and taking action to reduce their carbon intensity supports energy transition ambitions.
6	**Social housing (including council housing and housing association properties)**	1. Measure compliance with and implement requirements of the new Social Housing Net Zero Standard (SHNZS) where feasible. 2. Implement LHEES delivery plan actions. 3. Develop and implement retrofit strategy based on CoRE research. 4. Undertake area-based consultation. 5. Engage with housing association partners in development of retrofit strategy.	Scottish Government requirement for all social housing to have an Energy Performance Certificate rating of B or better by 2032.
7	**Privately owned housing (owner occupied and rented)**	1. Ensure masterplan objectives are reviewed to incorporate new legislation developments. 2. Engage with Scottish Government to ensure that regional objectives are included in national roll out and legislation. 3. Include sector in stakeholder engagement. 4.Continue to investigate and signpost residents to local and national energy funding and support i.e. Home Energy Scotland, ECO4 and Council initiatives.	Scottish Government requirement for all privately owned housing to have an Energy Performance Certificate rating of C or better by 2040 where it is technically and financially feasible.

	Theme	Recommendation	Rational
8	**Private Sector non-domestic properties, commercial and industrial premisses**	1.Support Net Zero business forums, with ambition to develop a sector led Net Zero delivery strategy. 2. Collate data on effective interventions and good practice through stakeholder engagement and signpost to wider market through ARES portal. 3. Support business through signposting to funding and loan opportunities. 4. Signpost to information on connection opportunities to heat networks, EV infrastructure and grid improvements.	Support businesses on their journey to net zero.
9	**Heat pumps**	1. Roll out as part of LHEES plan where financially viable. Ensure that fabric measures are considered. 2. Review options with supply/build capacity to ensure industry can deliver, link to Training & Skills. 3. Ensure heat pump options are assessed as part of non-domestic property energy audits, with recommendation on when to replace. (age, impact, linked to other works) 4. Focus priority for heat pump installation with highest impact - (by fuel replacement types, coal, oil, electricity, biomass & other fossil fuels, mains gas.	1. Roll out as part of LHEES plan where financially viable.
10	**Heat Networks**	1. Undertake feasibility studies for potential heat networks at **Kilmarnock 3**, **Cumnock Ayr Road, Ayr 3,** and **Irvine**. Include exploration of options to utilise waste heat; local disused mines as heat stores/ heat pump sources; opportunities to maximise the use of Ayrshire's potential wind, hydro, wastewater, and coastal energy sources. 2. Investigate the potential for one pilot project. (small scale, high impact) 3. Ensure consultation with the public and local businesses in the development of a heat network roll out plan, including consideration of opportunities. 4. Work with supply chain, Scottish and National Governments and public and private partners to develop a delivery mechanism.	High carbon heating accounts for 41% of carbon emissions in Ayrshire. Viable heat networks will be required to meet the heat energy transition.

	Theme	Recommendation	Rational
11	**EV charge points**	The ambition is for an additional 1200 publicly available chargers to be installed by 2030, and a further 1400 by 2045.To this aim the councils will: 1. Engage with supply chain partners to develop a delivery plan target of 200 additional public EV Charge points per year where funding allows, initially investigating potential at all public car parks and assessing how rural provision is developed in parallel with need. 2. Assess if installations can be provided at all public buildings where car parking for staff is provided. The initial focus will be on sites where significant grid infrastructure upgrading is not required. 3. Identify sites where significant grid infrastructure upgrading is required and engage with DNO's on upgrading plans. 4. Undertake early engagement with DNO's to assess grid capacity for cluster sites.	To meet national electric vehicle roll out legislation, a significant number of electric vehicle charge points are required to meet customer demands and reduce range anxiety.
12	**Energy infrastructure**	1. Appoint lead to work with DNO's to fully understand Grid restrictions and grid infrastructure upgrade plans. 2. Develop a regional map for publication showing developers where grid access is available and to what capacity. (building upon DNO maps)	Understand energy distribution networks and its limitations and opportunities within Ayrshire. Encourage information exchange to optimise development opportunities.
13	**Energy generation**	1. Undertake feasibility studies on expansion of renewable generation - link to grid access restrictions. 2. Support expansion where grid allows windfarms/solar/large scale heat pump and where grid access is required. 3. Undertake feasibility on energy storage opportunities, including "as heat" in disused mines, and connected to the substations at: New Cumnock/Dalmellington, Coylton, both Kilmarnock town and south, Ayr Holmston roundabout, Hunterston, Mark Hill, and Auchenwynd. 4. Build upon works already undertaken to understand and visualise wind energy opportunities and data to incorporate grid restraints and upgrade proposals to stimulate development	Understand and support development of low and renewable energy generation and storage. Encourage information exchange to maximise energy generation against grid capacity.

	Theme	Recommendation	Rational
14	**Grid Capacity**	1. Convene a working group with DNO's to fully understand: • Restrictions and opportunities within Council areas in terms of grid availability. • Understand grid upgrade plans. 2. Assess grid capacity against Energy Masterplan ambitions. 3. Set out net zero opportunities in line with energy infrastructure availability. 4. Prioritise net zero projects where grid capacity allows.	Grid capacity is restricting the development of additional renewable energy generation and ability of customers to access electric heat and EV charging at scale.
15	**Hydrogen**	1. Work with government and development partners to understand the scope for a hydrogen feasibility study within the region, set out objectives and timeline for delivery. Liaise with delivery partners on potential for investment. Work with research partners to understand appropriate technologies against supply and demand restrictions. 2.Hydrogen generation areas to consider are those that can be connected into the following substations: Coylton transmission, Kilmarnock South Transmission, Ayr transmission (Holmston roundabout), New Cumnock transmission and distribution, Auchenwynd transmission, and Hunterston.	Understand Hydrogen options within the Ayrshire region, keep up to date with technology advances and be aware and ready to adapt to legislation changes & funding opportunities.
16	**Transport**	1. Continue data collection to inform the development of transport hubs utilising the stakeholder engagement strategy. 2. Undertake public consultation exercise to understand transport needs and barriers. 3. Engage with the Scottish government and transport partners on EV bus roll out with the ambition of having all bus routes with capacity to utilise EV's. (ensure link to Council EV strategies and wider national transport strategies) 4. Undertake assessment for transport hubs within region including assessment of new Park & Ride facilities with significant EV provision. 5. Undertake feasibility studies for grid infrastructure requirements to facilitate significant EV charger provision within **Ayr, Kilmarnock, New Cumnock, Newton on Ayr and Holmston roundabout.** 6. Ensure that all contracts for EV charges include for maintenance, upgrading and end of life replacement.	Be ready for the transport revolution. Ensure that businesses and the public can access low carbon transport infrastructure including public transport options.

	Theme	Recommendation	Rational
17	**Skills transition**	1. Undertake an assessment to understand the current availability and level within the region to meet net zero ambitions. This should include existing skills base for insulation and fabric improvements; grid infrastructure improvements, associated civil engineering works and energy generation technologies; low and zero carbon technologies installation and availability of technologies; transport infrastructure improvements. 2. Work with training and skills partners to ensure appropriate course availability to support delivery of: • EV charger installation & Maintenance including associated infrastructure in Civils works and Electrical installations. • EV maintenance • Solar panel installation and maintenance • Heat pump installation and maintenance • Energy Assessment and design of appropriate interventions • Retrofit interventions Installation • Heat network design • Heat network installation and maintenance • Electrical infrastructure design, installation & • Maintenance • Hydrogen infrastructure, design installation and maintenance. • Wind energy design installation and maintenance • Battery installation and maintenance for heat and electrical storage	Be skills ready to deliver the energy transition at scale.
18	**Skills transition**	1. Note requirement for skill /workforce transfer from existing technologies to new/increased technologies and ensure appropriate trade led transition courses in: • Combustion engine to EV motors • Fossil fuel boilers to Heat pumps	Ensure that opportunities for businesses and trades are maximised and that customers can access the services required to maintain their electric vehicles and low carbon installations.

Appendix 5 sets out the socio-economic opportunities and potential job creation based on a representative sample of opportunities. As economic value and jobs created are entirely dependent on which projects are taken forward and how fast implementation is delivered cost benefit analysis should be undertaken as part of project development. Appendix 5 can be used as a guide for undertaking this during the early feasibility assessment stages of a project.

1. What is the Ayrshire Energy Masterplan?

The AEM covers the **geographic area covered by the three Ayrshire Councils**; East, North, and South Ayrshire Councils and incorporates a number of targets and strategies being implemented across the region. A summary of these targets can be seen in Appendix 1 with references made to them throughout this document which sets out the **strategic energy vision for Ayrshire**.

The AEM is a Clean Growth Workstream project funded through the Ayrshire Growth Deal in support of the Regional Economic Strategy. More information about the Regional Economic Strategy, Ayrshire Growth Deal, and origins of the AEM can be found in Appendix 1 alongside summaries of other relevant policies and strategies.

The overall objectives of the Ayrshire Energy Masterplan (AEM) are to:

- Present a **pathway to net zero energy use** that **maximises socioeconomic benefits for Ayrshire.**
- Act as a framework to be a **catalyst for investment in energy infrastructure** relating to:
    - **Heat**
    - **Transport**
    - **Power**
- Shape intervention strategies and pathways to ensure a **just transition** to net zero.

The recommendations made in the Ayrshire Energy Masterplan focus on **carbon emissions associated with energy use and are to be progressed alongside council Local Heat and Energy Efficiency Strategy (LHEES) delivery plans**. Other sources of carbon emission may be legislated as we drive towards the 2045 targets, the recommendation is that reviews are put in place to ensure that future changes in legislation and policy are integrated into the masterplan as they are implemented.

2. Emissions from Energy Use

2.1 Breakdown of Energy Emissions

Ayrshire's greenhouse gas emissions associated with energy use are estimated to be 2.23 $MtCO_2e$/year. Details of how this has been calculated can be seen in Appendix 2.

Figure 2-1 shows the breakdown of emissions by energy source.

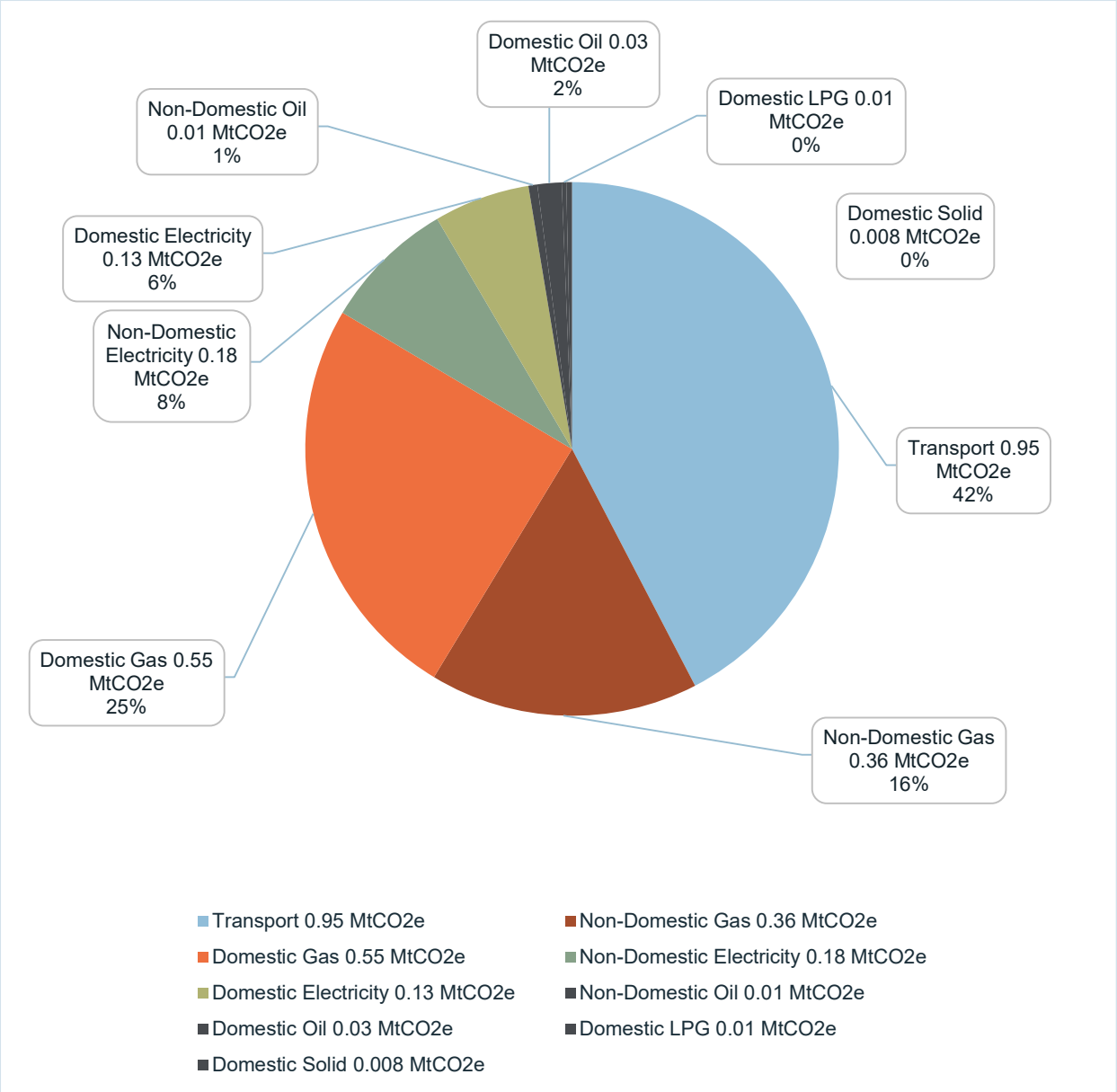


Figure 2-1 - Ayrshire's Total Energy Consumption Emissions: Proportional Breakdown by Source Compared with the Overall Transport Estimate.

Figure 2-2 shows the breakdown of energy use by energy source. Total energy use is estimated to be 8.7 TWh/year. Details of how this has been calculated can be seen in Appendix 2.

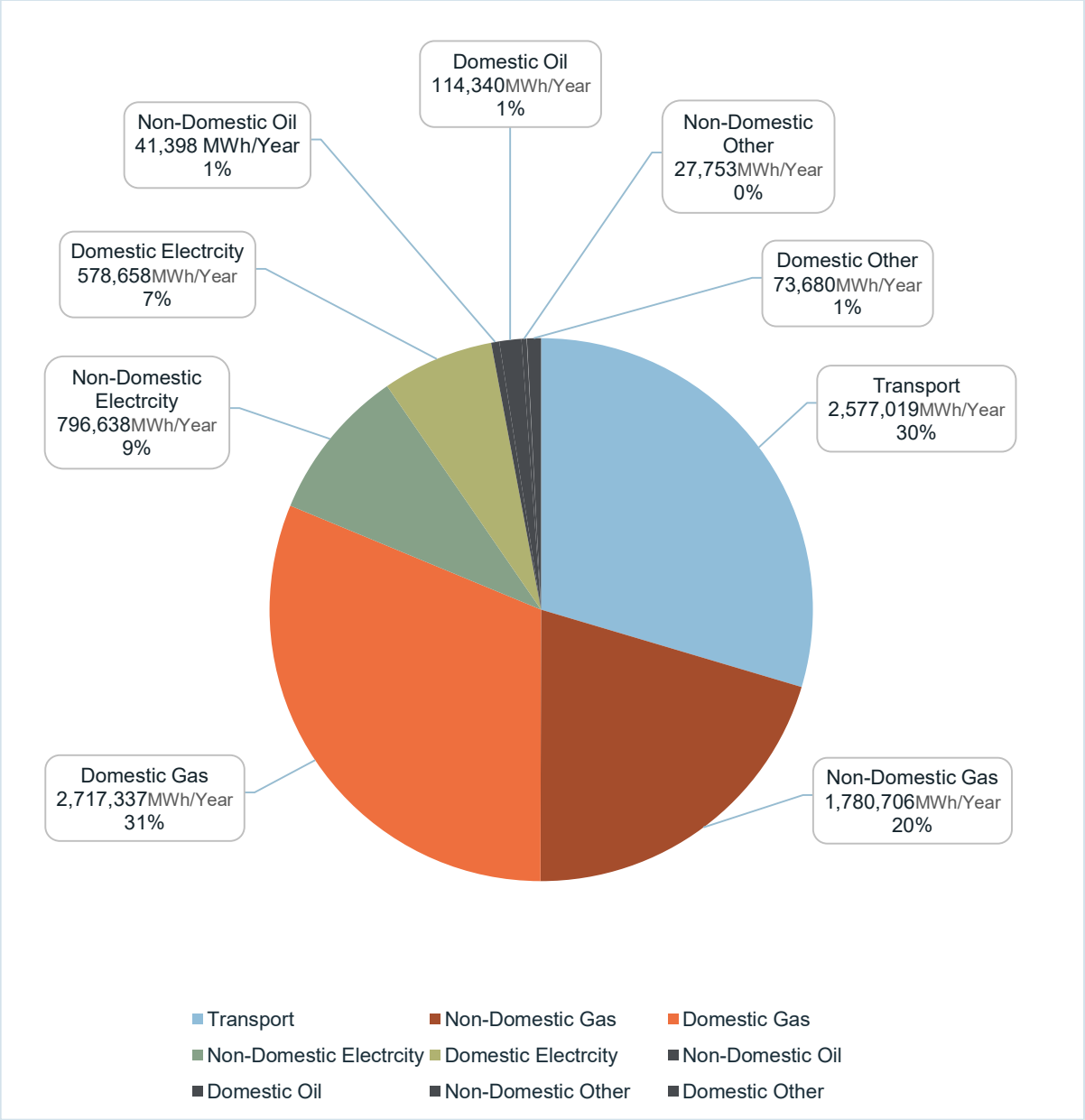


Figure 2-2 - Ayrshire's Total Energy Consumption: Proportional Breakdown by Source Compared with the Overall Transport Estimate.

It is important to understand how heat sectors are proportioned within the overall Ayrshire energy use estimate. Figure 2-3 provides a breakdown, indicating that approximately 30% of Ayrshire's energy use can be attributed to both transport and domestic heat.

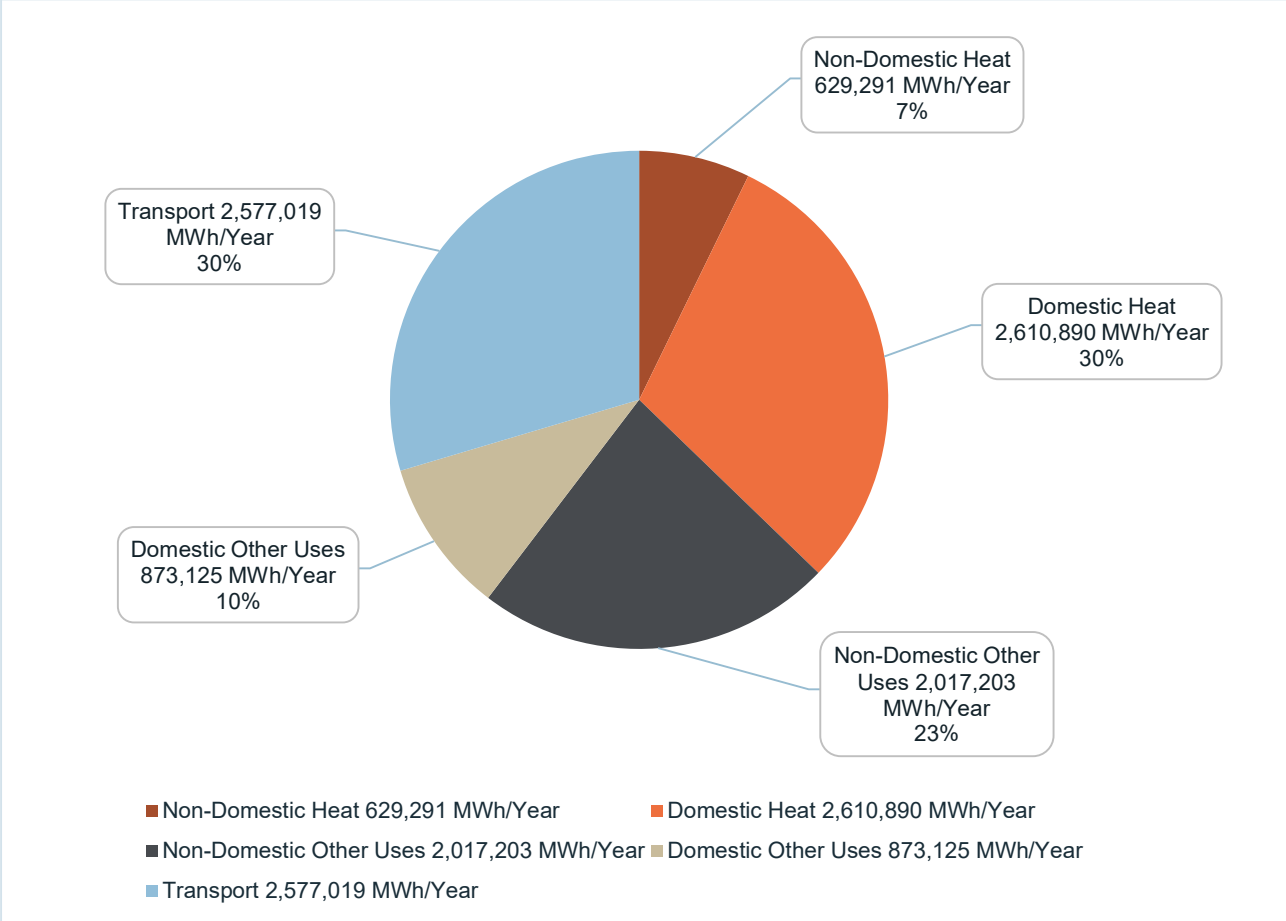


Figure 2-3 – Ayrshire's Total Energy Consumption: Proportional Breakdown by Use.

2.2 Net Zero Goal and Role of the Ayrshire Energy Masterplan

The overall target adopted by the AEM is for Ayrshire to achieve **net zero emissions by 2045,** in line with Scottish Government targets, with interim targets of 75% reduction from 1990 greenhouse gas emissions by 2030, and 90% reduction from 1990 greenhouse gas emissions by 2040.

Note that these targets apply Ayrshire wide, and that North Ayrshire has set the target of achieving Net Zero by 2030. East Ayrshire also has a target to be net zero as a council by 2030 and in communities by 2045.

Details of the policies from which these targets have been derived can be seen in Appendix 1, and the targets timeline can be seen in Figure 2-4. It is recommended that these targets are reviewed regularly.

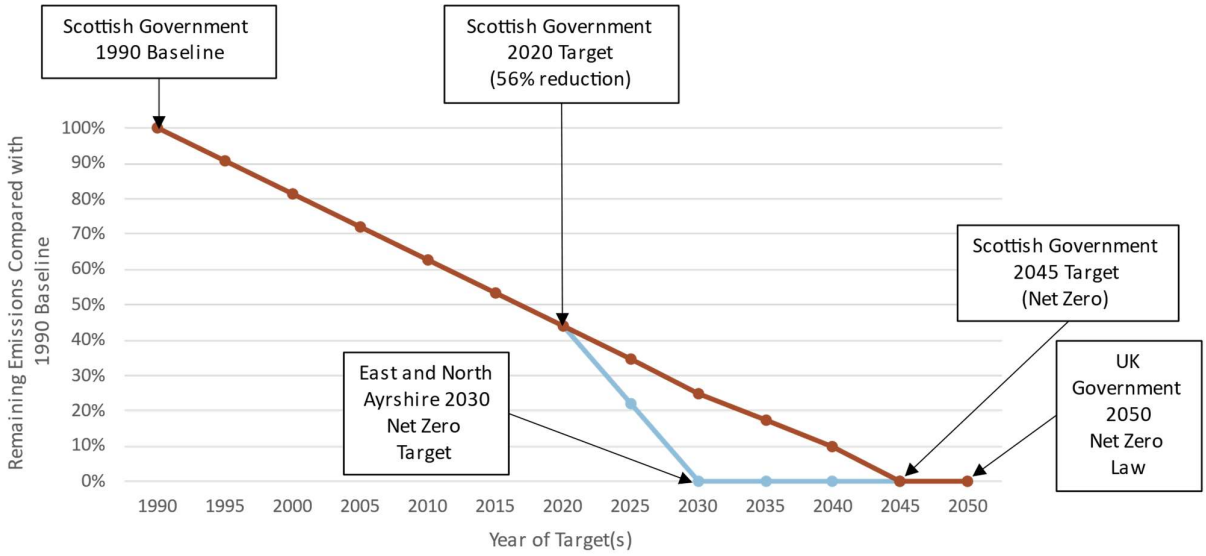


Figure 2-4 - Net Zero Targets Timeline adopted by the AEM.

Note that the goal of net zero relates to overall carbon and greenhouse gas emissions, of which emissions associated with energy use are one component. Residual emissions associated with energy use are likely to remain following implementation of the interventions recommended in the AEM, i.e. the current estimated emissions associated with energy use of 2.23 $MtCO_2e$/year are not expected to be brought down to 0 $MtCO_2e$/year through reductions in energy use and decarbonisation of energy sources alone. The residual emissions will require to be offset by sequestration. Whole life carbon emissions associated with interventions, which are not considered as part of the AEM will affect the net impact on carbon emissions of energy use reductions and decarbonisation of energy sources. These relationships are shown in Figure 2-5.

