JUST-Systems

Case Study Profile

Clackmannanshire: Community energy interventions as a pathway to a local just transition

Case Study Leads: Jen Dickie, Nathan Wood

Case Study Team: Leonardo Ricaurte

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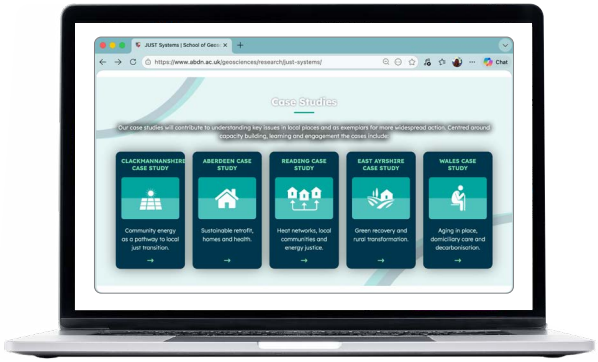
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1. Background

The JUST-Systems project (2025-2030) was developed in response to the UKRI Systems Approaches to Net Zero call, which supports research advancing the UK's transition to net zero with a focus on stakeholder engagement and empowerment. Our interdisciplinary team includes researchers from six universities, five UK case study partners, and an expert advisory board. Together, we aim to better understand the contexts and challenges of local and regional transitions and co-develop pathways for action.

The Clackmannanshire case study examines the role and efficacy of community energy initiatives as transformative mechanisms for advancing the transition to net zero. This case study builds on a previous project called 'Re-energising Clackmannanshire: engaging communities on energy for a healthier, wealthier and greener future', which explored local energy challenges and aspirations for positive changes to their areas. Fuel poverty and its impact on households, health, energy, mobility and access to services was identified as a priority area for action. By taking a systems approach and working closely with our project partners, Clackmannanshire Council and FEL Scotland, the research seeks to co-design community-centred pathways to net zero that embed principles of equity and inclusion while generating multiple socio-economic and environmental co-benefits.

Clackmannanshire is the smallest local authority on mainland Scotland, with a population of 51,940 [6], and is classed as semi-rural. There are five electoral wards in Clackmannanshire and nine main localities, Alloa, Alva, Clackmannan, Dollar, Menstrie, Muckhart, Sauchie, Tullibody, and Tillicoultry [8]. Alloa, the largest town in Clackmannanshire, commonly receives attention in relation to fuel poverty as parts of Alloa South and East are among the top 5% of most deprived areas in Scotland. However, challenges around poverty and unemployment are felt across the whole of Clackmannanshire, with 26% of the population living in the 20% most deprived areas of Scotland, and nearly 30% of children under 16 living in poverty, the third highest rate in Scotland [6, 7]. The persistent socio-economic challenges in Clackmannanshire are rooted in the historical decline of key local industries, including coal mining, textiles, and brewing, and these, coupled with structural constraints such as limited employment opportunities, inadequate transport infrastructure, and health and well-being inequalities, have led to enduring cycles of poverty within some families and communities [1, 7, 10, 13].

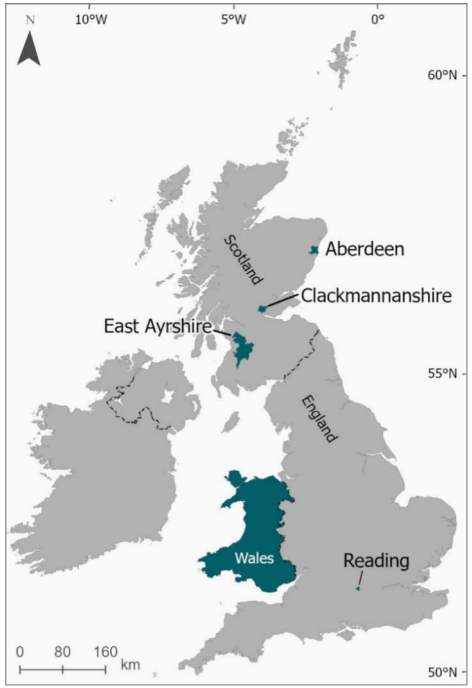
The region is home to multiple community groups and organisations with interests and services surrounding nutrition, climate change, active travel and sustainability. A regional energy masterplan forms part of a wider Stirling and Clackmannanshire Deal. This plan centres on being "fossil-fuel free" and "climate ready" by 2045 with Stirling Council and Clackmannanshire Council holding corporate net-zero targets of 2035 and 2040, respectively. Whilst the masterplan is wide ranging – focusing on efficiency, heating, generation, sequestration and a range of community benefits – community owned energy has featured in only a limited and passing capacity. FEL Scotland, project partners on this case study, have begun exploring the feasibility of community energy within the region [12].