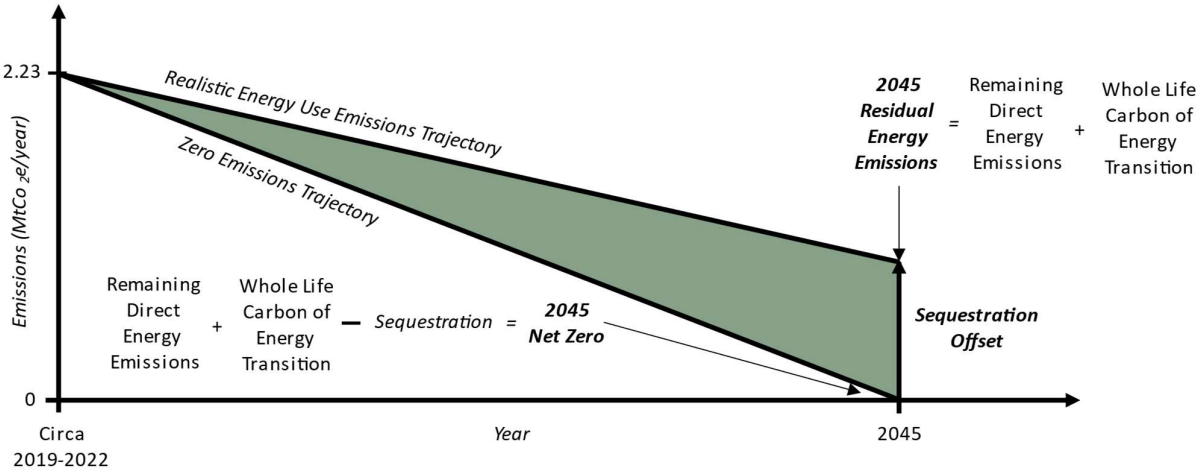


Figure 2-5 – How the AEM assists in achieving the goal of net zero, supported by sequestration, and accounting for whole life carbon.

These relationships between the AEM, whole life carbon, and sequestration are the basis of the Theory of Change (ToC) illustrating how the AEM assists in achieving the goal of net zero shown in Figure 2-6.

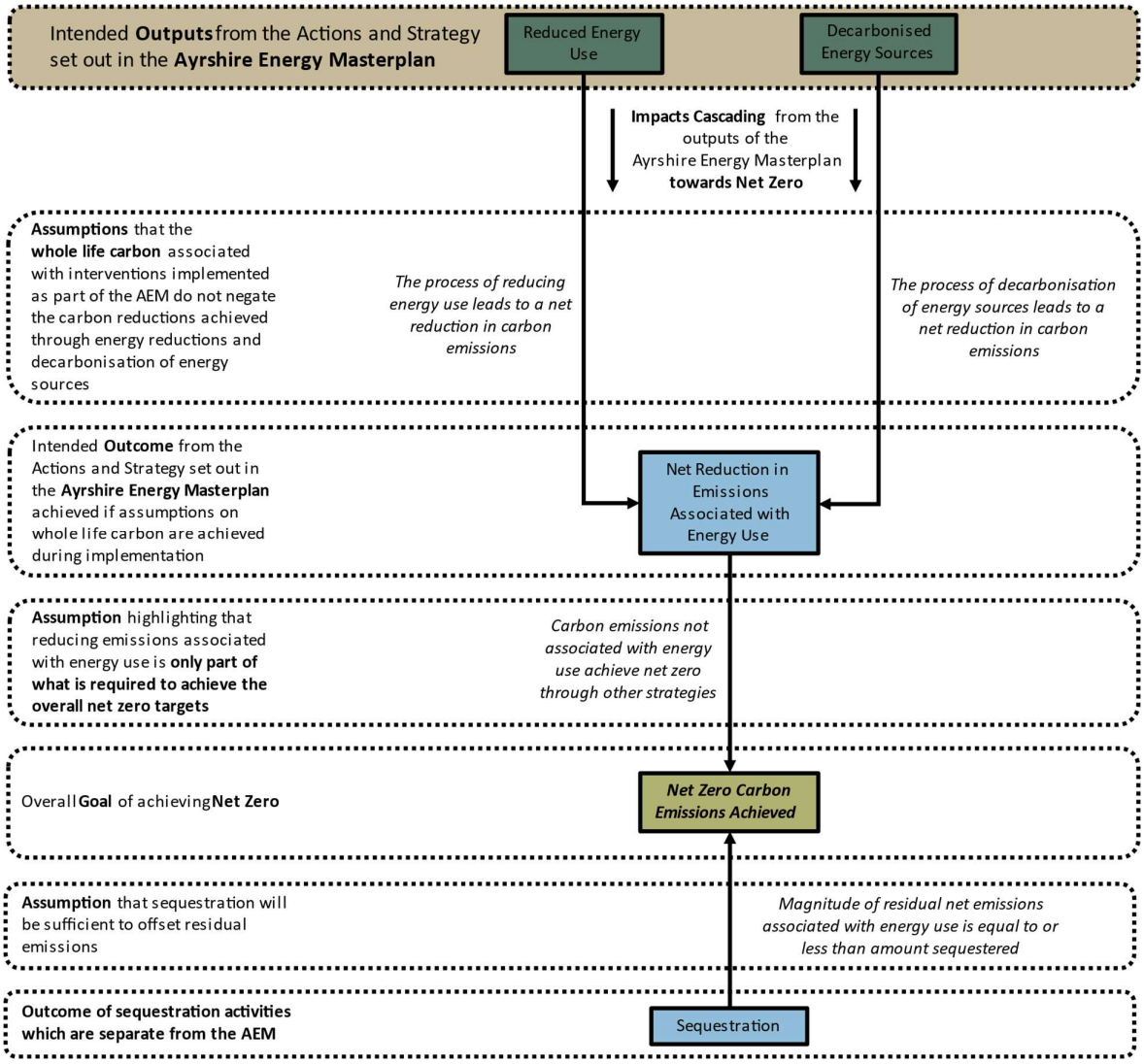


Figure 2-6 – Theory of Change showing how the AEM assists in achieving the goal of net zero, supported by sequestration, and accounting for whole life carbon.

3. Overview of the Recommended Ayrshire Energy Masterplan Approach

The **core strategy of the AEM** is to reduce carbon emissions by **reducing energy use** and **decarbonising energy sources** through a focus on **heat**, **transport**, and **power**. Councils will be acting across their estates to implement the AEM strategy, and supporting organisations, businesses, tenants, and homeowners in identifying the actions they can take and accessing funding.

Another key part of the strategy is that **clusters of opportunities** located in the same area are recommended to be **developed at the same time** so that **costs of upgrading infrastructure are shared and reduced overall**.

Ensuring a **just transition** is embedded in the strategy through a range of checks, targets, and policies that balance opportunities to ensure that **outcomes in addition to net zero are achieved** as the strategy is implemented.

The policy context and evidence base that the AEM strategy has been developed from can be seen in appendices 1, 2, and 3.

The Venn diagram in Figure 3-1 shows that the heat, transport, and power approaches overlap in the coordination of electrical infrastructure upgrades to comprise the overall Ayrshire Energy Masterplan. Whole life carbon and sequestration are highlighted as they are linked to the AEM Theory of Change for achieving net zero and are recommended to be considered in addition to the approaches being recommended as part of the AEM.

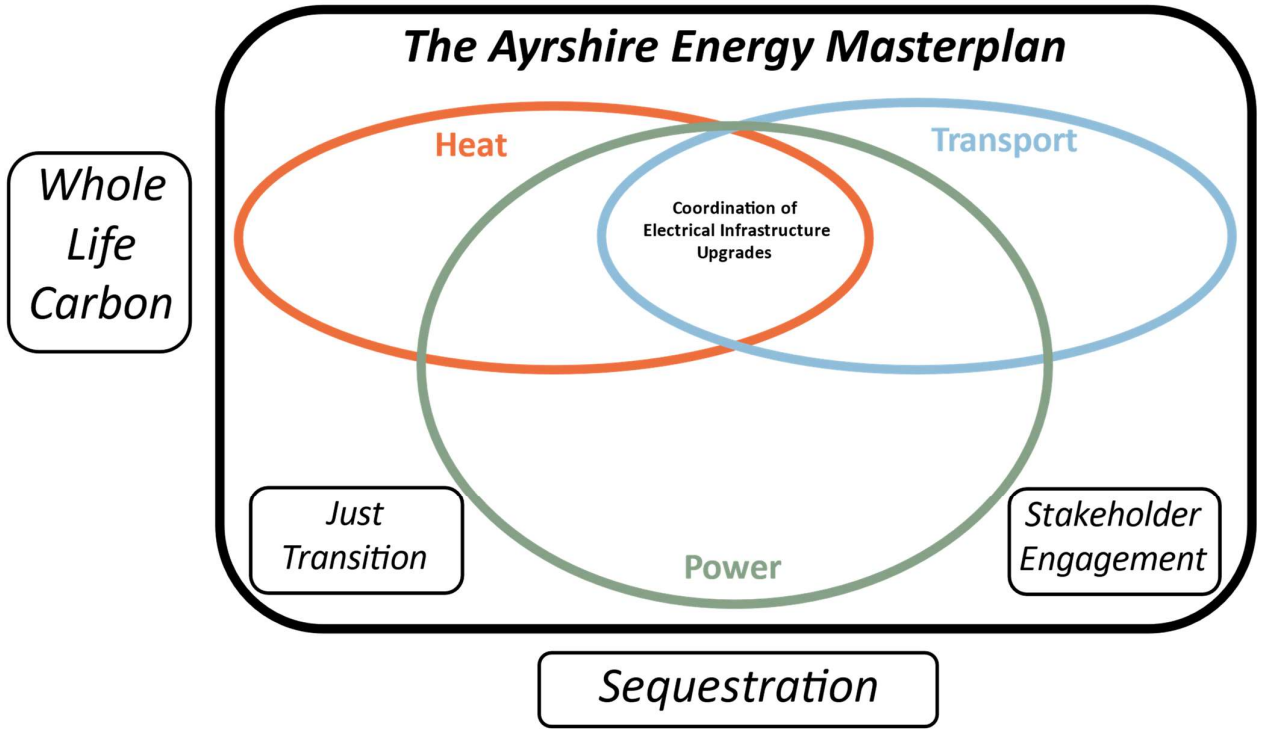


Figure 3-1 – Venn diagram showing the AEM comprised of overlapping heat, transport, and power approaches with whole life carbon and sequestration shown as separate from the AEM but highlighted as they are linked through the Theory of Change.

3.1 Heat Approach Overview

The heat approach consists of:

- **Energy Efficiency Measures** – ***Reducing heat and energy demand*** through supporting and implementing **fabric first retrofit**.
- Heat Management by:
    - Supporting and implementing the installation of **Heat Pumps** and **other sources of zero carbon heating**
    - Councils leading development of **Heat Networks**
- Encouraging the generation of **Renewable Energy**
- Investigating the role **Hydrogen** may play in ***decarbonising heat*** through replacing gas and beginning to develop supply and demand.

The AEM renewable energy strategy crosses over with the AEM heat approach, however the renewable energy strategy is predominantly part of the AEM Power Approach. The renewable energy strategy also has a relationship with proposed investigations into hydrogen. Electrical infrastructure upgrades, which are part of the AEM power approach, will be required to support heat pump installation and the development of heat networks. The key crossovers in these approaches are shown by the Venn diagram in Figure 3-2.

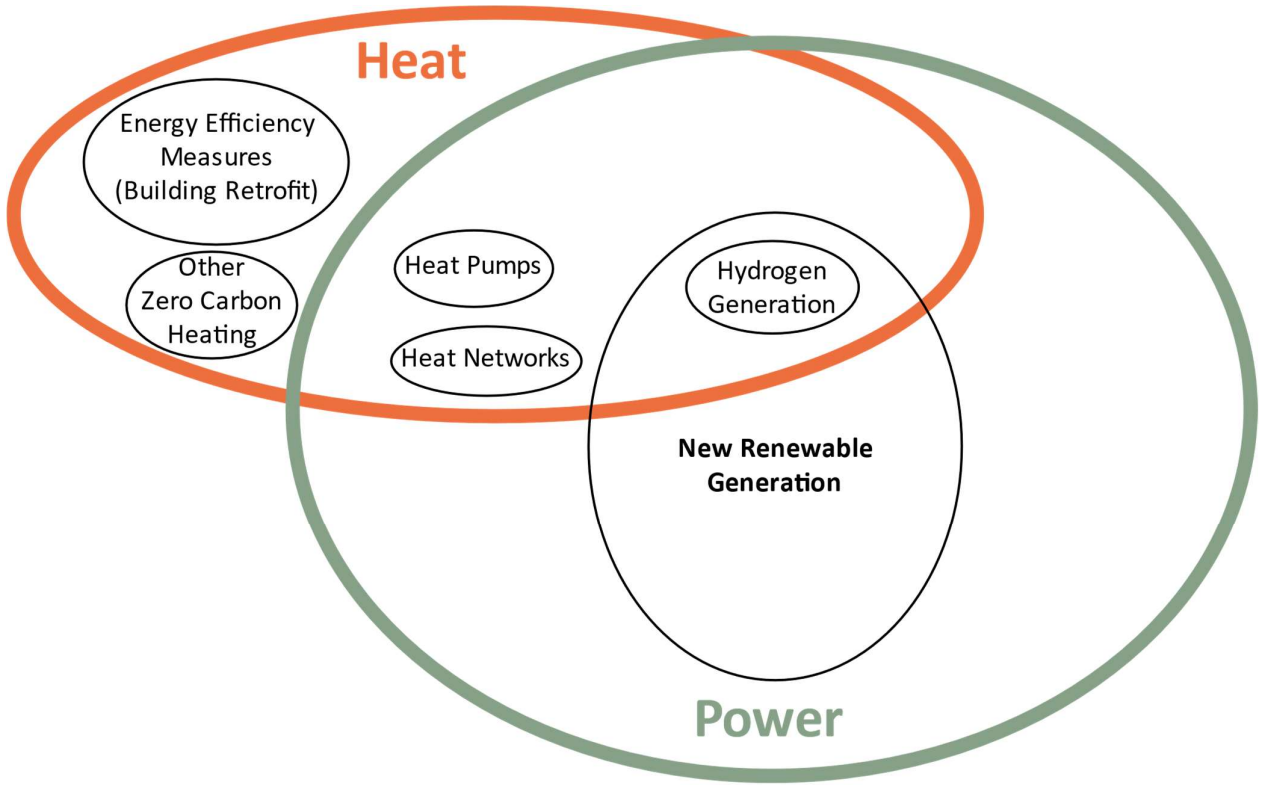


Figure 3-2 – Venn diagram showing all sub-approaches of the AEM heat approach and key crossovers with the AEM power approach.

3.2 Transport Approach Overview

The transport strategy consists of:

- ***Decarbonising transport*** energy sources by:
  - Encouraging the adoption of electric vehicles through installation of **electric vehicle charge points.**
  - Investigating the role **hydrogen** may play in decarbonising transport through hydrogen powered vehicles and beginning to develop supply and demand.
  - Replacing council fleets with either electric or hydrogen powered vehicles.
- Encouraging the generation of **Renewable Energy.**
- ***Reducing energy use*** by increasing the use of public transport and facilitating active travel by:
  - Developing **transport hubs.**
  - **Improving public transport** on existing routes and with new routes including road, rail, and ferry routes.
  - Developing and improving **active travel** routes.

Note that levels of active travel in Ayrshire are lower than the Scottish average as detailed by Appendix 2. It is recommended that root causes be analysed to assist in determining what the required improvements are.

Electrical infrastructure upgrades, which are part of the AEM power approach, will be required to support electric vehicle charge point installations. The AEM renewable energy strategy crosses over with the AEM transport approach, however the renewable energy strategy is predominantly part of the AEM Power approach. The renewable energy strategy also has a relationship with proposed investigations into hydrogen.

A core part of the AEM transport approach is **locating electric vehicle charge points and transport hubs in the same locations** to reduce the extent of the infrastructure upgrades required and share costs across both of these approaches.

The key crossovers in these approaches are shown by the Venn diagram in Figure 3-3.

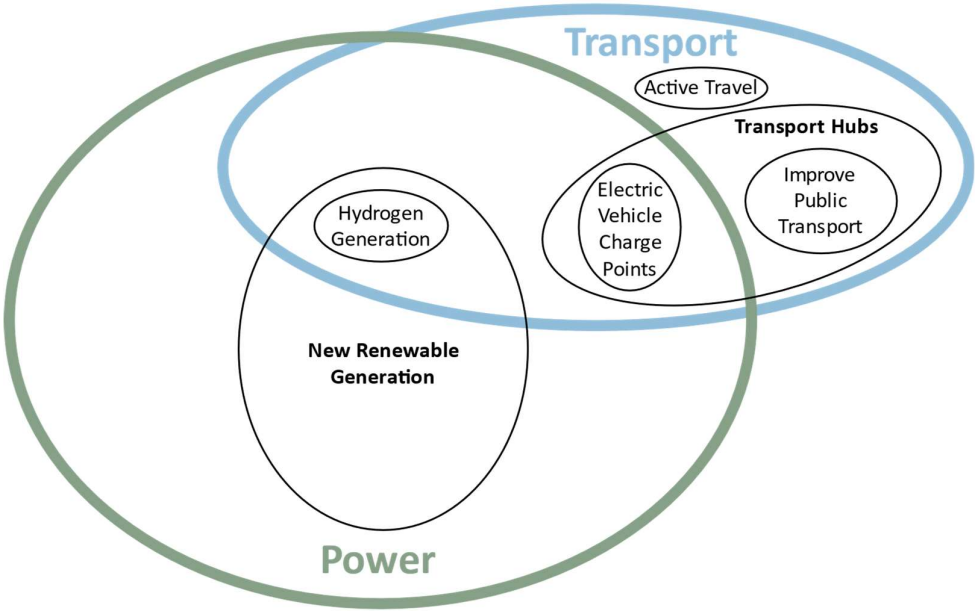


Figure 3-3 – Venn diagram showing all sub-approaches of the AEM transport approach and key crossovers with the AEM power approach.

3.3 Power Approach Overview

The power approach consists of:

- **Coordination of Electrical Infrastructure Upgrades** to share costs across implementation of the heat and transport approaches and reduce costs overall.
- Encouraging **new renewable energy generation** and investigating the role **hydrogen** may play in this.
- Councils leading on and encouraging the development of **energy networks.**

Note that integration of **energy storage** solutions is a key part of the new renewable generation, energy networks, and hydrogen sub-approaches.

Coordination of electrical infrastructure upgrades supports delivery of the heat and transport approaches by coordinating upgrades with development of heat networks, and installation of heat pumps and electric vehicle charge points. Investigations into the role hydrogen may play in decarbonising energy uses are part of the heat and transport approaches, however investigating the potential to generate hydrogen is captured by the AEM power approach by considering how hydrogen generation can support development of new renewable generation capacity. Note that hydrogen generation is not a near term solution and there remains uncertainty around viability and the extent of the role hydrogen will play in the medium and long-term, approaching 2045 and beyond.

How coordination of electrical infrastructure upgrades creates the crossover between the heat and transport approaches at the heart of the AEM is shown by the Venn diagram in Figure 3-4.

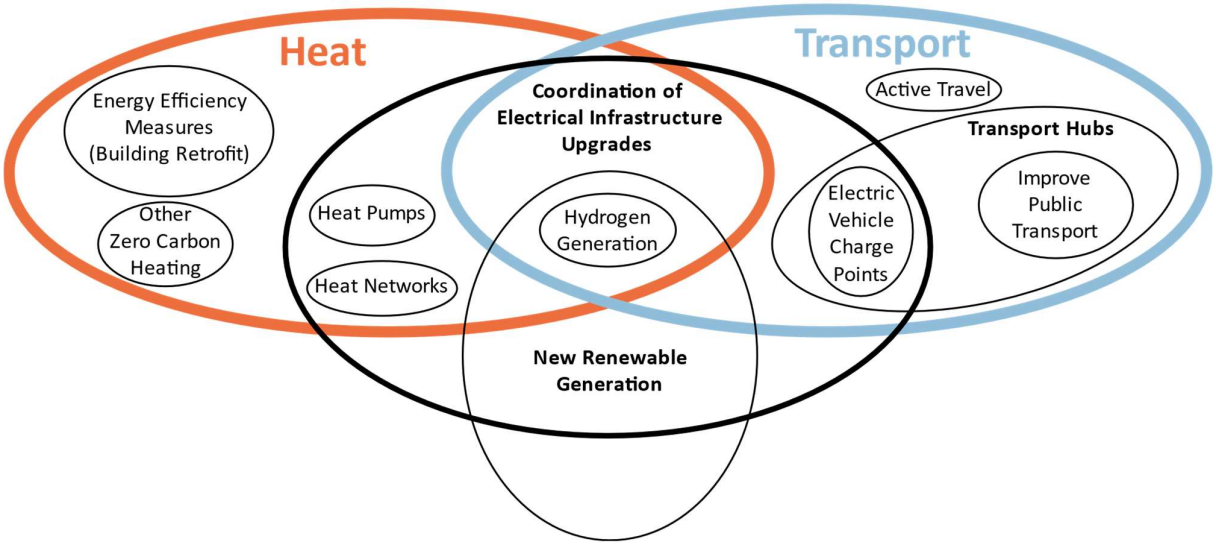


Figure 3-4 – Venn diagram showing all sub-approaches of the AEM heat and transport approaches and how coordination of electrical infrastructure upgrades creates a crossover.

Development of energy networks is part of how the power approach assists in overcoming limitations of the electrical power infrastructure and supports development of new renewable generation by encouraging '**behind the meter' power generation from renewable sources**. Therefore, this sub-strategy of the AEM power approach sits out with the coordination of electrical infrastructure upgrades and within the new renewable generation sub-approaches.

A core part of the AEM transport approach is locating electric vehicle charge points and transport hubs in the same locations, however some transport hubs are not suitable for significant electric vehicle charge point installation and may not require electrical infrastructure upgrades, meaning that the development of transport hub sub-strategy is partially out with the coordination of electrical infrastructure upgrades sub-strategy.

The sub-approaches that form the AEM power approach are shown in the Venn diagram in Figure 3-5.

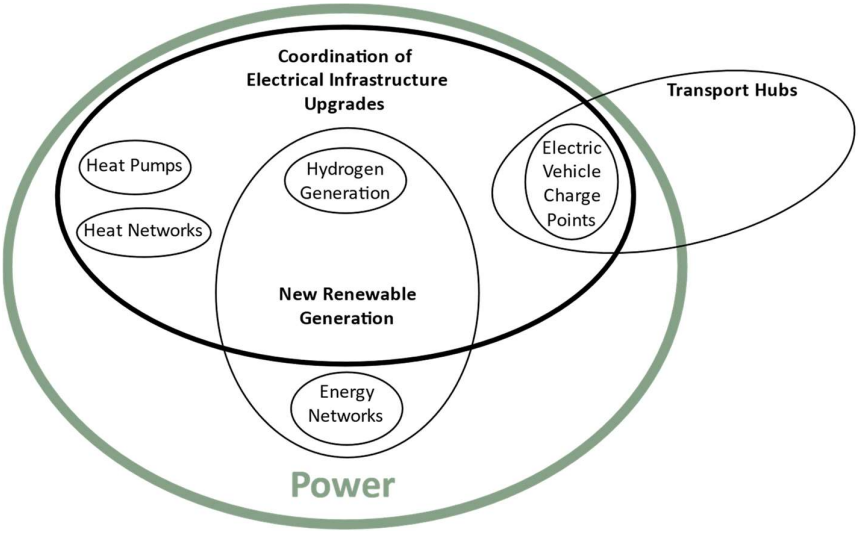


Figure 3-5 – Venn diagram showing all sub-approaches of the AEM Power approach and key crossovers.

3.4 Overview of Ayrshire Energy Masterplan Strategy Crossovers

The Venn diagram in Figure 3-6 shows all of the sub-approaches that make up the Ayrshire Energy Masterplan strategy, highlighting the key crossovers discussed above.

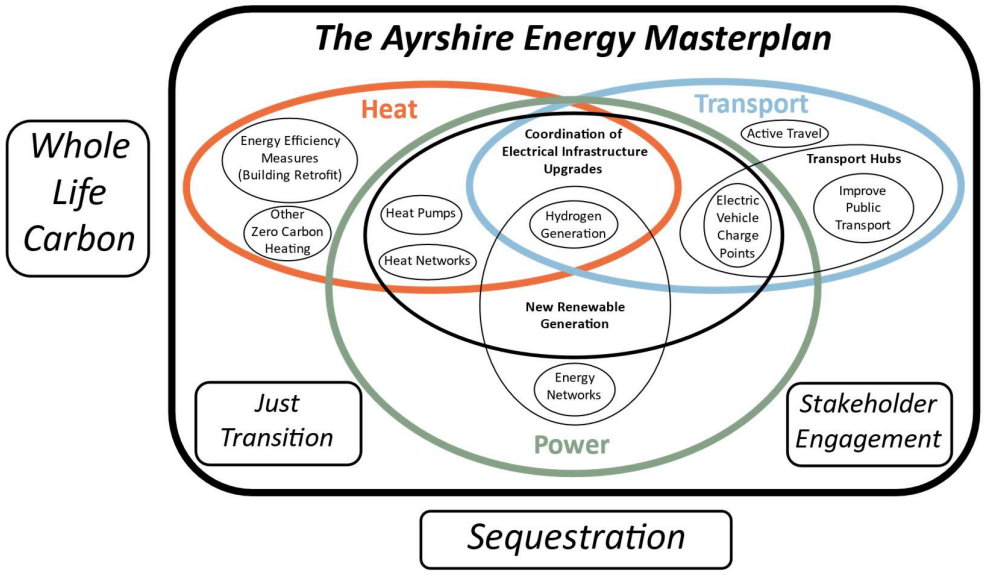


Figure 3-6 – Venn diagram showing all sub-approaches of the AEM and key crossovers with whole life carbon and sequestration approaches shown as separate from the AEM.

4. Stakeholder Engagement

Engagement with stakeholders was undertaken to gain an understating of the challenges faced by stakeholders in achieving net zero and what their priorities are for an energy masterplan.

Details of the steps taken to engage with stakeholders, breakdowns of groups engaged, and detailed discussion of the feedback obtained through an online survey and interviews can be seen in Appendix 3. This included engagement with businesses, community groups, utility companies, and housing associations.

As shown in Figure 4-1, in answer to the survey question "is your organisation fully prepared to switch to net zero related operations?" Circa 40% of stakeholders answered "Yes," 40% answered "No," and the remaining 20% answered "Don't Know." Therefore, around two thirds of respondents perceive that they have not identified a clear pathway to net zero, and that stakeholders need further support in addition to the support currently being provided.

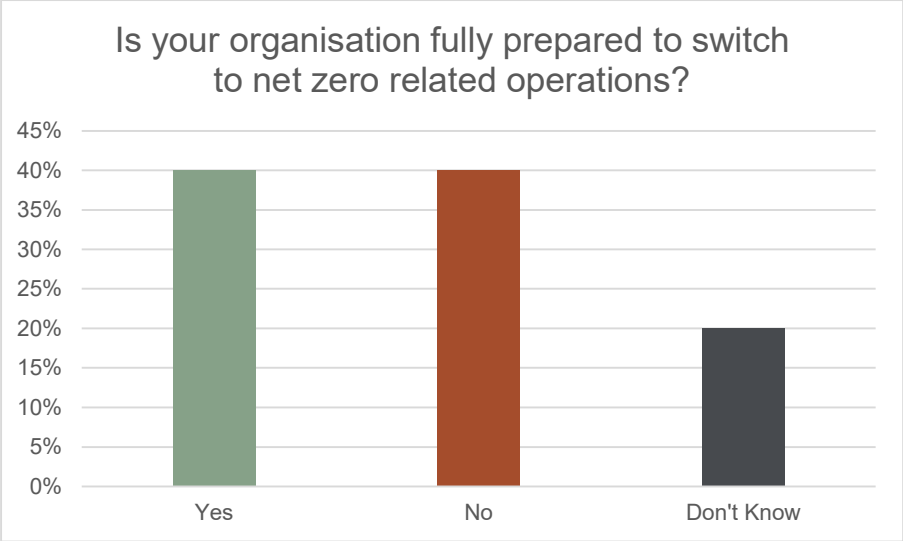


Figure 4-1 – Stakeholder responses to the question 'Is your organisation fully prepared to switch to net zero related operations?'

Specific challenges and priorities relating to heat, transport, power, and their sub-approaches were raised by stakeholders as detailed throughout Appendix 3, and how these have been addressed in the development of the AEM is set out against discussion of investment opportunities within this document.

The **overall priorities and key challenges** raised by stakeholders were:

- **The costs associated with** net zero transition.
- **Enhanced community engagement** to implement net zero projects by facilitating contact between. neighbours and the wider local community.
- **Clarity** on the following:
    - What the achievable targets are and how they are quantified.
    - What the strategies and approaches are for achieving these targets.
    - Who is responsible for undertaking actions required to achieve targets.
    - What the options are for achieving targets.
- Long term **retention of existing targets and commitments** to continue to support and not undermine what has been done already both by the councils, and by other groups and organisations.

4.1 Support Stakeholders Require

As part of the **Ayrshire Energy Masterplan implementation** stakeholders would like:

- **Assistance and guidance** in devising net zero interventions and strategies, and obtaining funding including the following:
    - Improving the energy performance of buildings and decarbonisation of energy sources.
    - Development of and connection to heat and energy networks.
    - Decarbonisation of energy use for industrial and commercial processes and operations
- Targeted funding to assist with intervention costs, with a focus on funding across interventions and enabling works as **integrated and optimised solutions**.

The **key strategic barriers** identified that stakeholders require support in overcoming in transitioning to net zero are:

- High **costs** of transitioning to net zero.
- A lack of **suitable interventions** for the nature of the operations of organisations.
- Lack of knowledge, or access to **guidance and support.**
- Technical **complexity** of upgrades.
- Lack of **ability** of tenants to implement interventions.

Specific barriers relating to heat, transport, and power were also identified with these being highlighted throughout this document.

The approaches that make up the Ayrshire Energy Masterplan have been recommended to assist in overcoming the barriers faced in achieving net zero.

4.2 Recommended area-based Community Engagement

Given the need for **community engagement for a range of issues** including but not limited to heat networks, development of renewable energy generation capacity, and improving the building performance of mixed tenure blocks, a strategy for engaging with communities on an area basis across a range of net zero and energy issues should be developed. Examples of where this kind of approach has achieved success can be seen on islands that were part of North Ayrshire's Green Island Programme, Isle of Arran and Isle of Cumbrae, and the Scottish Government Carbon Neutral Islands (CNI) Project, on the isle of Cumbrae. Consideration should be given to how the benefits of the **hyper localised multi-issue and multi-intervention approach** could be transferred to the mainland to facilitate community engagement in the transition to net zero. Key considerations would be determining which aspects of geography, spheres of influence, and infrastructure would play a similar role to the sea in separating communities in terms of transfers, and uses of, energy i.e., the impact of physical boundaries, population distribution, and the layout of infrastructure. Also capturing the benefits including but not limited to; greater engagement from communities in 'bottom up' reported by stakeholders as detailed in Appendix 3, clarity on who to go to if there is a single point of contact for all issues, and the local knowledge of the people coordinating community groups as community members.

There is also a need to **support homeowners and businesses in understanding and accessing funding** and **guidance for net zero interventions** including fabric first retrofit, zero carbon heating, and connecting to heat and energy networks. This can be done through a **continuous recommended area-based engagement with all stakeholders in addition to existing support services** which are often available on a sectorised basis. Gaps in engagement may be addressed as people and businesses who either don't know about services or don't know which service to go to, may be more likely to hear about a support hub in their immediate local area. **Where a stakeholder would benefit from a sector specific service, the local support hub can put them in touch**.

Likewise, the sectorised services should ensure that stakeholders are aware of all the support hubs in the areas a stakeholder operates, has premises, or lives so that they can **get involved in local projects**.

Note that the recommendation is that **communities be engaged on net zero and energy issues to help bottom-up identification of appropriate local projects and empower communities to take these projects forward**. Where projects are initiated on a top down, or outside basis (i.e. not initiated by communities), for example from council LHEES report recommendations, or large wind farm developers etc, then **the local support hubs or organisations** of the affected community or communities could help **facilitate community engagement**.

The **current sectorised support services and forums are having an impact** as evidenced by the feedback from stakeholders. Therefore, their activities should continue to be enhanced to assist organisations tackle nuanced challenges faced by sectors in the **optimisation of their energy use**. It is recommended that steps are taken to ensure that all organisations are aware of their energy use and are collecting data.

It is recommended that the recommended area-based strategy be developed with the remit to support delivery of the recommendations made, and considerations discussed throughout this document. Investigate and understand opportunities for funding including private sector and developer led projects.

For free support to make your business greener you can contact **Business Energy Scotland** on 0808 808 2268, Monday – Friday 9am – 5 pm or go to https://businessenergyscotland.org.

If you'd like more advice on how your business could be supported in its net zero journey, you can contact the **Local Business Gateway** on 0300 013 4753, Monday – Friday 9am – 5pm or go to https://findbusinesssupport.gov.scot for further information.

Funding changes regularly, however further information on funding opportunities can be found in Appendix 6.

5. Heat

5.1 Breakdown of Energy Use for Heat

Levels of emissions due to energy use for heat depend on both the energy demand and carbon equivalent emissions per kWh supplied associated with the source/fuel used to meet that demand. Therefore, understanding current demands from each source and the relative emissions highlights priority sources to adopt and reduce reliance upon.

Understanding the sectoral breakdown can assist in highlighting where emissions are greatest.

The breakdowns in the remainder of this section show that domestic gas use for heat is a significant source of emissions, and the primary heat source for most non-domestic buildings across Ayrshire.

Gas is a significant source of energy for heat across all sectors, with a large number of retail premises contributing towards a large demand for gas for heating.

Note that at present, there are significant emissions associated with electricity use, however it is assumed that these will reduce to zero as the grid decarbonises.

5.1.1 Non-Domestic Heat Breakdown

Ayrshire's non-domestic energy use for heat can be seen broken down by energy source in Figure 5-1. Details of how these numbers have been calculated can be seen in Appendix 2.

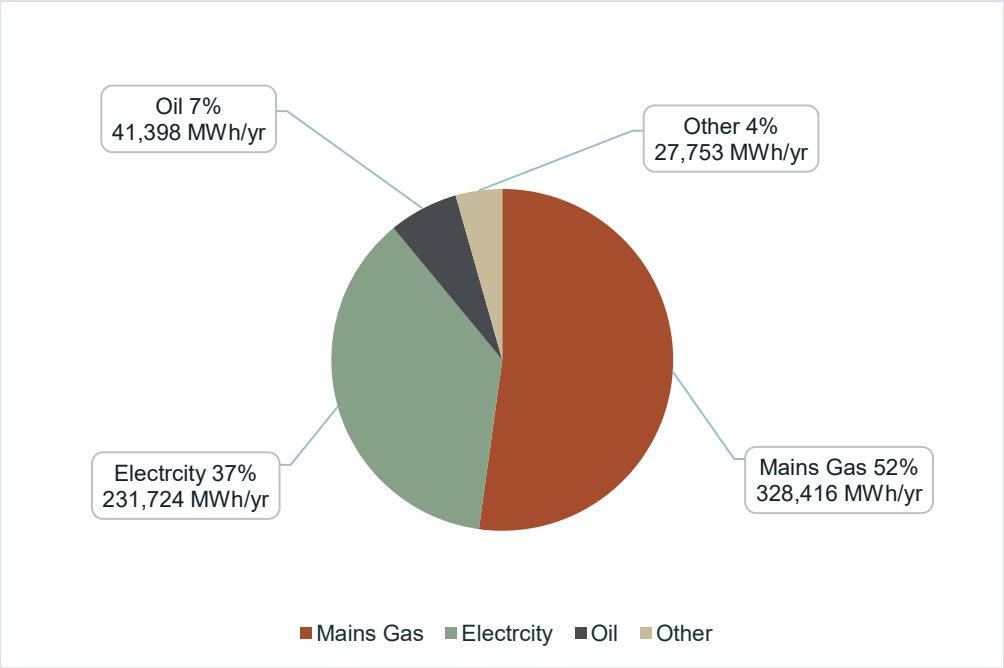


Figure 5-1 – Pie chart showing heating demand and percentage of total heat demand across all non-domestic building heating sources in Ayrshire.

The estimated sectoral breakdown of heat demand by source in non-domestic buildings can be seen in Figure 5-2, Figure 5-3, and Table 5-1. Details of how these numbers have been calculated can be seen in Appendix 2.

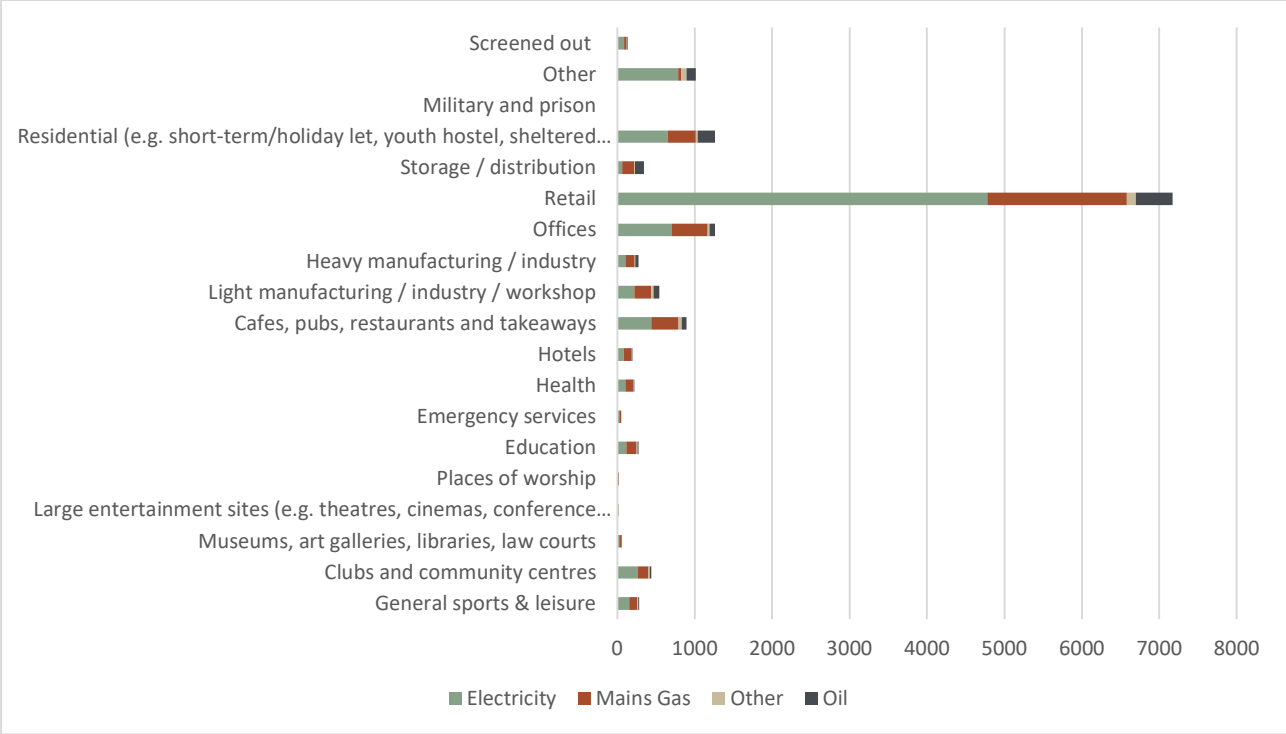


Figure 5-2 – Non-domestic heat source break down by sector in terms of the number of buildings (property count).

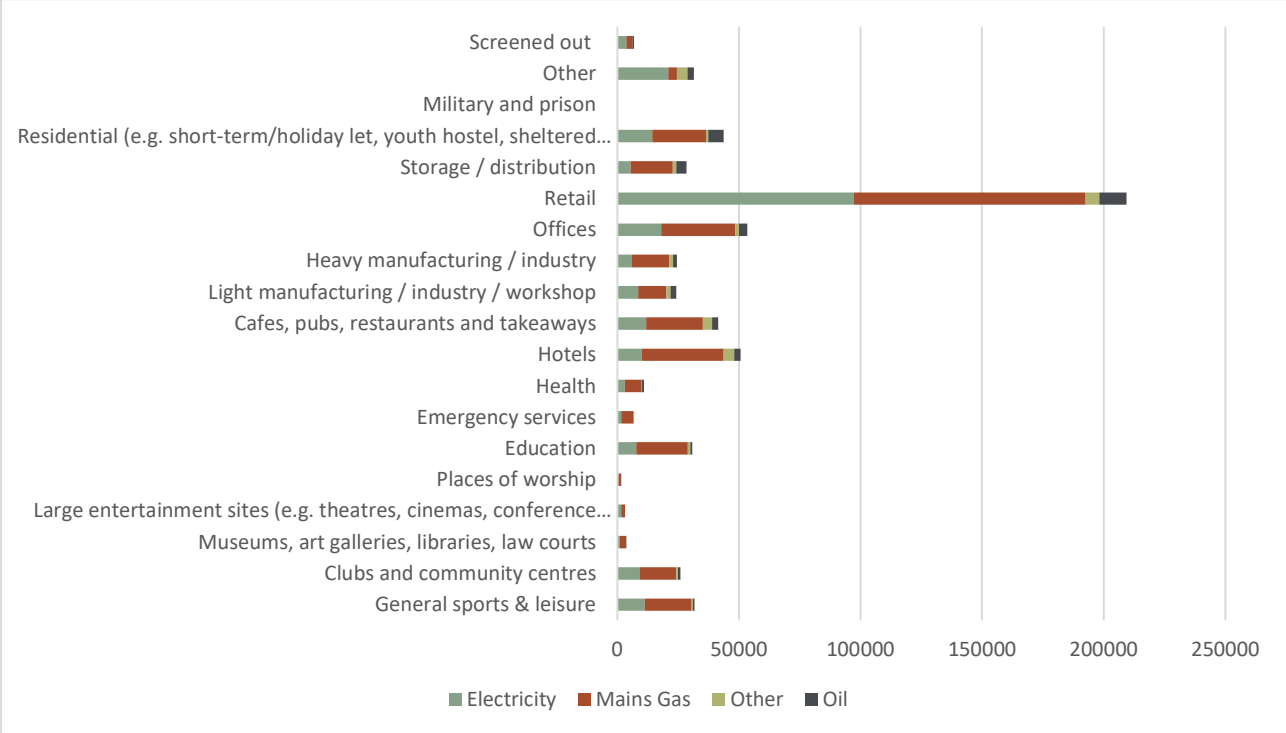


Figure 5-3 – Non-domestic heat source break down by sector in terms of estimated demand (MWh/year).

Table 5-1 – Non-domestic heat source break down by sector in terms of number of buildings (property count) and demand (MWh/year).

Property Typology	Electricity		Mains Gas		Other		Oil	
	(Count	MWh/Yr)	(Count	MWh/Yr)	(Count	MWh/Yr)	(Count	MWh/Yr)
General sports & leisure	155	11175	104	19386	10	556	12	654
Clubs and community centres	263	9091	141	15063	12	801	22	944
Museums, art galleries, libraries, law courts	25	919	30	2588	0	0	2	19
Large entertainment sites (e.g. theatres, cinemas, conference centres)	14	1491	4	1703	0	0	0	0
Places of worship	9	482	8	926	0	0	1	102
Education	117	7826	135	21137	11	975	11	962
Emergency services	26	1496	21	4979	2	230	4	140
Health	103	3050	105	7066	3	76	9	818
Hotels	83	10071	93	33700	10	4334	12	2534
Cafes, pubs, restaurants, and takeaways	442	11764	349	23471	44	3772	59	2513
Light manufacturing / industry / workshop	219	8588	224	11655	24	1535	76	2476
Heavy manufacturing / industry	105	5901	117	15448	10	1619	42	1587
Offices	700	18144	466	30307	24	1523	72	3491
Retail	4781	97211	1798	95240	115	5711	478	11229
Storage / distribution	66	5433	150	17443	13	1321	116	4272
Residential (e.g. short-term/holiday let, youth hostel, sheltered accommodation)	652	14357	362	22044	27	969	219	6412
Military and prison	1	122	1	35	0	0	0	0
Other	786	21008	42	3605	62	4260	124	2639
Screened out	86	3594	31	2620	5	72	11	606

5.1.2 Domestic Heat Breakdown

Ayrshire's Domestic energy use for heat can be seen broken down by energy source in Figure 5-4. Details of how these numbers have been calculated can be seen in Appendix 2.

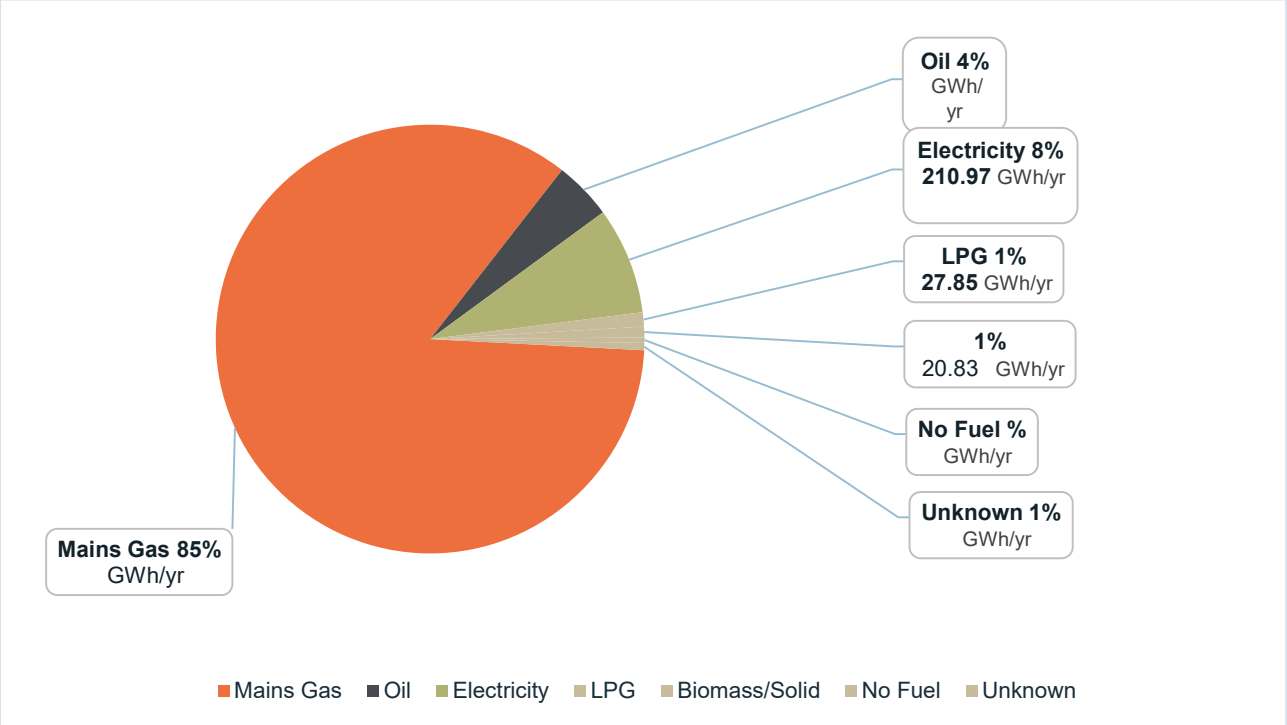


Figure 5-4 – Pie chart showing heating demand and percentage of total heat demand across all domestic building heating sources in Ayrshire.

5.2 Heat Approach and Investment Opportunities

The Ayrshire Energy Masterplan heat approach is recommended to be implemented through the following:

- Fabric first retrofit
- Zero carbon heating
- Heat networks

The relationship between **fabric improvements and zero carbon heating**, and how these interventions **lead to a net reduction in emissions** as part of a **just transition supported by community engagement** can be seen in the Theory of Change (ToC) shown in Figure 5-5.

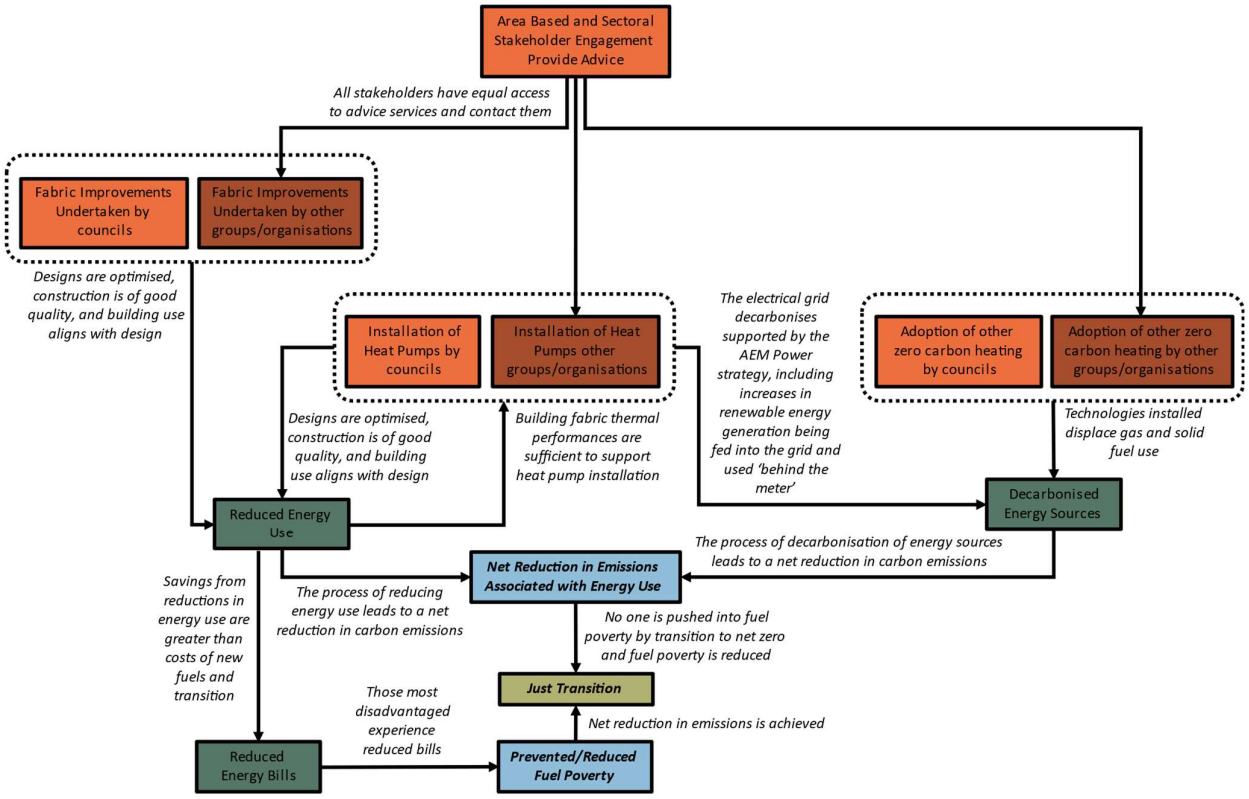


Figure 5-5 – AEM Retrofit Theory of Change showing the relationship between fabric improvements and zero carbon heating, and how these interventions lead to a net reduction in emissions as part of a just transition supported by community engagement.

The ToC shows that the route to impact is for **fabric improvements to reduce energy use first** which makes installation of **heat pumps viable, leading to further reductions in energy use**.

Electrification via the installation of heat pumps contributes towards the decarbonisation of heat alongside the adoption of other zero carbon heat sources. Then, providing the whole life carbon emissions are less than the reductions in emissions achieved by reducing energy use and decarbonising energy sources, a net reduction in emissions associated with energy use will be achieved.

It is recommended that councils take these steps across their own estates and provide advice in access funding and designing interventions through the recommended area-based and sectoral stakeholder engagement strategy recommended by the AEM.

There is an **opportunity to reduce fuel poverty** by ensuring that through community wide engagement those **most disadvantaged benefit from reduced energy bills** associated with reductions in energy use. **To ensure a just**

transition, carbon emissions must be reduced, and no one can be pushed into fuel poverty by transition to net zero heating.

As shown in the Theory of Change (ToC) in Figure 5-6, the recommendation for the development of heat networks is that the **recommended area-based and sectoral stakeholder engagement strategy be utilised to undertake feasibility studies of all heat network opportunities** identified as part of the AEM.

The ToC also shows that the **routes to impact for heat networks are through energy reductions**, as heat networks are an energy efficiency measure, and **adopting zero carbon technologies** to displace the use of energy sources that have inherent emissions.

As is the case for fabric improvements and zero carbon heating, t**o ensure a just transition, carbon emissions must be reduced, and no one can be pushed into fuel poverty by transition to net zero heating.**

There is also an **opportunity to reduce fuel poverty** by ensuring that through community wide engagement those **most disadvantaged benefit from reduced energy bills** associated with reductions in energy use where opportunities for heat networks are present.

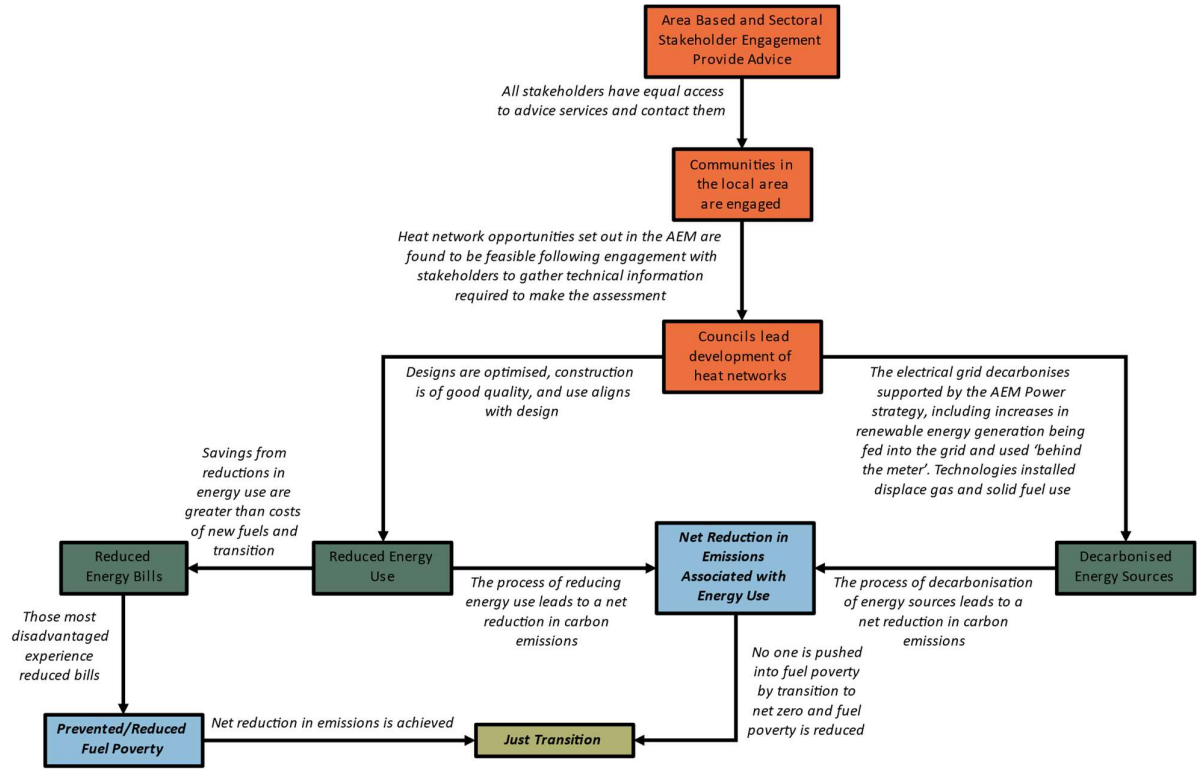


Figure 5-6 – AEM Heat Network Theory of Change showing how development of heat networks is expected to lead to a net reduction in emissions as part of a just transition supported by community engagement.

There is a Scottish Government target to reduce emissions from buildings by 33% between 2018-2032. This is approximately a 3% year on year reduction throughout this period which has been adopted by South Ayrshire Council. These targets are highlighted in Appendix 1.

Assisting communities and businesses to optimise their non-heating energy use is part of the AEM engagement strategy, however the extent that this activity will assist in achieving a net reduction in emissions is unknown. The

AEM heat approach is the primary means by which these targets are expected to be met through the ToCs shown in Figure 5-5 and Figure 5-6.

Scottish Government targets for overall reductions in emissions from buildings are discussed in Appendix 2. In direct reference to energy use, there are Scottish Government targets to reduce non-domestic heat demand by 20% by 2032 from 2018 levels (1.6% year on year) and reduce domestic heat demand by 15% by 2032 from 2018 levels (1.2% year on year).

The targets on heat demand relate to net reductions in emissions associated with energy use through the ToCs shown in Figure 5-5 and Figure 5-6, with reductions in emissions being achieved through the combined effect of reducing energy use and decarbonising energy sources to reduce a building's operational emissions. This is also shown in Figure 5-7. In addition, it is shown that reductions in emissions from reduced energy use and decarbonisation energy sources will be required to be greater than the targeted overall reduction in emissions from buildings due to whole life carbon associated with the works required to achieve the energy reduction targets.

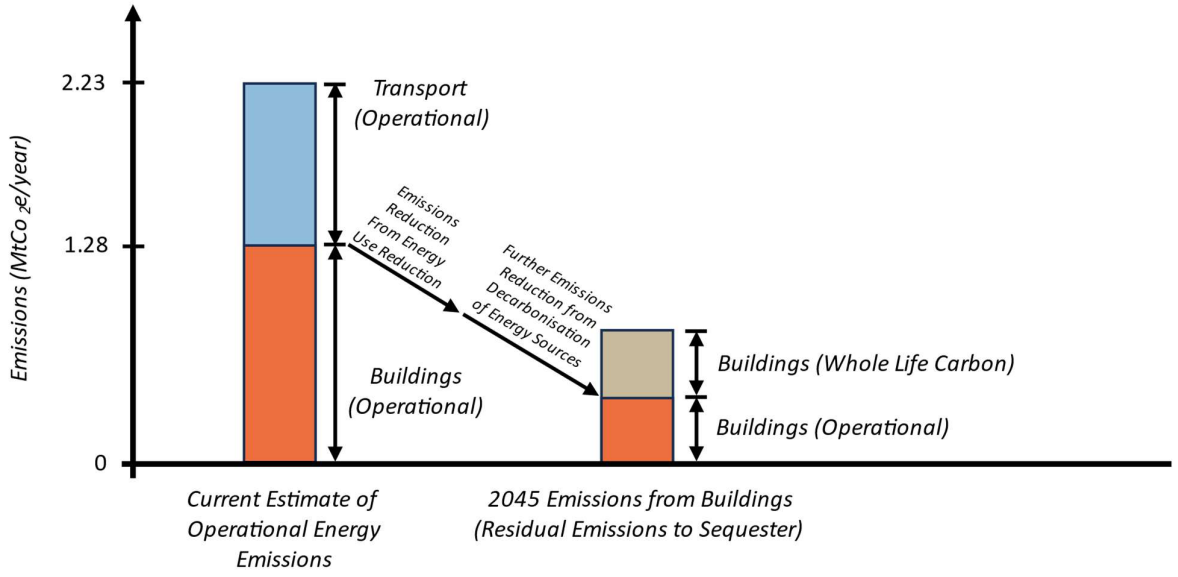


Figure 5-7 – Bar chart showing energy use reductions and decarbonisation of energy sources driving the reduction in emissions from current levels towards 2045 emissions from buildings target.

Information on business models for energy efficiency and decarbonisation of heat can be seen in Appendix 2.

5.2.1 Fabric First Retrofit

Fabric first retrofit means improving the thermal performance of a building to reduce energy use by modifying and enhancing the physical building first, then installing and/ or upgrading heating and ventilation systems to improve efficiency and further reduce energy use. Switching to low and zero carbon technologies as part of a fabric first retrofit process then further reduces operational emissions.

Fabric improvement measures are discussed in Appendix 4 and can include:

- Wall insulation
  - Cavity Wall Insulation (CWI)
  - External Wall Insulation (EWI)
  - Internal Wall Insulation (IWI)

- Window upgrades
- Doors upgrades
- Roof and or Loft insulation
- Floor insulation
- Heating Controls
- Hot-water cylinder insulation
- Draught-proofing

The targeted performances from each of these measures depends on the type of building and how the building is heated and ventilated, with guidance provided by the non-domestic handbook[1] and the domestic handbook[2].

Guidance on which measures would be appropriate for a building and funding can also be sought from The Carbon Trust[3] for non-domestic buildings and the Energy Saving Trust[4] for Domestic Buildings.

There are two pathways that are recommended in the AEM support for reducing energy use by improving building fabric thermal performance.

The first pathway is that **councils undertake fabric improvements** across their domestic and non-domestic estates.

The second pathway is that **councils engage with property owners and tenants through a recommended area-based and sectoral stakeholder engagement strategy** assisting all groups in identifying **interventions which encourage fabric first design methodology** that considering **occupancy and building use**, and **signposting to where funding is available**.

Achieving heat demand reduction, decarbonisation, and overall emissions from buildings targets will depend both on council led works, and works undertaken by private individuals, businesses, and other organisations. Heat demand will also increase when new buildings are constructed and occupied which will impact on these targets. Council policies and approaches for new buildings will determine the extent of these increases in heat demand within the council estates, alongside planning legislation and requirements which will determine increases in heat demand in other new build properties. Details of the policies and strategies can be seen in Appendix 1.

Ayrshire's buildings can be categorised as follows, with the routes to impact being different for each category.

- Public buildings (including council non-domestic properties and NHS buildings)
- Social housing (including council housing and housing association properties)
- Privately owned housing (both owner occupied and rented)
- Commercial and industrial premisses

[1] Building standards technical handbook June 2023: non-domestic - December 2023 addendum - gov.scot (www.gov.scot)
[2] Building standards technical handbook June 2023: domestic - December 2023 addendum - gov.scot (www.gov.scot)
[3] Climate Action Plans & Business Sustainability | The Carbon Trust
[4] Energy Saving Trust

Pathway 1 captures the buildings owned by the councils that are part of the public buildings and social housing categories, with routes to impact being through the council non-domestic and domestic retrofit strategies, aspects of which have been highlighted in Appendix 1.

Pathway 2 captures the remainder of the categories, including all other non-domestic and domestic buildings in Ayrshire. The non-council stakeholders in each category face differences in challenges and targets for retrofit, requiring differences in engagement through AEM recommended actions.

The impacts on energy use and emissions reductions from retrofit activities undertaken by each stakeholder group combine to form the overall impact. Buildings across Ayrshire could see improvements through retrofit; however, activities will be constrained by the challenges and limitations faced by each group. Prioritisation of geographic areas will also be driven by council Local Heat and Energy Efficiency Strategies (LHEES).

To support the installation of the insulation measures it is recommended that people in Ayrshire are continued to be offered support to train in carrying out these works. As set out in Appendix 5, insulation of a non-domestic building could support up to 20 one-off jobs in this field, and insulation of 100 domestic properties could support up to 10 one-off jobs in this field. If every domestic property in Ayrshire were insulated over a 20-year period, up to 1000 jobs could be created to undertake these works.

Figure 5-8 shows an extract of Figure 5-5 highlighting that fabric improvements impact on energy use and energy bills, showing that community engagement supports the implementation of fabric improvements.

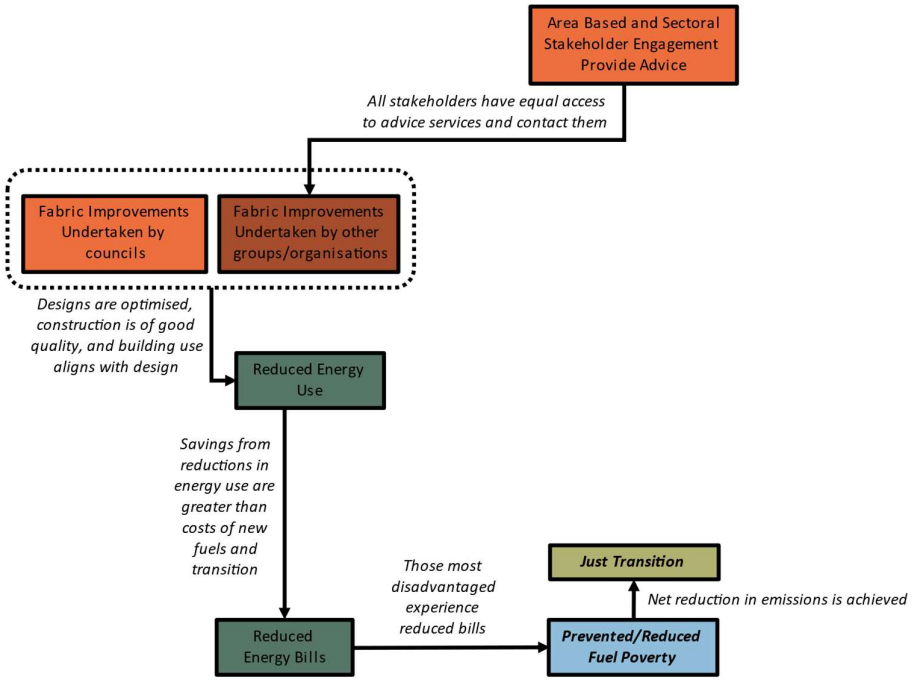


Figure 5-8 – Extract of the AEM Retrofit Theory of Change highlighting insulation measures impacting energy use and fuel poverty, supported by community engagement.

5.2.1.1 Retrofitting Public Buildings (Pathway 1)

The key targets in retrofitting public buildings are reductions in emissions from buildings and reducing heat demand by 20% by 2032 compared with 2018 levels. There are also targets for 70% of heat to come from low carbon sources in non-domestic buildings by 2032, and by 2030, 50,000 non-domestic buildings to convert to using zero or low emissions heating systems, with more information available in Appendix 1. There is a planned requirement for local authority buildings to have net zero emission heating systems by 2038.

It is recommended that a programme of retrofitting public buildings for net zero is taken forward, including all council non-domestic buildings and NHS buildings. Not all these buildings are part of the local authority remit, and taking this forward requires capital funding support from Scottish Government and private sector. Begin by undertaking feasibility studies on all buildings to estimate costs and understand funding requirements.

A sample of council non-domestic buildings were modelled using dynamic simulation modelling which is discussed in Appendix 4. With fabric improvements to bring buildings into line with thermal performances, set out in the non-domestic handbook[1], potential reductions in energy use intensity (EUI) were found to range from 7% to 77% (with associated potential carbon reductions ranging from 7% to 67%, and potential utility cost reductions ranging from 3% to 51%). The potential impacts on operational energy use, emissions, and costs of the electrification of heat including the installation of heat pumps are also set out in Appendix 4 for the properties modelled.

It is recommended that councils undertake extensive feasibility studies to gain a detailed understanding of what the potential energy savings could be across their non-domestic estates. Buildings that are located in areas highlighted by the AEM power approach for coordination of infrastructure upgrades should be prioritised for these feasibility studies, allowing for infrastructure upgrades to also support any upgrades to building heating and ventilation systems implemented alongside fabric improvements as part of the fabric first approach.

It is recommended that the NHS are coordinated with during the net zero feasibility process with the aim of coordinating infrastructure upgrades. This is where NHS buildings are within the same AEM power approach areas and where NHS buildings are near or rely on the same power and transport infrastructure as council non-domestic buildings, as captured by net zero feasibility studies or fabric first retrofit projects. These locations are identified in section 7.3 of this document.

5.2.1.2 Retrofitting Social Housing

The Scottish Government have set a requirement for all social housing to have an Energy Performance Certificate rating of B or better by 2032. There are also targets for 35% of heat to come from low carbon sources in domestic properties by 2032, and by 2030, 1 million homes to convert to using zero or low emissions heating systems. Further detail on targets can be found in Appendix 1.

The Scottish Government have also set targets relating to fuel poverty.

- By 2040, no more than 5% of households in Scotland are in fuel poverty and no more than 1% of households in extreme fuel poverty.
- By 2035, no more than 10% households in Scotland in fuel poverty and 3% extreme fuel poverty.
- By 2030, no more than 15% households in Scotland in fuel poverty and 5% extreme fuel poverty

East Ayrshire also have the target that by 2040 poor energy efficiency has been removed as a driver of fuel poverty in all social housing.

These targets are in addition to the target of reducing overall domestic heat demand by 15% by 2032 compared with 2018 levels (1.2% decrease year on year).

Social Housing (Pathway 1) – Council Properties

A sample of council domestic properties were modelled using dynamic simulation modelling which is discussed in Appendix 4. With fabric improvements to bring buildings into line with thermal performances set out in the non-domestic handbook[1], potential reductions in energy use intensity (EUI) were found to range from 12% to 43% (with associated potential carbon reductions ranging from 12% to 44%, and potential utility cost reductions ranging from 5% to 26%). The potential impacts on operational; energy use, emissions, and costs of the electrification of heat including the installation of heat pumps are also set out in Appendix 4 for the properties modelled.

The retrofit measures implemented by councils across their domestic estates will be driven by each of the council's strategies relating to housing discussed in Appendix 1, the EESSH2 requirement to achieve at least EPC B by 2032, fuel poverty targets, and the heat demand reduction target. It is recommended that the council LHEES recommendations in these areas be implemented. Note that the EESSH targets and EPC measurement methodology are under review by the Scottish Government.

Social Housing (Pathway 2) – Housing Association Properties

Parts of the social housing estate are part of Housing Associations who also have the requirement to ensure all properties are rated at least EPC B by 2032.

Key challenges highlighted by Housing Associations during the stakeholder engagement process detailed in Appendix 3 were:

- Costs of retrofit
    - Overall cost of required works being prohibitive.
    - Risk of making fuel poverty worse as costs of works are passed on to tenants through rents unless externally funded.
    - Costs of additional works required to enable insulation to be installed, for example structural works to increase the strength of walls before external wall insulation can be installed. These costs are often not covered by funding and can prevent or limit the number of properties housing associations can retrofit.
- Risk of electrification of heat making fuel poverty worse in cases where the high price of electricity mean that bills increase even in cases where energy demand for heat has been decreased by energy efficiency measures.
- Engaging with other owners in mixed tenure blocks.
- Developing retrofit strategies that take account of differences of different building typologies.
- Clarity on what the works are that housing associations are required to undertake to align with government requirements.

It is recommended that councils and housing associations engage through the recommended area-based stakeholder engagement strategy to assist in overcoming the challenges relating to fuel poverty and engaging with other owners in mixed tenure blocks.

Research is ongoing to support development of strategies to retrofit housing association social housing as part of East Ayrshire's Community Renewable Energy (CoRE) project. More information can be seen in Appendices 1 and 3. The recommendation is that the outputs from the CoRE research be used by housing associations to develop retrofit strategies for meeting EPC B requirements and reducing heat demand as far as possible to assist in meeting heat demand reduction targets.

5.2.1.3 Encouraging Retrofit of Privately Owned Homes (Pathway 2)

The Scottish Government have set the requirement for all privately owned housing to have an Energy Performance Certificate rating of C or better by 2040 where it is technically and financially feasible. In addition, targets for 35% heat to come from low carbon sources in domestic properties by 2032, and by 2030, 1 million homes to convert to using zero or low emissions heating systems. Further detail on targets can be found in Appendix 1

There are also Scottish Government targets relating to fuel poverty as follows, with more information available in Appendix 1.

- By 2040, no more than 5% of households in Scotland are in fuel poverty and no more than 1% of households in extreme fuel poverty.
- By 2035, no more than 10% households in Scotland in fuel poverty and 3% extreme fuel poverty.
- By 2030, no more than 15% households in Scotland in fuel poverty and 5% extreme fuel poverty

These targets are in addition to the target of reducing overall domestic heat demand by 15% by 2032 compared with 2018 levels (1.2% decrease year on year).

Homeowners are responsible for undertaking works to meet EPC C requirements. Funding opportunities change continually; however, some examples are presented in Appendix 6. The extent of the works undertaken by each homeowner will determine the overall impact privately owned homes have on achieving heat demand reduction targets. The requirement for EPC C where feasible acts as a driver to encourage homeowners to insulate their properties in addition to the motivation from potential savings on energy costs.

Cost and engaging with neighbours in mixed tenure blocks are significant barriers property owners face. In some areas, and for some buildings, planning constraints limit what property owners can do externally.

It is recommended that councils engage with homeowners through the recommended area-based strategy to assist homeowners in designing net zero interventions encouraging a fabric first approach, to assist in accessing funding, and to engage with other owners in mixed tenure blocks.

Private Properties (Pathway 2) – Owner Occupied Homes

Where people own their own home, energy reductions leading to savings on bills is a driver for homeowners to insulate their homes. It is recommended that as part of engagement with this group, homeowners are encouraged to go beyond EPC C where possible and maximise heat demand reductions.

It is recommended that owner occupiers are encouraged to consider fuel poverty, and any risks posed by works they are considering.

Where owner occupiers are experiencing fuel poverty it is recommended that they are engaged through the recommended area-based stakeholder engagement strategy.

Private Properties (Pathway 2) – Privately Rented Homes

Tenants are not responsible for and have no control over any works required to make their homes comply with the EPC C requirement. Property owners are responsible for the upfront costs of works; however, tenants may pay for the works through increases in rent.

Technologies installed as part of retrofit works may lead to increases in bills for tenants, which could have a detrimental impact on fuel poverty.

It is recommended that the recommended area-based stakeholder engagement strategy facilitates access to advice services, for both property owners and tenants.

5.2.1.4 Encouraging Retrofit of Commercial and Industrial Premises (Pathway 2)

Retrofit of commercial premisses contributes towards achieving the 20% reduction in heat demand in non-domestic properties by 2032 compared with 2018 levels, and the target for 70% heat to come from low carbon sources in non-domestic buildings by 2032, and by 2030, 50,000 non-domestic buildings to convert to using zero or low emissions heating systems, with more information available in Appendix 1.

It is recommended that councils engage with businesses through both the recommended area-based strategy and existing sectoral engagement to assist commercial property owners in implementing net zero interventions encouraging a fabric first approach, and to assist in accessing funding.

5.2.2 Zero Carbon Heating Technologies

The key targets for adopting zero carbon heating are: 70% of non-domestic and 35% of domestic heat from low carbon sources by 2032, and by 2030, over 1 million homes and 50,000 non-domestic buildings to convert to using zero or low emissions heating systems. More information on these targets can be found in Appendix 1.

For existing properties, it is recommended that adoption of zero carbon heating technologies is facilitated and encouraged as part of a fabric first approach with engagement with stakeholders as set out under the Fabric First Retrofit section of this document. It is recommended that stakeholders consider fabric improvements to mitigate potential increases in energy bills. However, installation of zero carbon heating technologies without fabric improvements may be appropriate for some stakeholders and buildings. The recommendation is that costs, emissions, and energy use are considered in the decision-making process, and that all stakeholders are supported to gather and understand the evidence against these factors in order to make decisions.

For new build properties it is recommended that electrically powered, and other zero carbon heating systems, are incorporated into the building design as part of a fabric first design approach for maximising energy efficiency and minimising emissions.

Electrification of heat is the primary means by which heat is, at present, recommended to be decarbonised, supported by new renewable generation and energy storage both ‘behind the meter’ and as part of the wider decarbonisation of the electrical grid.

Figure 5-9 shows an extract of Figure 5-5 highlighting that community engagement supports the adoption of zero carbon heating, electrification supports decarbonisation, and that energy reductions may be required to facilitate the installation of heat pumps leading to further energy use reductions.

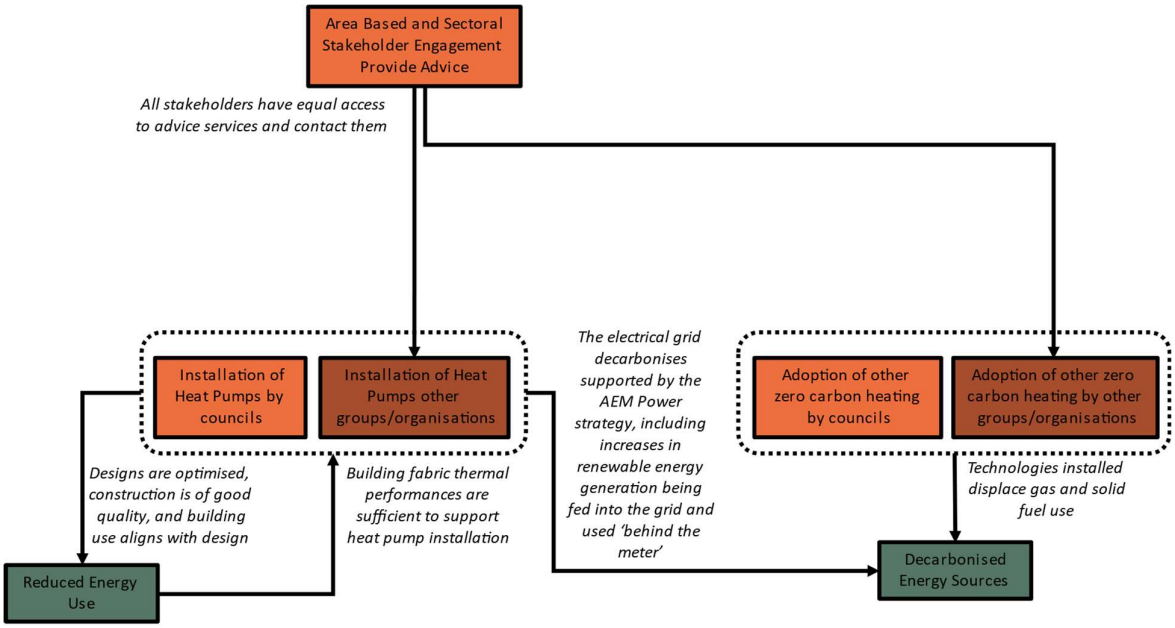


Figure 5-9 – Extract of the AEM Retrofit Theory of Change highlighting community engagement supporting the adoption of zero carbon technologies, the role of electrification in decarbonisation of heat, and heat pumps enhancing reductions in energy use.

Adoption of other zero carbon heating technologies, the extent of heat networks and their designs, and the role hydrogen may play in heating will each play a part in determining the full extent to which electrification is the best option for decarbonising heat. Electrification of heat and the installation of heat pumps (which are typically electrically powered) will be driven by council Local Heat and Energy Efficiency Strategies (LHEES).

The role hydrogen will play in domestic heat will be determined by the UK Government Heat Policy decision in 2026, however it is recommended that steps are taken to enable hydrogen to replace much of the non-domestic, particularly industrial, demand currently provided by gas. The recommended steps for councils to take are set out as part of the AEM power approach.

Achieving energy demand reduction, decarbonisation, and overall emissions from buildings targets for heat will depend both on council led works, and works undertaken by private individuals, businesses, and other organisations.

5.2.2.1 Heat Pumps

As discussed in Appendix 4, conversion to direct electric heating for the sample of non-domestic buildings modelled could result in heating bill increases ranging from 21% to 48%, with increase ranging from 26% to 52% in domestic properties. Installation of air source heat pumps for the buildings modelled could result in impacts on heating bill costs, ranging from a decrease of 42% to an increase of 22% for non-domestic buildings, and a decrease ranging from 2% to 5% for domestic properties. These numbers highlight the risk of increased bills with electrification of heat that sits alongside the opportunity to reduce bills. The numbers also highlight that exploring the installation of heat pumps often provides a greater likelihood of bills being reduced, or achieving greater reductions in operational costs, however for an individual building there is a risk that electrification of heat through installation of a heat pump may increase bills. This lends weight to the recommendation that a fabric first design approach is taken.

There is a UK Government target for 600,000 heat pumps to be installed by 2028. Installations by councils and other groups across Ayrshire will contribute towards this target. As is the case with other zero carbon heating

technologies. It is recommended that heat pumps are installed and encouraged to be installed through the stakeholder engagement pathways set out in the Fabric First Retrofit section of this document.

To support the installation and maintenance of heat pumps it is recommended that people in Ayrshire are trained in carrying out these works.

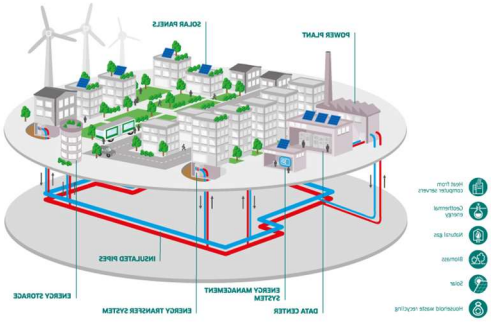
As set out in Appendix 5, if every domestic property in Ayrshire had a heat pump installed over a 20-year period, up to 400 jobs could be created to undertake the installation and maintenance works.

It is recommended that installation of heat pumps in public buildings be coordinated with infrastructure upgrades associated with development of; heat networks, transport hubs, and electric vehicle charge point installations. The locations of these potential developments are set out as part of the AEM Power approach.

5.2.3 Heat Networks

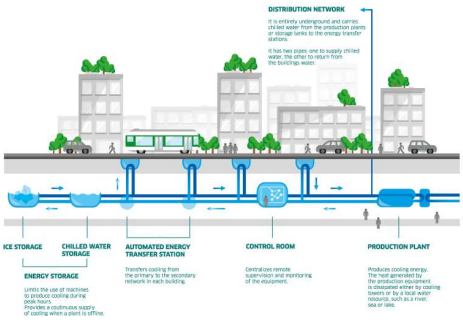
There are Scottish Government targets for 2.6 TWh of thermal energy to be supplied by heat networks by 2027, and 6 TWh by 2030 with more information available in Appendix 1. Development of heat networks in Ayrshire are recommended to contribute towards achieving these targets.

Areas identified for potential heat network development significantly contribute towards defining the areas where electrical infrastructure and transport infrastructure upgrades are being recommended to be investigated as a core part of the AEM Power approach. As part of these recommendations, it is recommended that feasibility studies across electrical and transport developments are coordinated so that combined options can be considered. The different potential developments in each area are set out as part of the recommendations of the AEM power approach in section 7.3 of this document.



(Image Source: District heating and cooling systems | ENGIE)

It is recommended that stakeholders are engaged through the area-based stakeholder engagement strategy which development of has been recommended. Supporting information gathering for feasibility studies and subsequent development of the heat networks, if they are technically feasible. Where properties are near to heat networks but cannot be connected to the networks, it is recommended that the stakeholders (owners, tenants, businesses, and facility managers) be engaged through the recommended area-based strategy to explore how they can benefit from infrastructure upgrades.



10 potential heat networks across Ayrshire were identified as part of the analysis undertaken by the Ayrshire Energy Masterplan. These are discussed below, and a story map[5] has been produced where interactive versions of the maps below are available.

The number of properties contained within the areas identified for each potential heat network opportunity are shown in **Table 5-2** which has been extracted from Appendix 5 where the potential socio-economic impacts of developing these opportunities are set out in detail.

(Image Source: District heating and cooling systems | ENGIE)

[5] Ayrshire Energy Masterplan (arcgis.com)

Table 5-2 – Number of properties within potential heat network opportunities

Cluster Reference	Potential Heat Network Opportunity	Non-Domestic	Domestic	Total
A	Drongan	6	119	125
B	Cumnock	509	116	625
C	Kilmarnock 1	589	1,310	1,899
C	Kilmarnock 2	19	387	406
C	Kilmarnock 3	10	231	241
D	Ayr 1	282	764	1,046
D	Ayr 2	9	519	528
E	Ayr 3	13	18	31
F	Irvine	13	249	262

If all of these opportunities were developed in parallel, between 15,060 and 18,760 people could be required to undertake the construction work, and on a per opportunity basis between 110 and 10,940 people could be required depending on the size of the heat network. More information is set out in Appendix 5.

Maps of the potential heat network opportunities listed in **Table 5-2** can be seen in Figure 5-10 to Figure 5-17.

Note that potential heat networks were identified based on existing heat demands, however potential further expansion of the boundaries of possible heat networks was identified based on locations of existing heat networks.

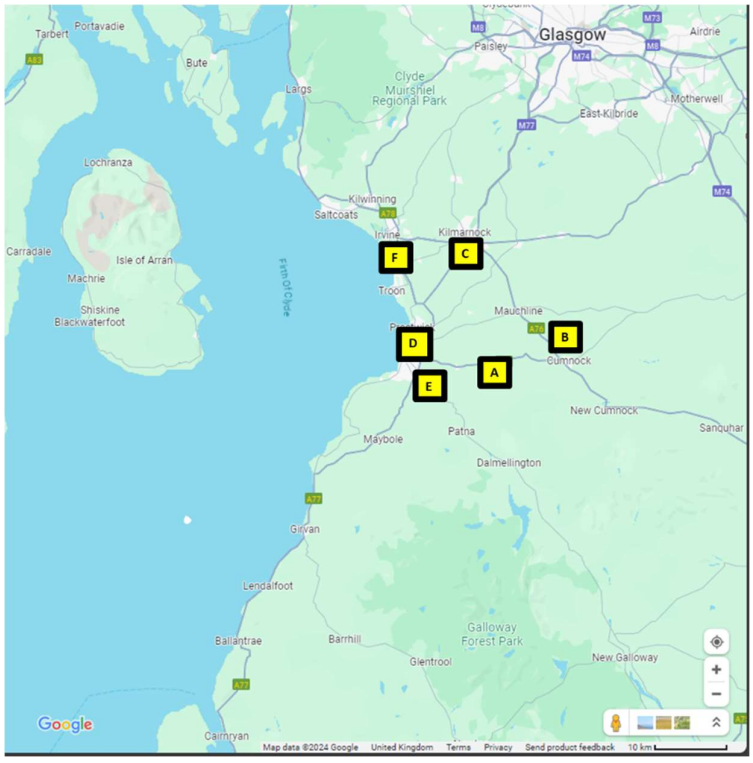


Figure 5-10 – Google Map overmark showing locations of investment opportunity clusters with potential for heat networks (Map Source: https://www.google.co.uk/maps).

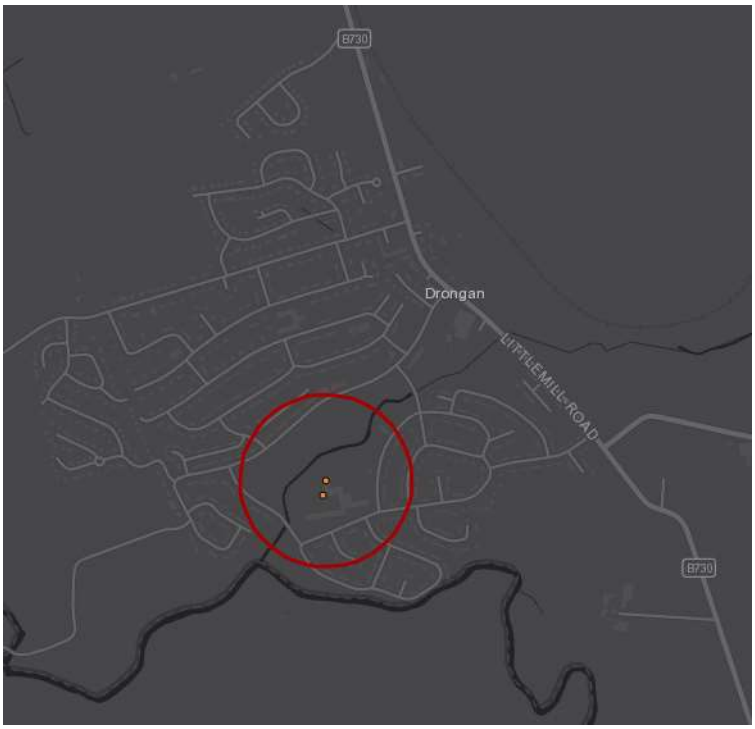


Figure 5-11 – Map of potential Drongan heat network opportunity (cluster reference A).

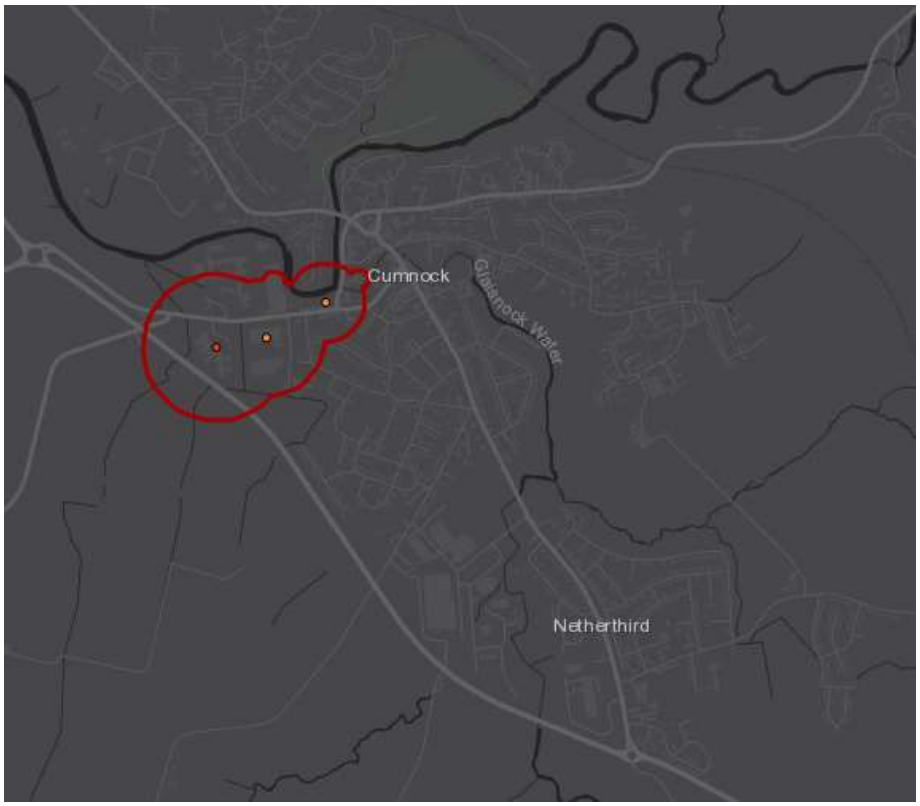


Figure 5-12 – Map of potential Cumnock heat network opportunity (cluster reference B).

Figure 5-13 – Map of potential Cumnock heat network opportunity and potential further expansion of the opportunity (as indicated by the resulting perimeter with the addition of the shaded blue circles) (cluster reference B).

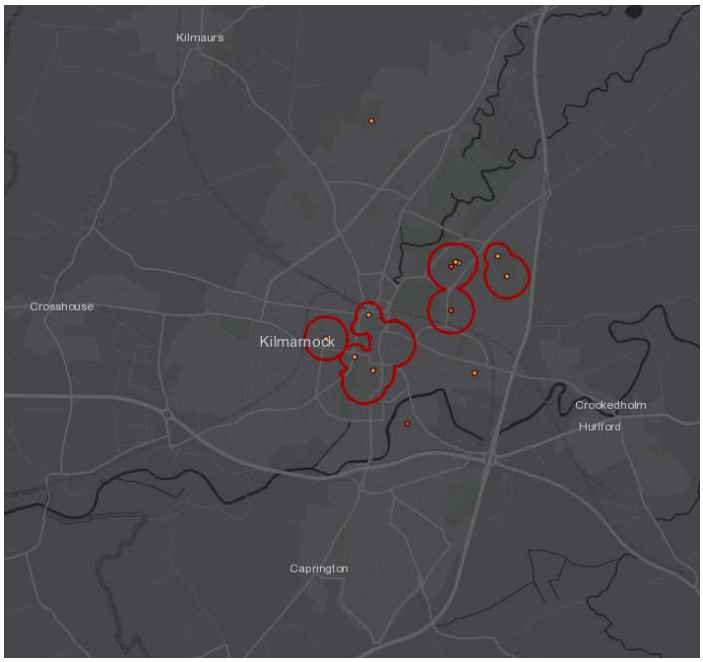


Figure 5-14 – Map of potential Kilmarnock heat network opportunities (cluster reference C).

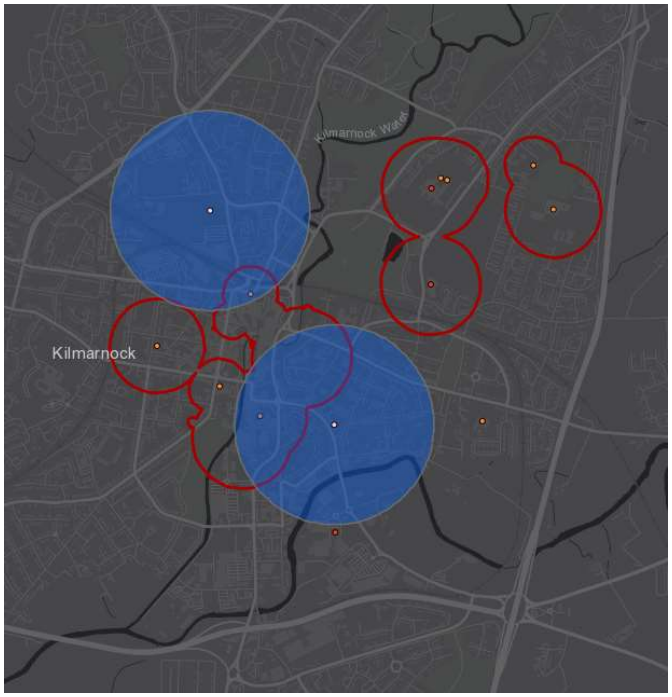


Figure 5-15 – Map of potential Kilmarnock heat network opportunities and potential further expansion of the opportunity (as indicated by the resulting perimeter with the addition of the shaded blue circles) (cluster reference C).

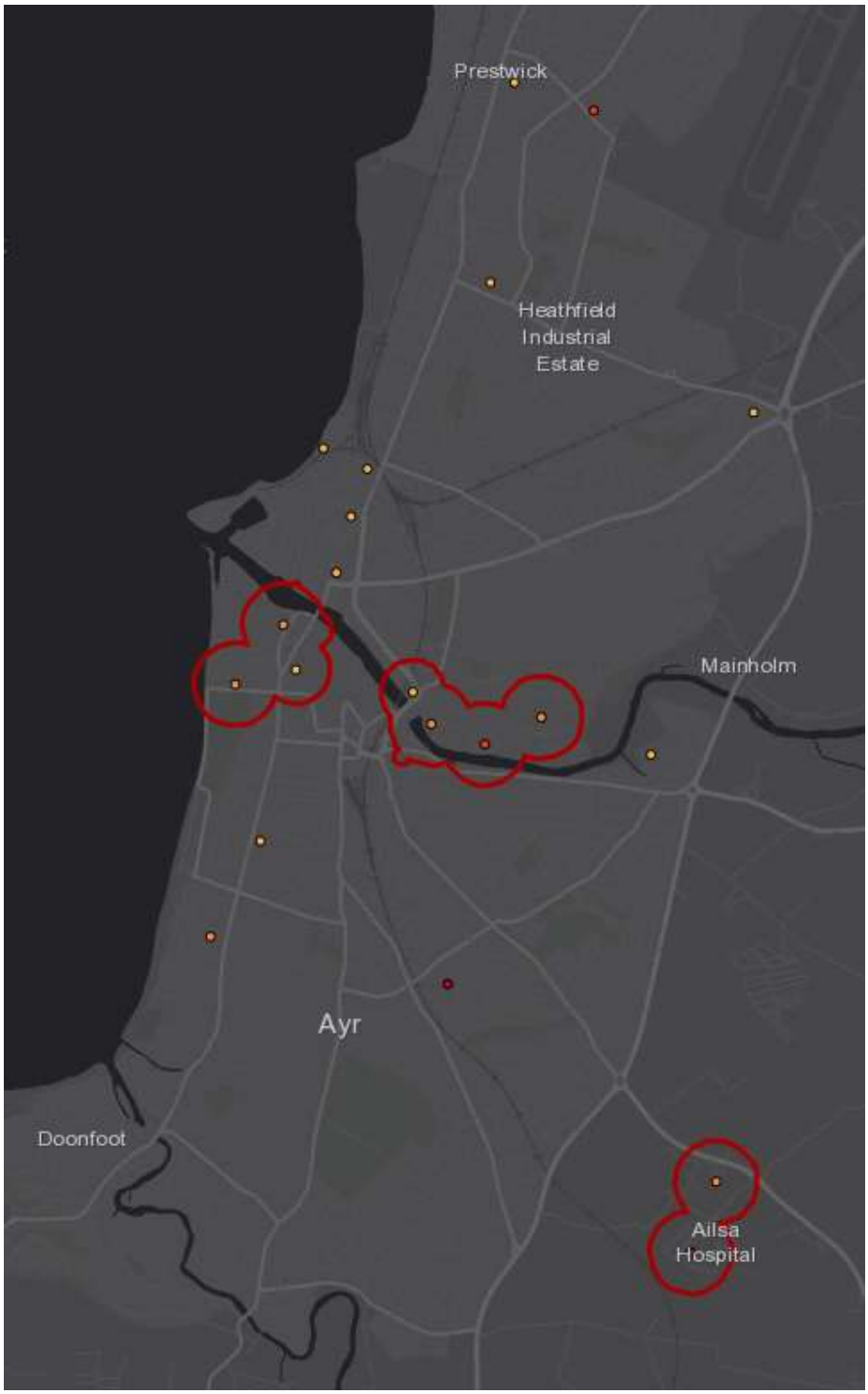


Figure 5-16 – Map of potential Ayr heat network opportunities (cluster references D and E).

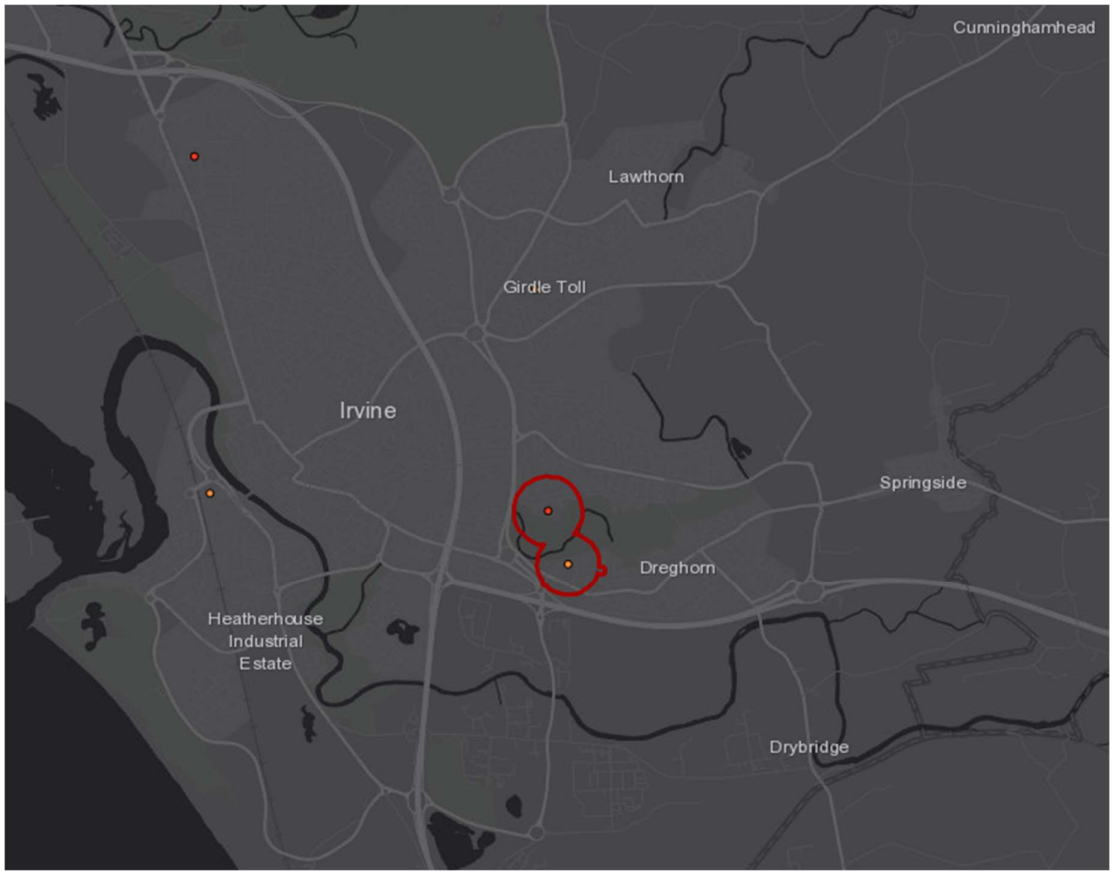


Figure 5-17 – Map of potential Irvine heat network opportunities (cluster reference F).

5.2.3.1 Ground Source Heat and Heat Storage in Mines

It is recommended that, in line with the LHEES methodology, the feasibility of greenspaces within and near the identified potential heat networks to provide ground source heat is assessed. These green spaces are detailed in the story map[5].

It is recommended that opportunities be explored in relation to the storage and extraction of heat in mines as part of the heat network feasibility studies to take advantage of Ayrshire's disused mines, the depths of which are mapped in Figure 5-18 and Figure 5-19.

(Image Source: Barony A Frame - Ayrshire Colliery Memorial" by kitmasterbloke is licensed under CC BY 2.0.)

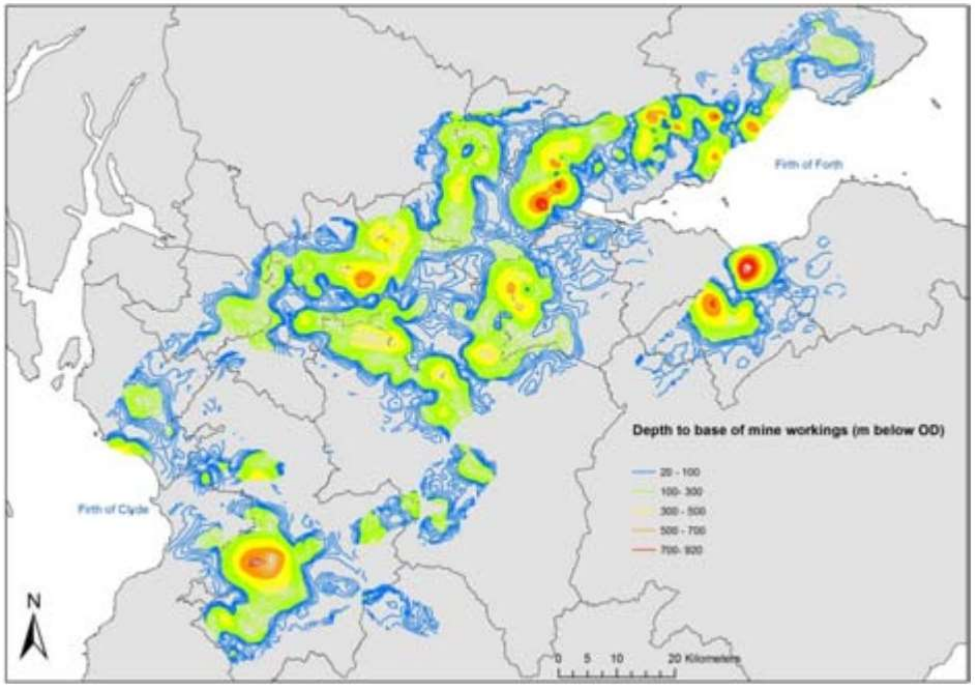


Figure 5-18 – Depth of mine workings in the Central Scotland including Ayrshire, viewed in GOCAD® (©Paradigm) 3D modelling software, and showing deepest workings in orange and red (Image Source: Depth of mine workings (interpolated from SOBI data), showing deepest... | Download Scientific Diagram (researchgate.net)).

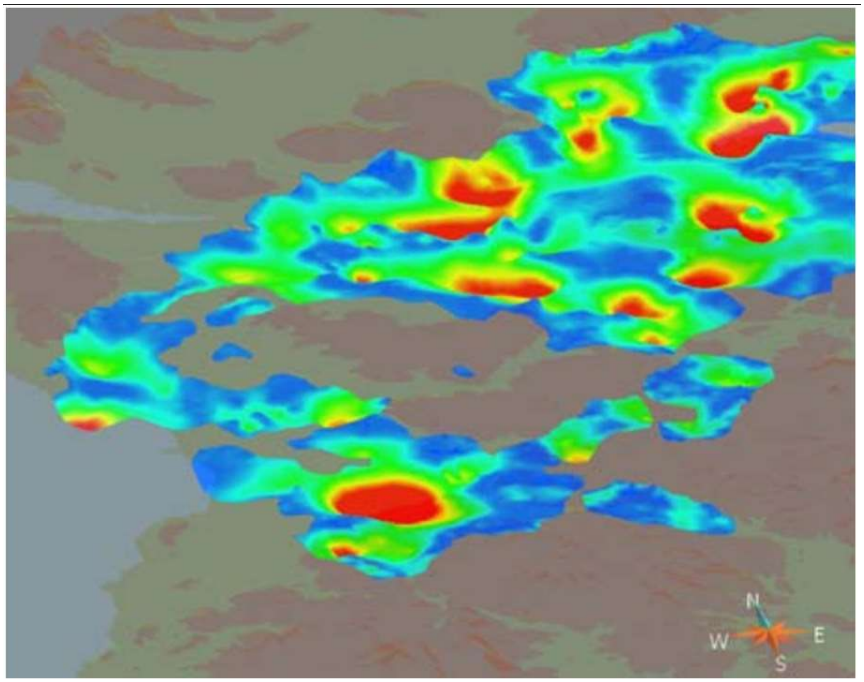


Figure 5-19 – Depth of mine workings in the Ayrshire, Douglas and Central coalfields, viewed in GOCAD® (©Paradigm) 3D modelling software and showing deepest workings in orange and red (Image Source: Depth of mine workings in the Lothians, Fife and Central coalfields,... | Download Scientific Diagram (researchgate.net)).

6. Transport Approach and Investment Opportunities

Options for reducing emissions include transition of passengers and freight between modes of transport, and decarbonisation of each mode.

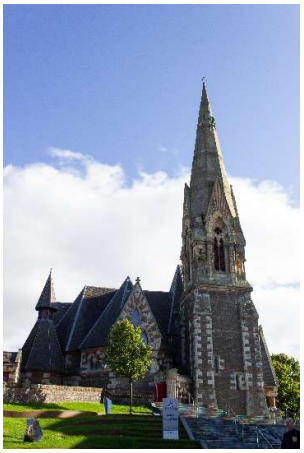
During engagement with the AEM Stakeholders, challenges were identified relating to the capacity of port and rail infrastructure to support the development of renewable generation capacity within and out of Ayrshire. It was also highlighted that adoption of Electric and or Hydrogen powered vehicles are the routes preferred by stakeholders to decarbonisation of modes of transport both for individuals and for public transport.

Electric and hydrogen cars, and electrified and hydrogen powered public transport, share the same or similar infrastructure. Also, improvements in public transport would reduce the requirements for development of infrastructure to support the adoption of electric or hydrogen cars. It is recommended that installations of EV charge points to meet projected demands are strategically aligned with improvements to, and decarbonisation of, public transport. It is recommended that this includes meeting peak season demands where these occur. This means considering greater numbers of EV chargers being installed at tourist and leisure sites and transport hubs.

As part of the decarbonisation of transport, the Scottish Government have introduced targets to phase out new petrol and diesel cars as well as reduce car kilometres by 20% by 2030. Details of these targets can be found in Appendix 1.

In addition to the ongoing replacement of council fleets, it is recommended that encouragement of the adoption of electric and hydrogen vehicles be one way that the AEM assists in phasing out diesel and petrol vehicles. This is by providing ways for people to access energy to run their vehicles by installing charging points and or developing a supply of hydrogen to power vehicles.

Note that the whole life carbon associated with electric and hydrogen powered vehicles, will require to be offset to achieve net zero in line with the discussion of whole life carbon in section 2.2 of this document.



Improvements to public transport are recommended to provide an alternative to private vehicles as another way to phase out petrol and diesel vehicles, and as one way of reducing the number of kilometres travelled by car. Developing transport hubs and active travel routes together is another way that is recommended to decrease the use of cars by making public transport more accessible and convenient. Installation of electric vehicle chargers at transport hubs is also recommended to make use of public transport more appealing and support access whilst encouraging reductions in the distance travelled by cars.

Equal access to public transport for those with mobility issues should be maintained and enhanced as part of improvements and transition to net zero. It is recommended that training be facilitated or provided to increase the number of drivers able to drive heavier vehicles that are required as part of the decarbonisation of public transport, including community transport groups.

Overall, the areas to be developed in relation to transport are:

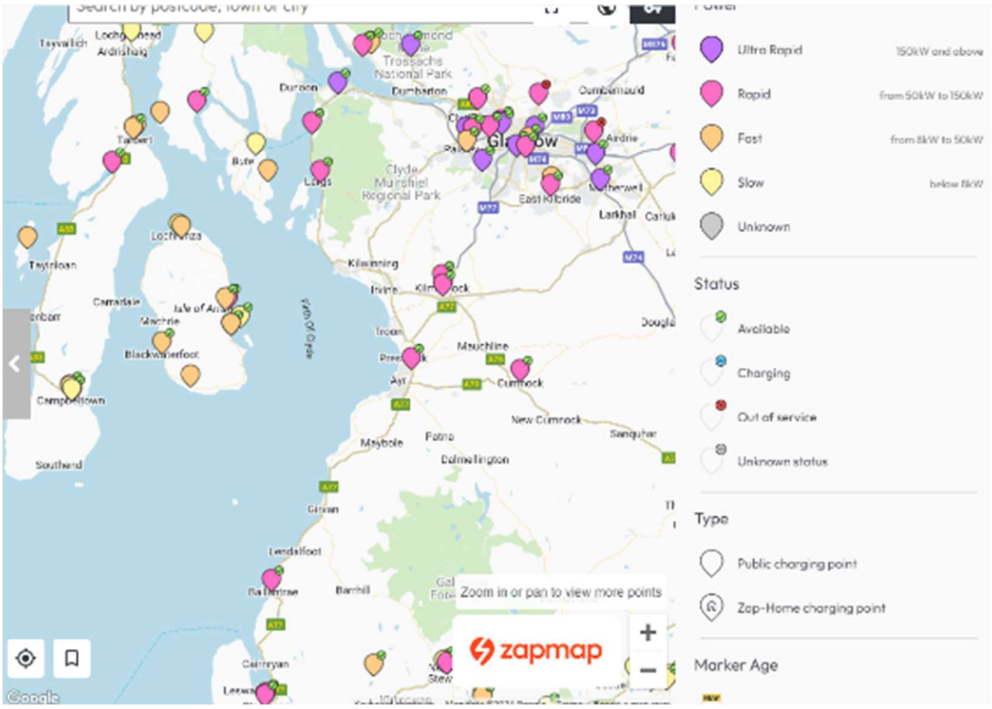
- **EV Charging Infrastructure**
- **New and existing public transport routes/systems**
- **Replacement of existing fleets with either electric or hydrogen powered vehicles**
- **Ferries**

The projected needs for publicly available electric vehicle charge points are discussed in Appendix 5, and details can be seen in **Table 6-1**. Consideration is also given to the role hydrogen may play in transport in these projections.

120 people may be required to install and maintain the additional charge points required to meet projected demand. The full economic impact assessment can be seen in Appendix 5.

Table 6-1 - Ayrshire EV Public Charger Requirements

	Current Network (March 2024)	2030 requirement	2045 requirement
7kw charger	101	732	1,386
22kw charger	169	61	115
43kw charger	14	303	574
50kw charger	70	437	828
Total	**354**	**1,533**	**2,902**



(Image Source: Map of electric charging points for electric cars UK: Zapmap.)

It is recommended that charge points installation be coordinated with other power infrastructure upgrades being undertaken at existing transport hubs. There may also be opportunities to develop transport hubs and EV charging in locations where other power upgrades are planned due to development of heat networks and coordinate these infrastructure upgrades to minimise cost.

The optimal locations and connections between Ayrshire's transport hubs being recommended to be developed, is not known due to a lack of data on how many people use each route and where multiple modes of transport are used. There may be a need or opportunity for transport hubs to be located in places where there are no existing transport hubs or opportunities identified for heat networks.

Where potential opportunities to coordinate power infrastructure upgrades for EV charging, transport hubs, and electrified public transport these have been indicated as part of the AEM power approach.

It is recommended that data is collected to inform the development of transport hubs and guide improvements to existing routes. The data recommended to be collected is where people are currently traveling to and from and by what means, how people perceive their access to public transport, and information to assess the equality of access to public transport.

Maintained and improved accessibility of public transport was identified as a key priority by stakeholders.

Costs of purchasing electric vehicles was a key challenge identified by stakeholders.

Increased weights of electric vehicles compared with petrol or diesel mean that in some cases drivers require additional qualifications. This is a skills gap recommended to be addressed for freight and public transport.

The routes to impact discussed above are shown in the Theory of Change in Figure 6-1.

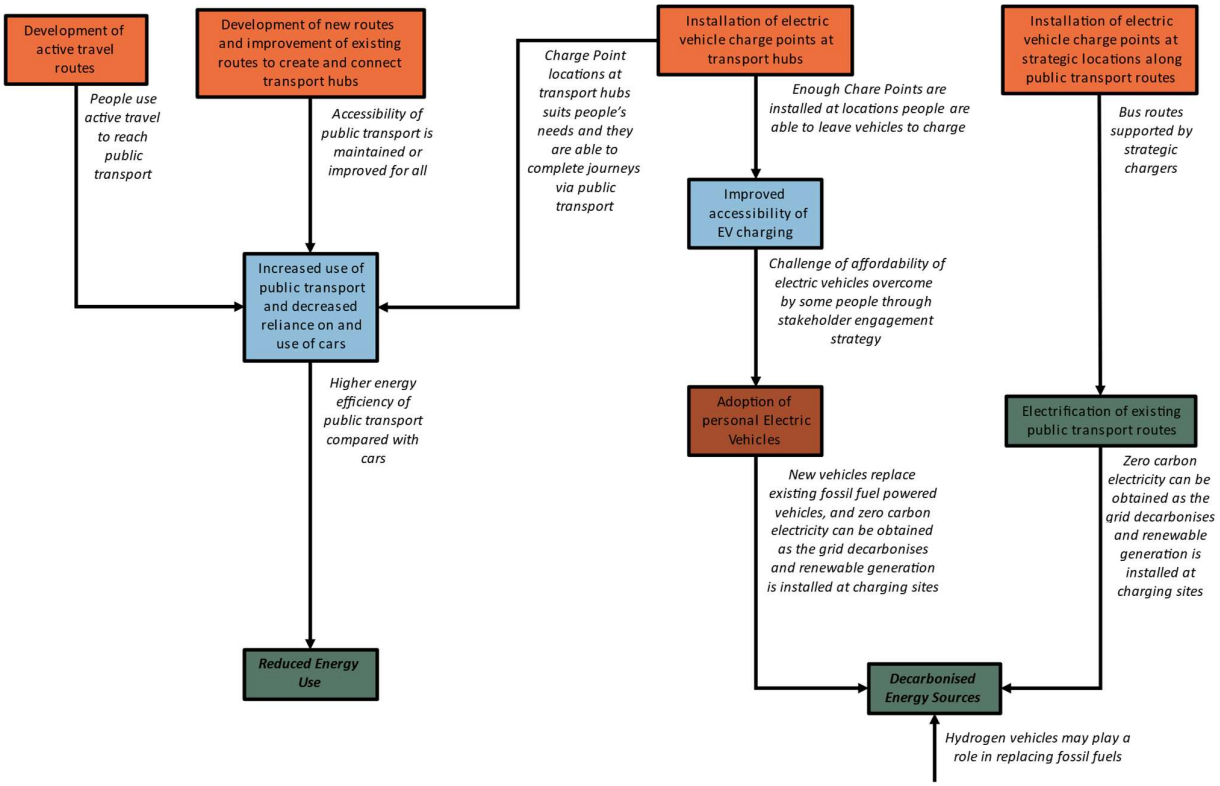


Figure 6-1 – Theory of Change showing how the AEM transport approach recommendations lead to reductions in energy use and decarbonisation of energy sources.

7. Power – Grid Infrastructure Development Strategy, Renewable Energy Development Strategy, and Links with Investment Opportunities

Priorities in relation to power are development of renewable generation and energy storage capacities.

Decarbonisation of the electrical grid is a grid-wide objective, encompassing extensive areas and energy systems out with Ayrshire. Increasing the proportion of energy used from renewable sources is an outcome that assists with grid decarbonisation and targets are discussed in Appendix 1. Ayrshire contributes towards this by increasing renewable generation capacity. This is limited by wider grid constraints which means that whilst the AEM supports the first objective of grid decarbonisation where possible, it may be the case that future development of renewable generation capacity will be providing power to off grid and or energy storage systems.

There is an abundance of natural wind resource and geo-thermal potential due to number of abandoned mine workings in Ayrshire which could be developed if greater grid capacity was available. However, with current developments being limited by grid connections it is recommended that further exploitation of these resources is investigated with consideration being given to increasing energy storage as an ancillary service to support in tacking grid capacity challenges.

7.1 Community Engagement, Renewable Energy, and Energy Networks

The recommendations remain to support communities through the recommended area-based engagement strategy in developing community owned renewable generation capacity, as well as supporting other renewable developers engage with communities for developments intending to connect to the grid. However, lack of a grid connection should not prevent a development proceeding, with the recommendation being to explore options relating to energy storage and using energy locally through energy networks. Information on business models to assist communities in renewable energy generation can be seen in Appendix 2.

It is recommended that all renewable energy developers be supported in providing power to energy networks and energy storage. This includes the generation of hydrogen for use in transport and industry in addition to energy storage for reconversion back to electrical power. It is also recommended that a pilot involving the distribution of hydrogen to domestic properties be considered ahead of the UK Government decision on the role of hydrogen in domestic heating due in 2026. This could be aligned with distribution of hydrogen to businesses, utilising the same distribution method and infrastructure if domestic properties are located near the industry being supplied.

7.1.1 Renewable Energy Sources: Rooftop Solar

Fitting solar panels to roofs is one potential community-based energy generation resource. Figure 7-1 shows how this resource is distributed across Ayrshire. Note that fitting panels may form part of a building retrofit. Note that water heating panels may be fitted instead of photovoltaic panels as a zero operational carbon water heating system to contribute towards meeting hot water demands. Discussion on the socio-economic impact of the installation of solar panels can be seen in Appendix 5.

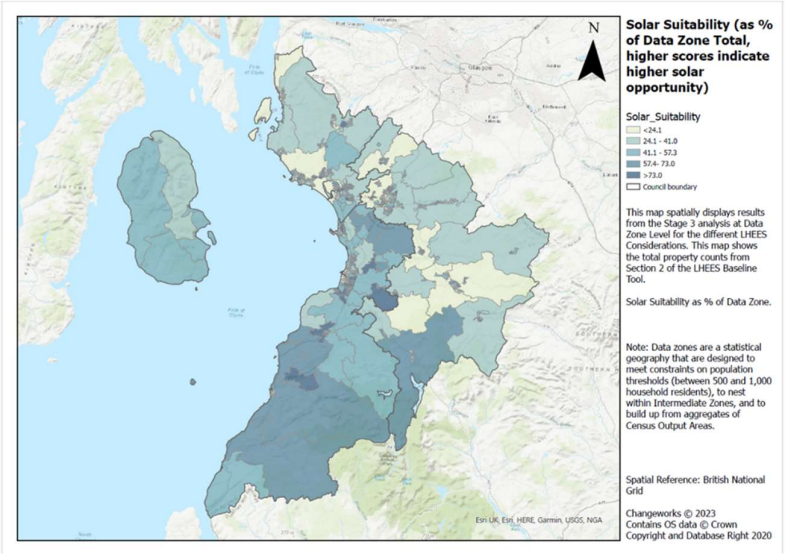


Figure 7-1 – Ayrshire map showing percentage suitability of solar PV per data zone

7.1.2 Renewable Energy Sources: Wind

The Ayrshire region is primarily situated on the West coast of Scotland and whilst provided some protection from the Isle of Arran and Northern Ireland further to the West, there is significant wind resource. As can been seen in the following maps, there is already a good network of wind turbines and wind farms, most notably the Whitelee windfarm.

The current situation in relation to the exploitation of Ayrshire's wind resources can be seen in Figure 7-2 to Figure 7-5. It is recommended that the development of Ayrshire's wind generation capacity is supported through energy storage and conversion as discussed in section 7.2 of this document.

Significant further development is restricted by grid capacity and a key recommendation of the masterplan is engagement with the DNO's, suppliers and communities to fully understand grid capacity, upgrade plans and programme for delivery to ensure that supply meets potential.

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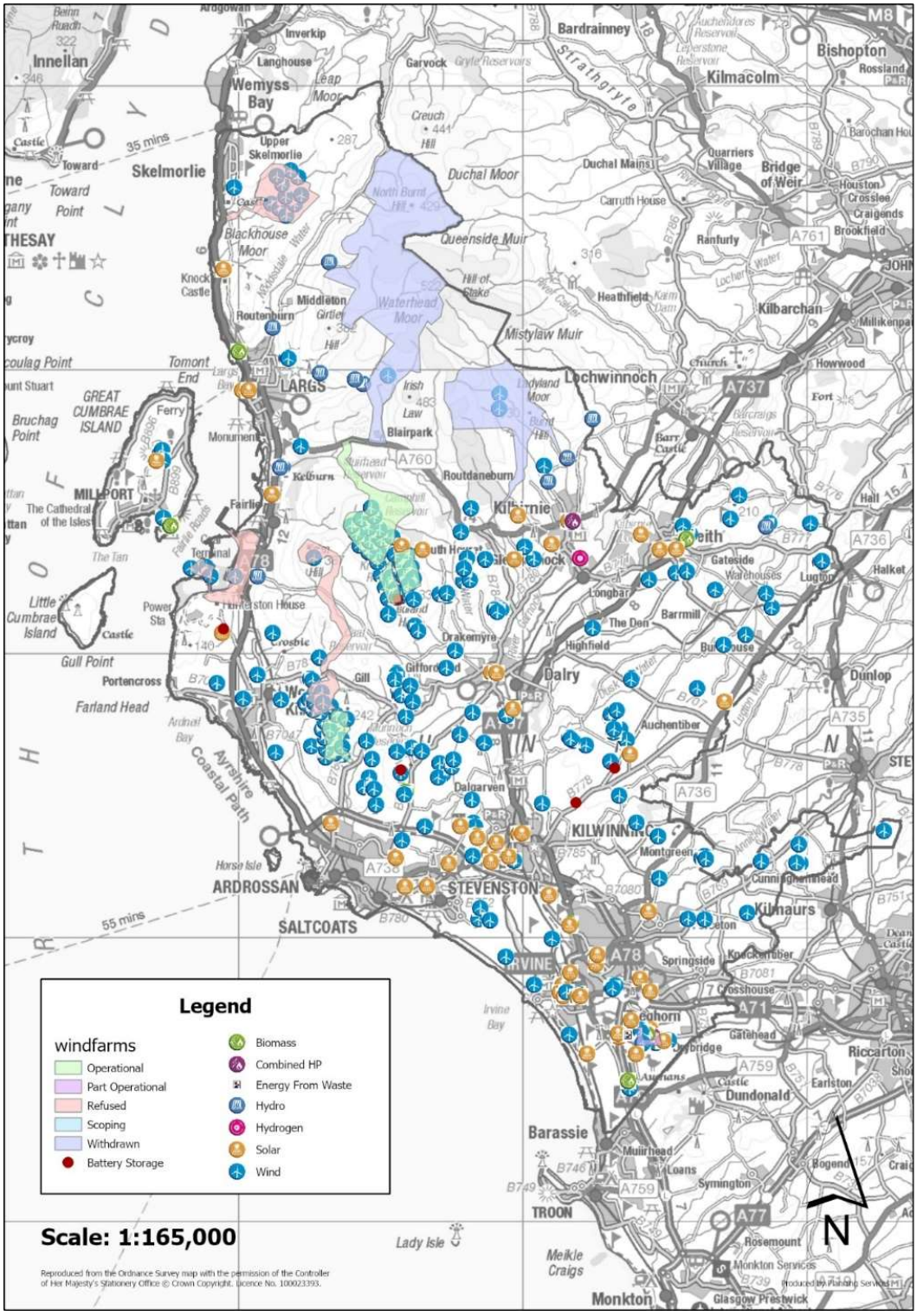


Figure 7-2 – Exploitation of North Ayrshire's Wind Resources.

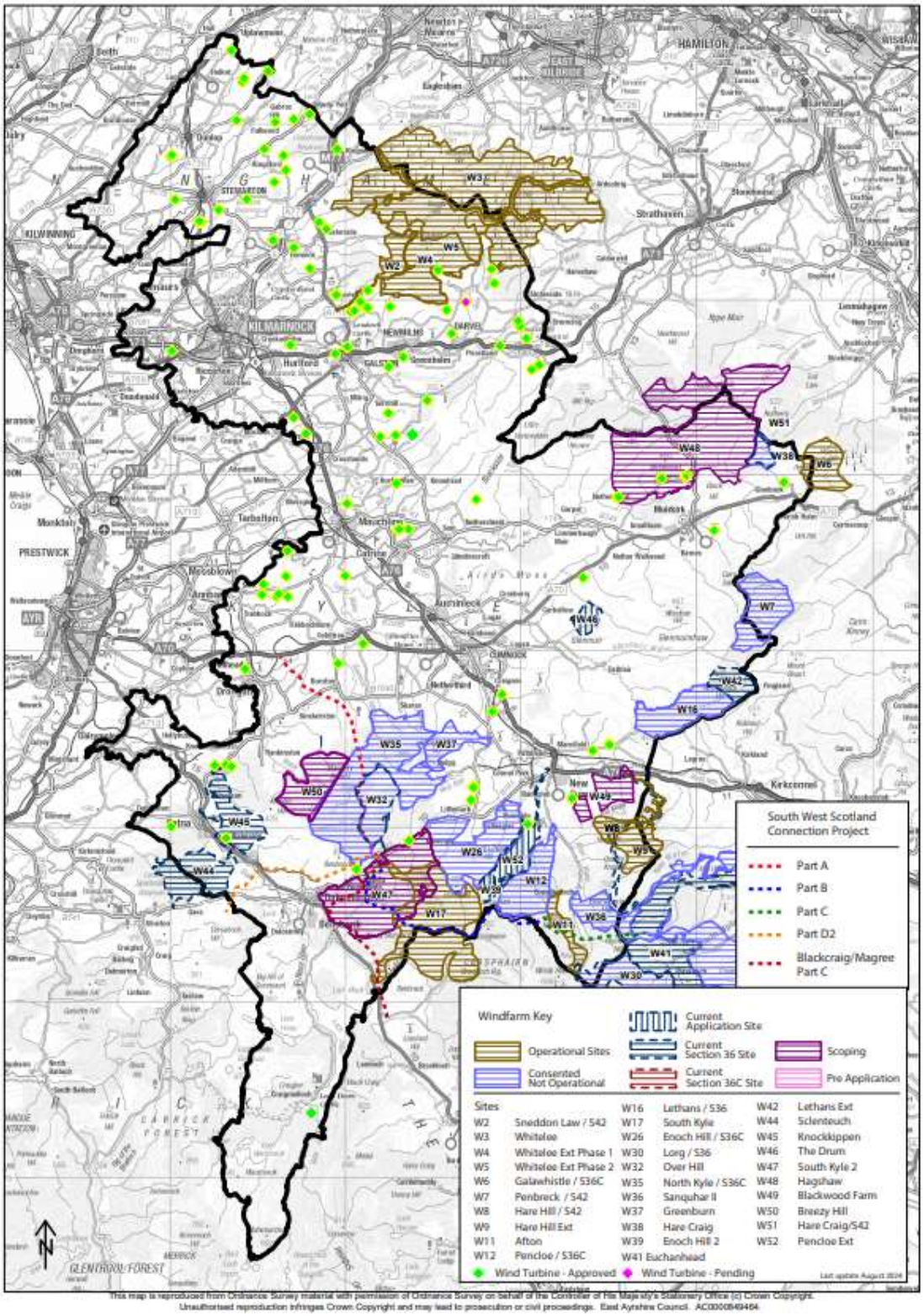


Figure 7-3 – Exploitation of East Ayrshire's Wind Resources (Image Source: [EA Web Wind Map August 2024 (east-ayrshire.gov.uk)](#).

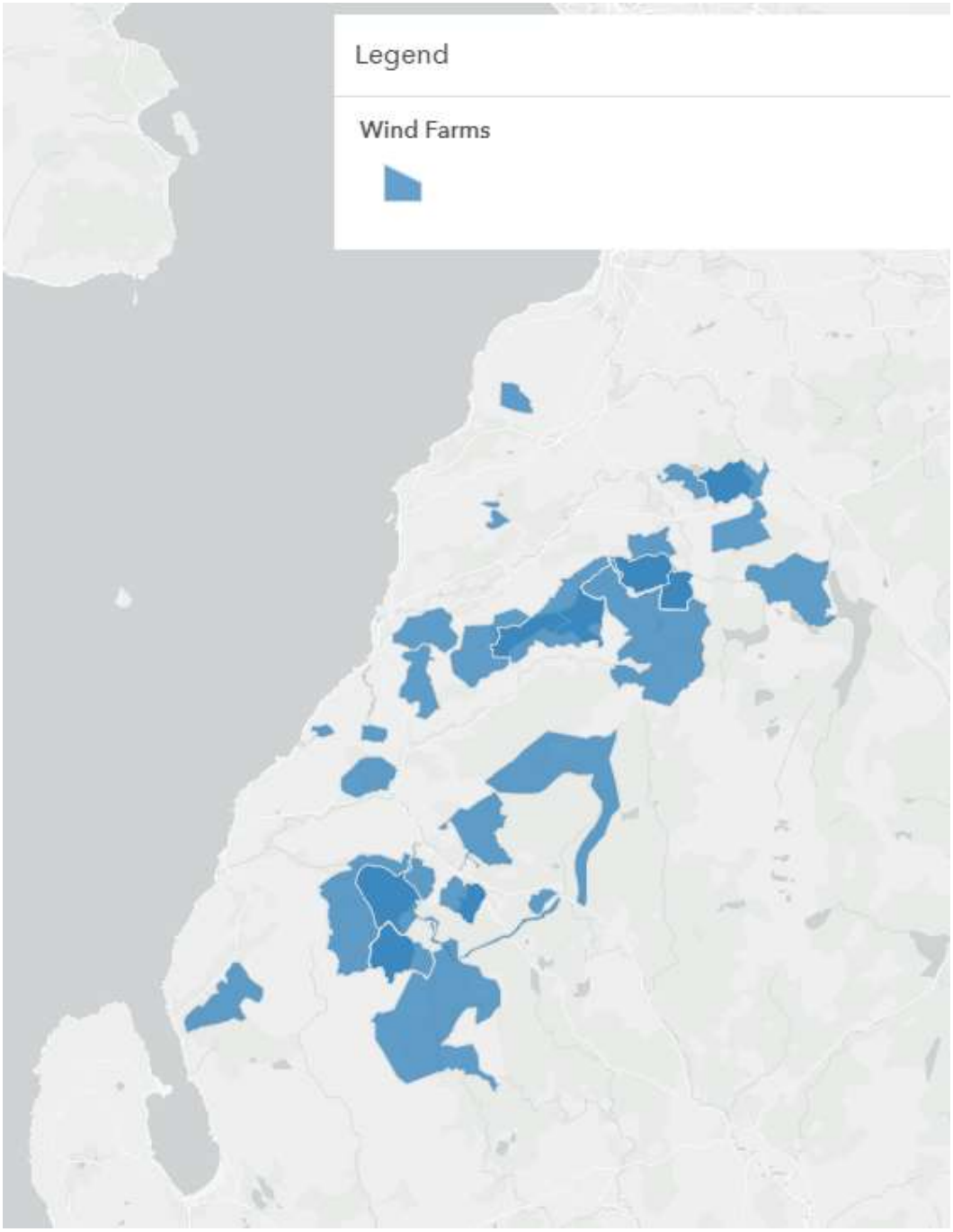


Figure 7-4 – Exploitation of South Ayrshire's Wind Resources (Wind Farms) (Image Source: Wind Farms | Wind Farms | South Ayrshire Council Open Data (arcgis.com) Copyright South Ayrshire Council, contains Ordnance Survey data © Crown copyright and database right (2024).

Figure 7-5 – Exploitation of South Ayrshire's Wind Resources (Turbines) (Image Source: Wind Turbines | Wind Turbines | South Ayrshire Council Open Data (arcgis.com) Copyright South Ayrshire Council, contains Ordnance Survey data © Crown copyright and database right (2024)).

7.2 Hydrogen Generation and Energy Storage to Support Grid Decarbonisation and Develop Ayrshire's Renewable Generation Capacities

It is recommended that surplus wind power be utilised to generate hydrogen, making use of existing grid infrastructure. Construction of Hydrogen generation capacity supports development of renewable resources either through grid balancing mechanisms as an ancillary service or through direct off-grid connections that mitigate the need for new renewable generation capacity to connect to the grid. Potential sites for hydrogen generation that are recommended for feasibility studies are listed below. These have been selected as they are substations within Ayrshire that connect to areas with existing renewable energy generation capacity and areas where renewable generation capacity is proposed or in the process of being developed. Beginning Hydrogen generation and or installation of energy storage has the potential to enable new renewable generation capacity to connect to the grid, including those across Ayrshire experiencing difficulty in obtaining grid connections.

- Direct connection to any windfarm in Ayrshire, including those seeking a grid connection.
- Connected to New Cumnock Substation as an ancillary service consuming excess power at that node.
- Connected to Coylton Substation as an ancillary service consuming excess power at that node.
- Connected to Kilmarnock South Substation as an ancillary service consuming excess power at that node.
- Connected to the Hunterston Substation(s) as an ancillary service consuming excess power at that node.
- Connected to the Ayr Substation as an ancillary service consuming excess power at that node.
- Connected to Mark Hill Substation as an ancillary service consuming excess power at that node.
- Connected to Auchenwynd Substation as an ancillary service consuming excess power at that node.

(Image Source: "Hunterston A Nuclear Power Station" by Reading Tom is licensed under CC BY 2.0.)

It is recommended that challenges in developing hydrogen infrastructure and supply chain are identified by beginning to develop hydrogen generation capacity and reviewing experiences of pilots that are currently underway.

It is recommended that use of hydrogen be developed alongside generation of hydrogen, with potential users being existing industrial gas users and those with or adopting hydrogen powered vehicles.

The sources for hydrogen generation, and use of generated hydrogen being recommended to be investigated further are summarised below.

- Energy sources
  - Curtailed renewables.
  - Off grid, potentially large scale, renewable generation capacity that would not be developed otherwise due to the lack of electrical grid capacity for a connection to be granted.
- Uses
  - Energy storage and power generation.
  - Transportation fuel.
  - Industrial processes and heat.
  - Note that the role hydrogen will play in domestic heat will be determined by the UK Government Heat Policy decision in 2026, and this may become a further use in Ayrshire in the future.

It is also recommended that other energy storage solutions be implemented to maximise grid support.

7.3 Developing Electrical Infrastructure to Assist in Achieving Net Zero

Estimated energy use from non-electrical sources is approximately 5 times that of electrical energy estimated to be used at present. If these energy demands are to be met by increased electricity supply, then significant infrastructure upgrades are required across the Ayrshire grid at transmission, distribution, and supply levels. The role hydrogen plays in heating, transport, and enabling development of renewable energy generation will impact the extent of the electrical infrastructure upgrades required in the mid to long term as the picture is expected to become clearer following the UK government decision on hydrogen for heat in domestic buildings due in 2026.

It is recommended that in the short to medium term (2024-2029) ahead of the next LHEES review point required by the Scottish Government (in 2029), an initial phase of electrical infrastructure upgrades are undertaken to support development of opportunities identified at this time. The initial phase of upgrades is recommended to be undertaken with a view of implementing heat networks and taking the opportunity to coordinate with other heat and transport electrification opportunities that would connect to the same major pieces of electrical infrastructure. Once the role of hydrogen is better understood, and at the LHEES review point in 2029, it is recommended that the extent of the role heat pumps play in council LHEES be reviewed with this in mind, and the next phase of electrical infrastructure upgrades be pursued.

Information relating to grid constraints has been made available by network operators. Scottish and Southern Energy (SSE) operate the grid supplying the Ayrshire Isles of Arran and Cumbrae, from the Carradale and Dunoon respectively[6]. The isle of Arran is supplied from the Carradale Grid Supply Point (GSP) located, out with Ayrshire, on the Kintyre peninsula. Cumbrae is also supplied by a GSP out with Ayrshire, being connected to the Dunoon GSP via the Isle of Bute.

For mainland Ayrshire, Scottish Power Energy Networks have developed an open data portal[7] which allows local authorities *"to simulate the effects of implementing their heat & energy strategies and low carbon technologies upgrades on the SP network, giving a view of current cable and substation capacity, network constraints, required reinforcement works and consequent costs.*

[6] Network Maps (ssen.co.uk)
[7] Home — SPENOpenDataPortal (opendatasoft.com)

The tool assists local authorities in developing their LHEES plans. It also informs SP Energy Networks' decision-making on potential requirements in network reinforcement works and ultimately promotes a shared knowledge and strategy for future network implementation."

Opensource information is also available for grid and generation infrastructure[8]

The matrix contained within Table 7-1 indicates where clusters of investment opportunities have been identified. Note that it is recommended that data is collected to inform the development of transport hubs which may add additional clusters to this matrix. The locations of these clusters are indicated on the map overmarks in Figure 7-6 and **Figure 7-7** by the cluster references also listed in **Table 7-1.**

[8] Open Infrastructure Map (openinframap.org)

Table 7-1 –Coordination of Investment Opportunities Matrix AEM Power Approach Electrical Infrastructure Phase 1

Cluster Ref	Heat Network(s)	Existing Transport Hub(s)	Exploration of Installation of EV Chargers	Priority Areas for Public Building Retrofit Feasibility Studies and Electrification of Heat for All Buildings in the Area	Potential Energy Storage and or Hydrogen Generation	Potential Hydrogen Pilot Distribution Network Area(s)
			Additional Transport hub locations identified following data collection	Towns and villages where additional transport hub development initiates electrical infrastructure upgrades		
A	Drongan			Drongan	Connected to Coylton Transmission Substation	Drongan Coalhall Hillhead Coylton-Joppa
B	Cumnock (Include investigation of Barony A Frame mine shaft for heat storage)			Cumnock Holmhead Netherthird		
C	Kilmarnock 1 Kilmarnock 2 Kilmarnock 3	Kilmarnock Train Station Kilmarnock Bus Station	Kilmarnock South Substation Kilmarnock Town Substation	Kilmarnock	Connected to Kilmarnock South Transmission Substation	Kilmarnock Hurlford Crookedholm
D	Ayr 1 Ayr 2	Ayr Train Station Ayr Bus Station Newton on Ayr Train Station	Ayr Train/Bus Station (Ayr 1/Ayr 2 Heat Network) Newton on Ayr Train Station	Ayr	Connected to Ayr Transmission Substation	Ayr
E	Ayr 3		Alisa and University Hospitals (Ayr 3 Heat network) Holmston Roundabout (Ayr Substation)	Alisa Hospital		
F	Irvine			Irvine Dreghorn Stanecastle Perceton		
G					Connected to New Cumnock Transmission Substation	Dalmellington Bellsbank
H		New Cumnock Train Station	New Cumnock Train Station	New Cumnock Pathhead Mansfield	Connected to New Cumnock Distribution Substation	New Cumnock Pathhead Mansfield
I					Hunterston	Hunterston West Kilbride-Seamill Crosbie Fairlie
J					Connected to Mark Hill Transmission Substation	
K		Maybole Train Station			Connected to Auchenwynd Transmission Substation	Maybole

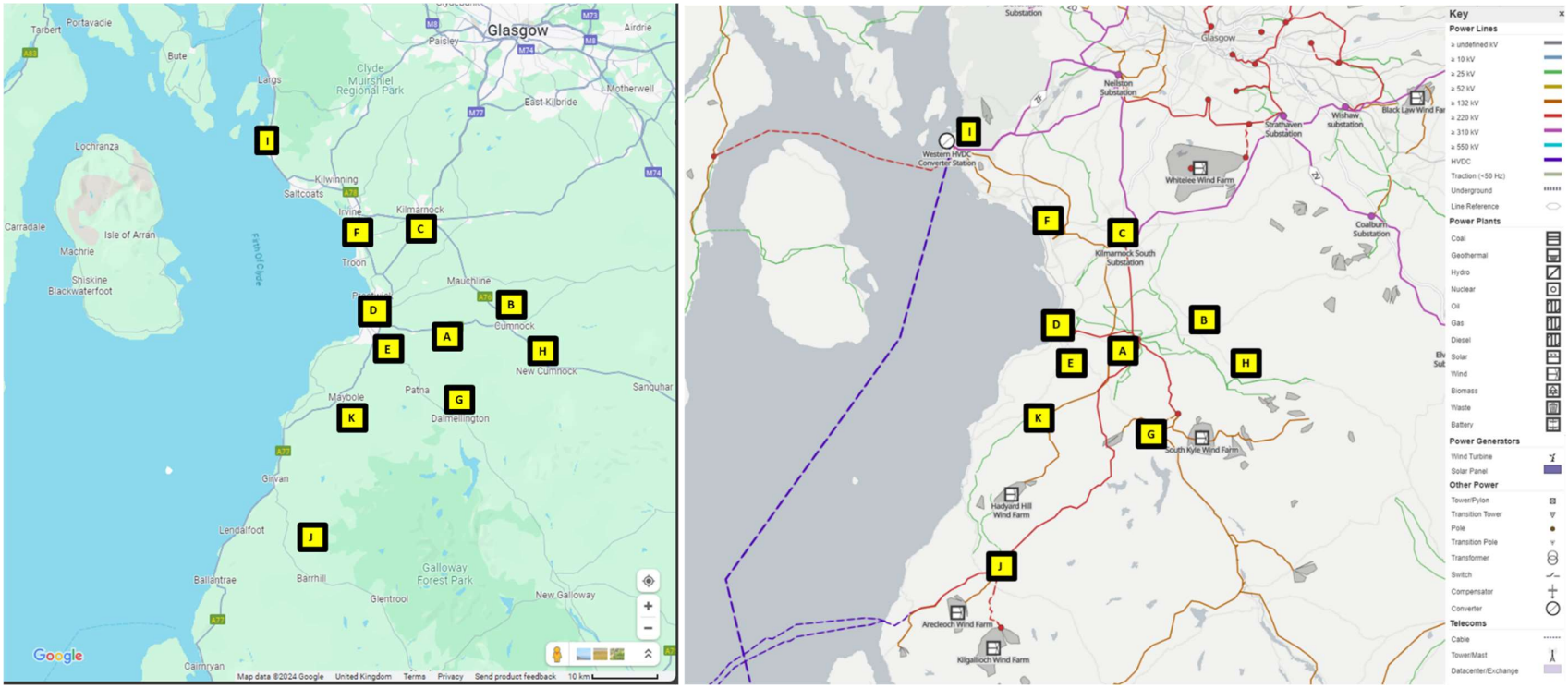


Figure 7-6 – (Left) Google Map overmark showing locations of clusters (Map Source: Google Maps).

Figure 7-7 – (Right) Electrical Grid overmark showing locations of clusters (Map Source: Open Infrastructure Map (openinframap.org)).

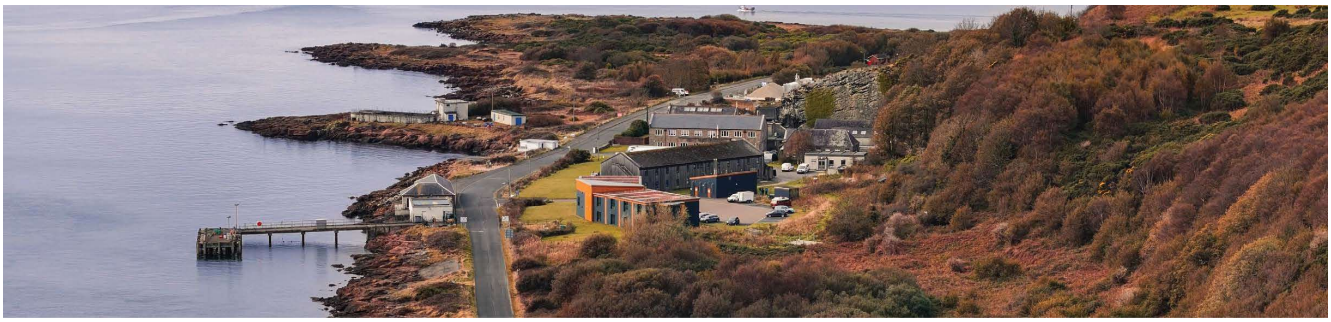
8. Relating Skills to Investment Opportunities – Strategy Summary

Net Zero technology installation and maintenance skills gaps have been highlighted. This could be addressed by increased training opportunities being offered within schools, higher education, apprenticeships, industry qualifications and continuous development. This includes training people in the following areas:

- Wind energy generation capacity development, installation, and maintenance.
- Installation and maintenance of heat pumps.
- Installation of PV systems.
- Installation and maintenance of EV charge points.
- Installation of insulation including floor, roof/loft, external wall insulation, cavity wall insulation, and internal wall insulation.
- Training opportunities to increase the number of drivers able to drive heavier vehicles that are required as part of the decarbonisation of public transport, including community transport groups.

The recommended area-based stakeholder engagement strategy could be utilised to assist in this. The economic impact assessment in Appendix 5 provides analysis of how many people may be required to undertake the construction works which depends on the size of the hydrogen generation capacity installed.

Particular challenges were highlighted for islands by stakeholders in terms of installers gaining and maintaining accreditations. Also, the increased costs of works arising from higher transaction costs associated with travel across the water. Some support is offered from North Ayrshire Council, including initiatives to support worker accommodation on islands, working with ferry operators. Funding opportunities change continually; however, some examples are presented in Appendix 6.



It was noted by stakeholders that the areas where skills gaps exist often overlap with areas of high fuel poverty and areas where the greatest renewable energy resources are also located.

The whole net zero eco-system is recommended to be upskilled to assist in meeting legislative ambitions, requiring training through all levels of business manufacturing and installation including to support electrical grid infrastructure upgrades.

It is recommended that the public are to be informed of the changes necessary for the implementation of net zero such as journey planning and building operation.

9. Ensuring a Just Transition

The recommendations made by the AEM target a just transition by aligning with pathways to achieve several outcomes.

In relation to heat, alleviation of fuel poverty is a driver behind undertaking insulation works and is also recommended to be considered as a constraint when considering the electrification of heat. Capital costs of works are also recommended to be considered in relation to the risk of poverty.

The recommendations made for an area-based stakeholder engagement strategy to be adopted are made to assist with equality of access to support, by providing connection with communities as a route to identify and access the support required based on their needs and circumstances. This includes support for all parties when undertaking retrofit activities as well as ensuring community engagement in the development of renewable generation capacities. The recommended area-based strategy allows all businesses and private individuals to gain access to support. Table 9-1, Figure 9-1, Figure 9-2, and Figure 9-3 show the number and distribution of properties estimated to already be suitable for heat pump transition, have poor energy efficiency and or high fuel poverty.

Table 9-1 – Summary statistics at local authority level showing the relation between property count and relevant LHEES Considerations

Count of properties (data zone level)	EAC	NAC	SAC	Ayrshire Total
Category 1 Heat Pumps Off Gas	911	758	1,685	3,354
Energy Efficiency measures (wall insulation)	5,957	7,719	2,505	16,181
Energy Efficiency as a driver of Fuel Poverty	5,166	6,310	4,535	16,011

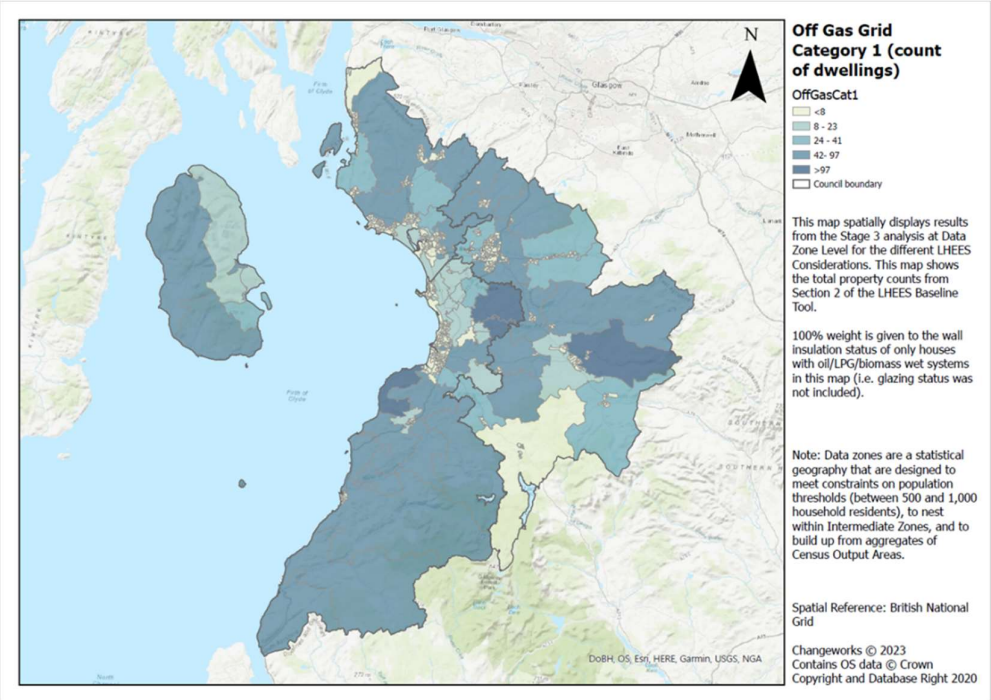


Figure 9-1 - Ayrshire map showing count of Off Gas Grid Category 1 properties.

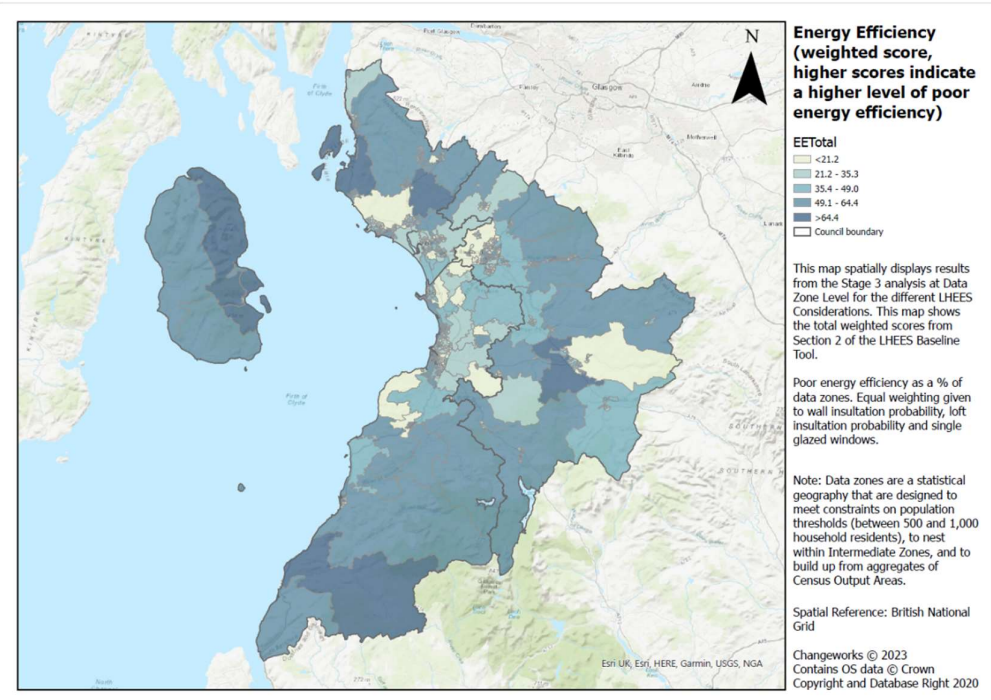


Figure 9-2 - Ayrshire map showing weighted scores for poor energy efficiency indicators outlined within the map.

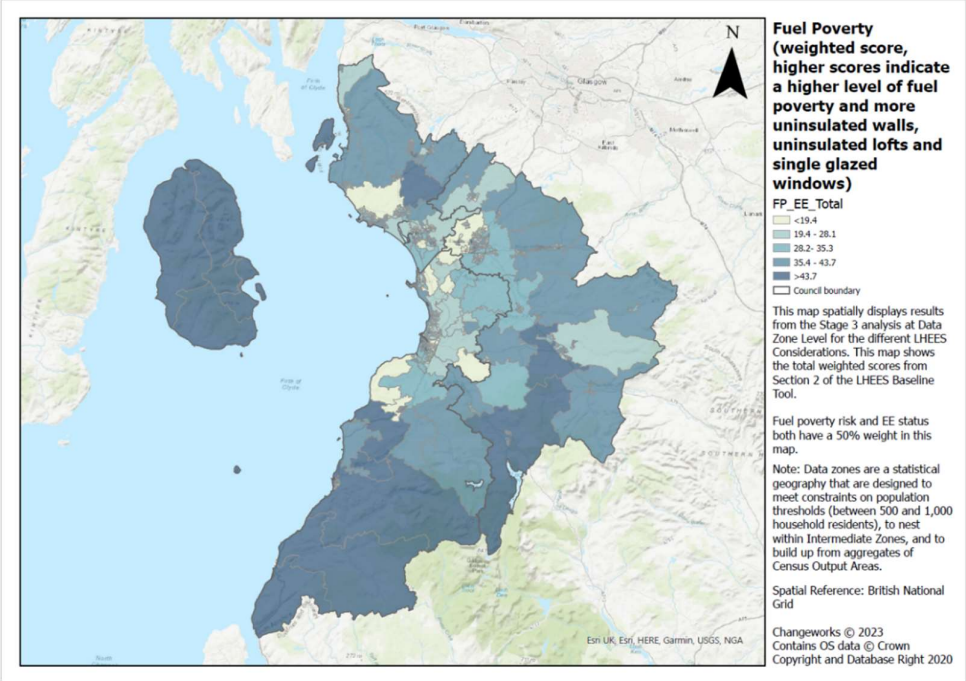


Figure 9-3 - Ayrshire map showing weighted scores for poor energy efficiency as a driver of fuel poverty.

Improving and decarbonising public transport is being recommended to assist people in reducing their travel emissions, with the recommendation being that improvements are made, taking account of people's perception of public transport and to maintain and improve accessibility for all groups.

Recommendations to align distribution of training and jobs with council policies are made to provide a route to impact that sees Ayrshire gain the potential socio-economic benefits available from the transition. Council strategies on fair work and pay within these policies assist with distributing the economic benefits.

Definition of and achieving a just transition will be determined by the wider policy landscape. Discussion of outcomes and council policies can be seen in Appendix 1 with the recommendation being that defining a just transition is explored by determining impacts of the AEM on, and links to, other indicators and outcomes of Scotland's National Performance Framework (NPF) not set out below are determined, and that ripple/cascade impacts are explored through Theory of Change (ToC).

The 11 NPF outcomes are outlined in Figure 9-4, with the outcomes being (from the top and centre of Figure 9-4 moving clockwise):

- Economy
- International
- Poverty
- Communities
- Children and Young People
- Education
- Fair Work and Business
- Health
- Environment
- Culture
- Human Rights

Figure 9-4 - The Purpose and Values of Scotland's National Performance Framework (NPF), and Outlines of Outcomes (Image: nationalperformance.gov.scot[9]).

The NPF outcomes and indicators that explicitly mention energy, heat, transport, power (in relation to energy issues), greenhouse gases, carbon, fuel, or just transition are as follows:

- Economy outcome
  - Carbon Footprint indicator
    - Scotland's carbon footprint expressed in million tonnes of carbon dioxide equivalent.
  - Greenhouse gas emissions indicator
    - Greenhouse gas emissions as a percentage change achieved from the baseline figure in 1990.
- Environment outcome
  - Energy from renewable sources indicator
    - Percentage of energy consumption which comes from renewable energy sources.
- Human Rights outcome
  - Quality of public services indicator
    - Percentage of respondents who are fairly or very satisfied with the quality of local services (local health services, local schools, and public transport)
- Poverty outcome
  - Cost of living indicator
  - Percentage of net income spent on housing, fuel, and food by households in Scotland and is measured as a three-year rolling average.

More detail on the SDGs and Scotland's NPF can be seen in Appendix 1.

[9] National Performance Framework | National Performance Framework

10. Recommendations and Priority Matrix

In conclusion, the journey to net zero can seem a daunting task, especially on the scale of change required at Ayrshire regional level, this will require a collaborative approach between Ayrshire Councils, the Scottish and UK Governments, Energy Suppliers, Energy Network Operators to fully understand the needs of communities and customers. The eighteen recommended actions set out below highlight the key activities that the Ayrshire Councils will target over the next 20 years to drive the change required to support the energy transition to net Zero.

In developing priorities and recommendations for Ayrshire, it is important to focus on affordable actions that can be achieved in a reasonable timescale. The recommendations matrix set out in table 10.1 is split into four, five-year phases, starting in 2026 with a recommendation to review and update every 5 years. Full details can be found in Appendix 7.

The RAG rating score shown in table 10.1 below is aligned with the overall ease, complexity, cost, and time to delivery of each recommendation. The lower the score the quicker the win.

Table 10.1 Ayrshire Energy Masterplan Recommendations and Priorities Matrix and Action Plan

Ref.	Recommendation	RAG	Action			
			2026-2030	2031-2035	2036-2040	2041-2045
			Phase 1	Phase 2	Phase 3	Phase 4
1	**General**	7	1. Review and update of masterplan every 5 years. Review actions when there are significant changes in legislation. 2. Establish a cross authority steering group to take forward the recommended actions from the masterplan; develop governance; delivery structure; roles and responsibilities; management procedures; reporting structure; Task/action working group scope and objectives; oversight to delivery.	1. Review legislation and update masterplan.	1. Review legislation and update masterplan.	1. Review legislation and update masterplan.

2	**Funding Environment & Carbon Assessment**	7	Funding is a key restraint in the delivery of net zero. It is important to ensure that the economic impacts of the transition to net zero are sustainable and affordable to both the public and private sector. 1. Ensure that costs are fully assessed against the long-term impacts for carbon, capital costs and operational costs for large scale Council projects. 2. Ensure that positive and negative impacts are assessed and presented in an open and transparent manner. 3. Set a carbon target for individual capital projects over £1m, Include for carbon reporting on capital projects at committee level. 4. As opportunities are developed through feasibility studies, ensure that a funding/development partner assessment is undertaken to assess private sector interest and delivery models. 5.As funding opportunities are identified, review recommendations and link to appropriate delivery actions and communication strategy. 6. Identify cross authority funding opportunities and collaborate to realise economies of scale, share resources and best practice.	1. Ongoing review and reporting against targets	1. Ongoing review and reporting against targets	1. Ongoing review and reporting against targets
3	**Stakeholder engagement (section 4.2)**	7	1. Establish a working group through the Clean Growth Workstream to develop a cross-authority stakeholder engagement strategy. (For all sectors) 2. Stakeholders to be identified on an area, theme, and project basis to develop outcomes that support stakeholder. 3. Develop digital media packages for inclusion in the Ayrshire Regional Economic Strategy (ARES) portal, include links to best practice, case studies and key projects. 4. Ensure that stakeholder engagement is built into project deliverables and net zero strategies. 5. Investigate and understand opportunities for funding including private sector and developer led projects.	1. Review stakeholder engagement and education plan.	1. Review stakeholder engagement and education plan.	1. Review stakeholder engagement and education plan.

4	**Communities**	8	1. Develop a cross-authority strategy for engaging with communities, linking to the stakeholder engagement plan area based targeted approach. Incorporate best practices from existing organisations and community groups i.e. those on isles of Arran and Cumbrae. 2. Ensure engagement actions are included during feasibility studies for local projects such as heat networks, LHEES roll out, new energy infrastructure. 3. Grant availability - consider an application process for groups within region.	1. Continuous and expansion of engagement as opportunities develop. 2. Feedback through stakeholder engagement process.	1. Continuous and expansion of engagement as opportunities develop. 2. Feedback through stakeholder engagement process.	1. Continuous and expansion of engagement as opportunities develop. 2. Feedback through stakeholder engagement process.
5	**Public buildings (including council non-domestic properties and NHS buildings)**	11	1. Identify funding and conduct energy audits to 50% of Council non- domestic properties to recognised standard such as BSEN 16247. Include for Building Assessment Reports for suitability to connect to heat networks. 2. Review carbon liabilities and develop decarbonisation plans for Council stock. 3. Commit to undertake all activities where a payback is financially viable. 4. Repeat every 5 years.	1. Review existing energy audits and conduct energy audits to remaining 50% of Council non- domestic properties to recognised standard such as BSEN 16247. Include for building assessment reports for suitability to connect to heat networks. 2. Connect to heat networks where available. 3. Heat pump roll out for end-of-life boilers.	1. Review energy audits. 2. Commit to undertake all remaining interventions where financially viable. 3. Connect to heat networks where available.	1. Review energy audits. 2. Connect to heat networks where available.
6	**Social housing (including council housing and housing association properties)**	14	Scottish Government requirement for all social housing to have an Energy Performance Certificate rating of B or better by 2032. 1. Measure compliance with and implement requirements of the new Social Housing Net Zero Standard (SHNZS) where feasible. 2. Implement LHEES delivery plan actions. 3. Develop and implement retrofit strategy based on CoRE research. 4. Undertake area-based consultation. 5. Engage with housing association partners in development of retrofit strategy.	1. Implement LHEES delivery plan actions. 2. Implement retrofit strategy.	1. Implement LHEES delivery plan actions. 2. Implement retrofit strategy.	1. Implement LHEES delivery plan actions. 2. Implement retrofit strategy.

7	**Privately owned housing (owner occupied and rented)**	16	Scottish Government requirement for all privately owned housing to have an Energy Performance Certificate rating of C or better by 2040 where it is technically and financially feasible: 1. Ensure masterplan objectives are reviewed to incorporate new legislation developments. 2. Engage with Scottish Government to ensure that regional objectives are included in national roll out and legislation. 3.Include sector in stakeholder engagement. 4.Continue to investigate and signpost residents to local and national energy funding and support i.e. Home Energy Scotland, ECO4 and Council initiatives.	1. Roll out stakeholder engagement. 2. Sign post to legislation.	1. Roll out stakeholder engagement. 2. Sign post to legislation.	1. Roll out stakeholder engagement. 2. Sign post to legislation.
8	**Private Sector Non-domestic properties, Commercial and industrial premisses**	16	1.Support Net Zero business forums, with ambition to develop a sector led Net Zero delivery strategy. 2. Collate data on effective interventions and good practice through stakeholder engagement and signpost to wider market through ARES portal. 3. Support business through signposting to funding and loan opportunities 4. Sign post to information on connection opportunities to heat networks, EV infrastructure and grid improvements	1. Implement P1. 2.Consider if carbon reporting by businesses in region can support development of a non-domestic net zero strategy.	1. Implement P1.	1. Implement P1.
9	**Heat pumps**	11	1. Roll out as part of LHEES plan where financially viable. Ensure that fabric measures are considered. 2. Review options with supply/build capacity to ensure industry can deliver, link to Training & Skills. 3.Ensure heat pump options are assessed as part of non-domestic property energy audits, with recommendation on when to replace. (age, impact, linked to other works) 4.Focus priority for heat pump installation with highest impact - (by fuel replacement types, coal, oil, electricity, biomass & other fossil fuels, mains gas.	1. Roll out as part of LHEES plan where financially viable.	1. Roll out as part of LHEES plan where financially viable.	1. Roll out as part of LHEES plan where financially viable.

10	**Heat Networks**	13	1. Undertake feasibility studies for potential heat networks at **Kilmarnock 3**, **Cumnock Ayr Road, Ayr 3,** and **Irvine**. Include exploration of options to utilise waste heat; local disused mines as heat stores/ heat pump sources; opportunities to maximise the use of Ayrshire's potential wind, hydro, wastewater, and coastal energy sources. 2. Investigate the potential for one pilot project. (small scale, high impact) 3. Ensure consultation with the public and local businesses in the development of a heat network roll out plan, including consideration of opportunities. 4. Work with supply chain, Scottish and National Governments and public and private partners to develop a delivery mechanism.	1. Undertake feasibility studies for all remaining heat network sites noted in masterplan. 2. Roll out heat networks on an impact and viability basis.	1. Roll out heat network on an impact and viability basis	1. Roll out heat network on an impact and viability basis
11	**EV charge points**	8	The ambition is for an additional 1200 publicly available chargers to be installed by 2030, and a further 1400 by 2045. To this aim the councils will: 1. Engage with supply chain partners to develop a delivery plan target of 200 additional public EV Charge points per year where funding allows, initially investigating potential at all public car parks and assessing how rural provision is developed in parallel with need. 2. Assess if installations can be provided at all public buildings where car parking for staff is provided. The initial focus will be on sites where significant grid infrastructure upgrading is not required. 3.Identify sites where significant grid infrastructure upgrading is required and engage with DNO's on upgrading plans. 4. Undertake early engagement with DNO's to assess grid capacity for cluster sites.	1. Work with supply chain partners to target the delivery of 200 additional public EV Charge points per year where funding allows. 2. Focus on sites where significant grid infrastructure upgrading is required, this will include sites where clusters of opportunities have been identified by the AEM such as Kilmarnock Town and Kilmarnock South substations, Near Ayr train and bus stations, Newton-on-Ayr Train station, Ailsa Hospital Ayr, Holmston Roundabout, New Cumnock train station. Additionally other transport hub locations identified following the recommendation below to gather data on where these are required should be considered where electrical infrastructure upgrades are also required in these locations. 3. Ensure that 100% provision is delivered to all new build activities.	1. Review EV provision and use. 2. Ensure availability at all hard to access sites. 3. Potential replacement programme for existing EV ChargePoint's, replace with increased capacity where grid capacity allows. 4. Consider storage capacity for hard to access sites	1. Review EV provision and use. 2. Complete EV charge point installations ensuring overall access within region.
12	**Energy infrastructure**	15	1. Appoint lead to work with DNO's to fully understand Grid restrictions and grid infrastructure upgrade plans. 2. Develop a regional map for publication showing developers where grid access is available and to what capacity. (building upon DNO maps)	1. Update map as grid capacity is improved, update to show extent of work required to improve capacity. 2. Link to hydrogen feasibility study.	1. Update map as grid capacity is improved, update to show extent of work required to improve capacity.	1. Update map as grid capacity is improved, update to show extent of work required to improve capacity.

13	**Energy generation**	12	1. Undertake feasibility studies on expansion of renewable generation - link to grid access restrictions. 2. Support expansion where grid allows windfarms/solar/large scale heat pump where grid access is required. 3. Undertake feasibility on energy storage opportunities including "as heat" in disused mines and connected to the substations at; New Cumnock/Dalmellington, Coylton, both Kilmarnock town and south, Ayr Holmston roundabout, Hunterston, Mark Hill, and Auchenwynd. 4. Build upon works already undertaken to understand and visualise wind energy opportunities and data to incorporate grid restraints and upgrade proposals to stimulate development	1. Support roll out of additional energy generation linked to infrastructure development. 2. Support pilot energy storage project,	1. Support roll out of additional energy generation linked to infrastructure development 2. Support energy storage roll out.	1. Support roll out of additional energy generation linked to infrastructure development 2. Support energy storage roll out.
14	**Grid Capacity**	13	1. Convene a working group with DNO's to fully understand: • Restrictions and opportunities within Council areas in terms of grid availability. • Understand grid upgrade plans. 2. Assess grid capacity against Energy Masterplan ambitions. 3. Set out net zero opportunities in line with energy infrastructure availability. 4. Prioritise net zero projects where grid capacity allows.	1. Proactively work with developers to ensure infrastructure availability is utilised.		
15	**Hydrogen**	17	1. Work with government and development partners to understand the scope for a hydrogen feasibility study within the region, set out objectives and timeline for delivery. Liaise with delivery partners on potential for investment. Work with research partners to understand appropriate technologies against supply and demand restrictions. 2.Hydrogen generation areas to consider are those that can be connected into the following substations: Coylton transmission, Kilmarnock South Transmission, Ayr transmission (Holmston roundabout), New Cumnock transmission and distribution, Auchenwynd transmission, and Hunterston.	1. Undertake feasibility studies to determine which site(s) are to be developed for hydrogen generation considering power availability and distribution and use of the hydrogen generated including pilot piped distribution networks near to the following substations: Coylton transmission, Kilmarnock South Transmission, Ayr transmission (Holmston roundabout), New Cumnock transmission and distribution, Auchenwynd transmission, and Hunterston. 2. Work with development partners within each site to support a demand assessment through engagement with potential users.	1.Undertake hydrogen pilot project within the region where viable technology, delivery partners and funding allows.	1. Roll out projects within the region where viable technology, delivery partners and funding allows.

16	**Transport**	11	1. Continue data collection to inform the development of transport hubs utilising the stakeholder engagement strategy. 2. Undertake public consultation exercise to understand transport needs and barriers. 3. Engage with the Scottish government and transport partners on EV bus roll out with the ambition of having all bus routes with capacity to utilise EV's. (ensure link to Council EV strategies and wider national transport strategies) 4. Undertake assessment for transport hubs within region including assessment of new Park & Ride facilities with significant EV provision. 5.Undertake feasibility studies for grid infrastructure requirements to facilitate significant EV charger provision within **Ayr, Kilmarnock, New Cumnock, Newton on Ayr and Holmston roundabout.** 6. Ensure that all contracts for EV charges include for maintenance, upgrading and end of life replacement.	1. Ensure that 100% provision of EV chargers is delivered to all new build activities funded by the council. 2. All council fleet to be EV where technically feasible. 3. Ensure that new build developments have considered EV charge points. 4. Assess if Hydrogen is an option for public transport and HGV fleets. 5. Review EV charge point distribution	1. Review EV charge point distribution.	1.Review EV charge point distribution
17	**Skills transition**	9	1. Undertake an assessment to understand the current availability and level within the region to meet net zero ambitions. This should include existing skills base for insulation and fabric improvements; grid infrastructure improvements, associated civil engineering works and energy generation technologies; low and zero carbon technologies installation and availability of technologies; transport infrastructure improvements. 2. Work with training and skills partners to ensure that the appropriate course availability to support delivery of: • EV charger installation & Maintenance including associated infrastructure in Civils works and Electrical installations. • EV maintenance • Solar panel installation and maintenance • Heat pump installation and maintenance • Energy Assessment and design of appropriate interventions • Retrofit interventions Installation • Heat network design • Heat network installation and maintenance • Electrical infrastructure design, installation & • Maintenance • Hydrogen infrastructure, design installation and maintenance. • Wind energy design installation and maintenance • Battery installation and maintenance for heat and electrical storage	1. Review and update skills opportunities.	1. Review and update skills opportunities. 2. Include Carbon Capture and Storage.	1. Review and update skills opportunities.

18	**Skills transition**	6	1. Note requirement for skill /workforce transfer from existing technologies to new/increased technologies and ensure appropriate trade led transition courses in: • Combustion engine to EV motors • Fossil fuel boilers to Heat pumps	1. Review and update skill opportunities.	1. Review and update skill opportunities.	1. Review and update skill opportunities.

The recommend actions align well with the route map in Figure 10-1 and a coordinated delivery will set Ayrshire on a viable and just transition to net zero.

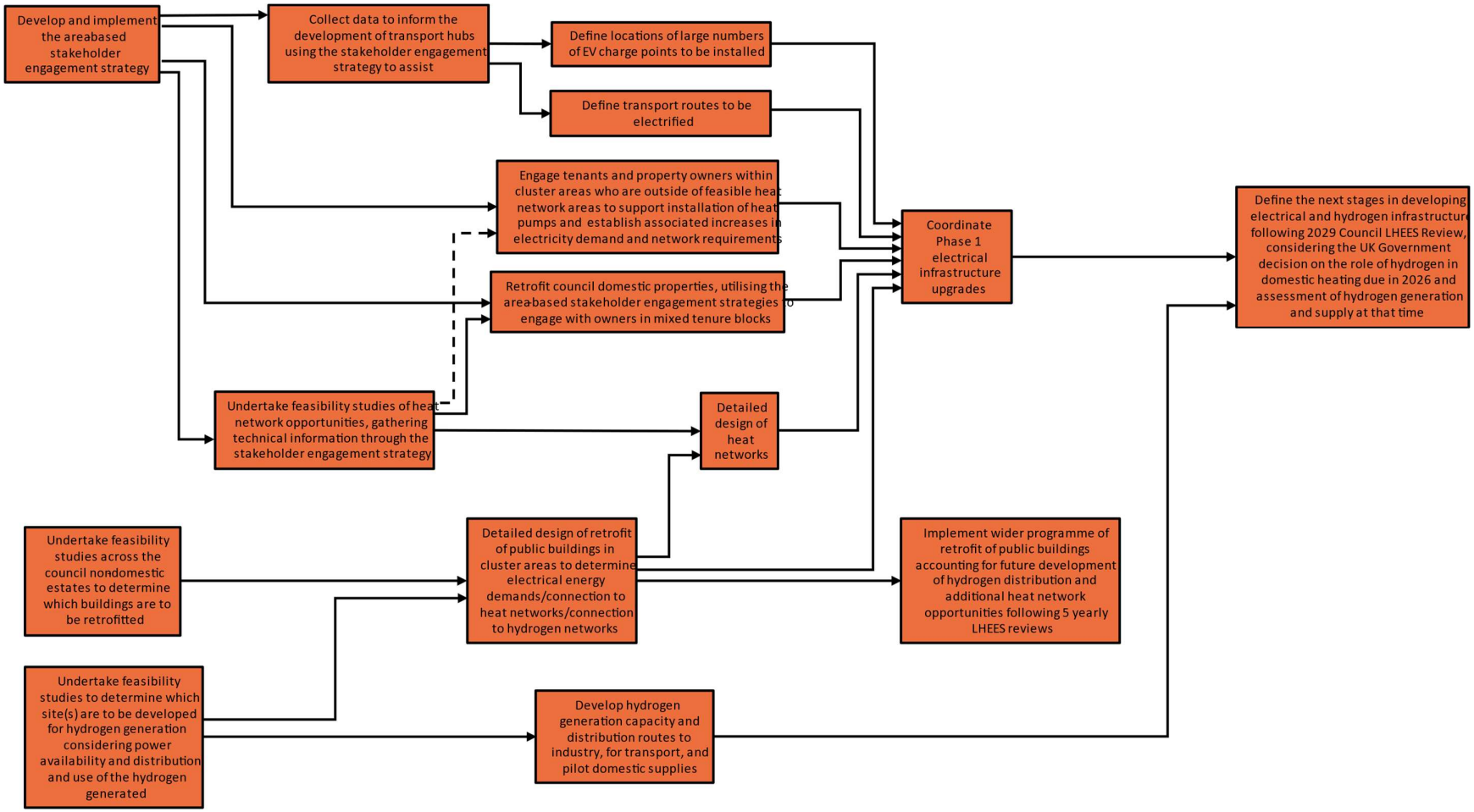


Figure 10-1 - Block Diagram showing how the AEM recommendations approach interact as a route map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