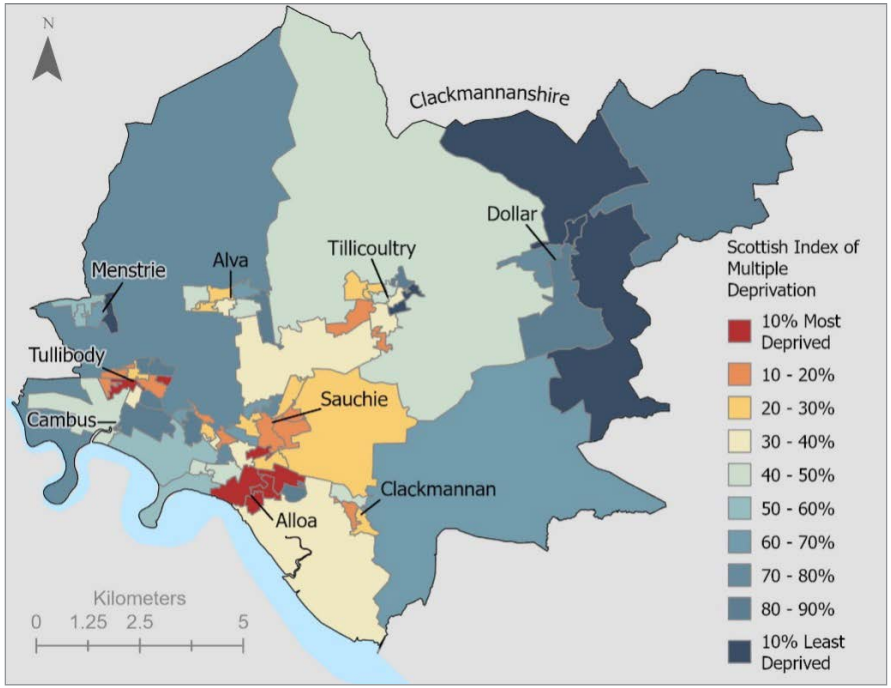
This case study profile offers a breakdown of the regions demography, economy, communities, and relevant regional and national policies. From this is distilled a primary outline of the systemic challenges facing a net zero transition.



Figure 1: *Photograph credit: Clackmannanshire Council*

2. Location and Context





From left to right:

Figure 2: *Position of Clackmannanshire in the UK case studies*

Figure 3: *Area of multiple deprivation in Clackmannanshire*

3. Data Profile

3.1. Historical Background

The region, in particular Alloa, has an industrial tradition that goes back to the 1760s. Industries such as glassworks, textiles manufacturing, brewing and coal mining all had a strong presence in the region, sustaining the local economy and generating jobs. Alloa's port was a busy transport and trading hub on the River Forth that experienced significant development in the 18th century.

Many of these industries experienced significant decline in the 20th century, resulting in the closure of the port, along with breweries and glassworks, leading to unemployment and economic impacts.

More recently, the closure of the Longannet Power Station in 2016 generated further loss of jobs and wider, indirect economic activity. The power station, a symbol of coal-fired power generation in Scotland, was a major employer in the region, with approximately one-third of its employees living in Clackmannanshire postcodes. To offset the impact of this decision, the Scottish Government established the Longannet Task Force, which provided a package of support strategies including on-site resource centres, employability assistance and targeted regeneration funds. Despite these efforts, which included a £2 million grant for Clackmannanshire, reports from the Just Transition Commission found that insufficient consideration was given to the impact that closing the plant would have on local communities [14].

3.2. Population, Households and Demographics

Population trends, age profile and migration

Clackmannanshire has a population of 51,940 (2023) within an area of 158.97 km², representing around 0.95% of Scotland's total population [1]. The gender distribution is broadly balanced, with 49% males and 51% females [3].

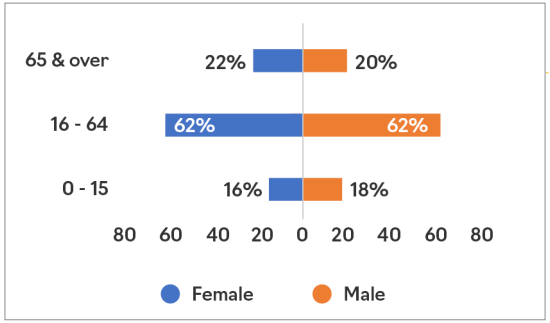


Figure 4: *Age distribution by gender in Clackmannanshire (Own elaboration based on 2022 Scotland's Census data)*

In terms of age structure, 17% of the population is aged under 16, 62% are aged 16-64 and those aged 65 or over make up 21% of the population [1]. The age profile is similar for men and women, with small differences at both younger and older age groups: among women, 16% are under 16, 62% are 16-64 and 22% are 65 or over; among men, 18% are under 16, 62% are 16-64 and 20% are 65 or over (see Figure 4) [5]. This points to a sizeable working-age population, but with a considerable older-age group – a trend aligned with Scotland's ageing population dynamic.

Looking ahead, demographic projections suggest a gradual ageing and population contraction. According to 2022-based projections, Clackmannanshire's population is expected to fall to 50,684 by 2047 – a decline of around 2.1% - in contrast to a projected 6.2% increase for Scotland as a whole over the same period, a growth primarily driven by inward migration [1,2]. Over this period, the dependency ratio in Clackmannanshire is expected to rise from 58% to 61%, compared with an increase from 54% to 55% for Scotland [1]. In practical terms, a dependency ratio of 61% means that by 2047 there would be around 610 people of non-working age for every 1,000 people of working age, implying fewer workers supporting more children and pensioners and, potentially, greater pressure on local and national services.

Patterns of migration and place of birth further shape Clackmannanshire's demographic profile and population trends. Between 2013 and 2023, net migration to the area totalled 1,388 people across all age groups, including 733 people aged 15-64 [1]. Most residents were born in Scotland (84.27%), followed by those born in England (8.73%), Northen Ireland (0.58%), Wales (0.36%) [6].

Only 6.03% of residents were born outside the UK, compared with 10.24% for Scotland as a whole [6], suggesting a less internationally diverse population than the national average. Among those born outside the UK, 10.35% have lived in the UK for less than 2 years, 18.87% for 5-10 years and 59.93% for 10 years or more [6]. Overall, these figures denote that while international migration does not play a relevant role in local population change, the majority of migrants in Clackmannanshire are long-term residents who have been in the UK for at least a decade.

Ethnicity and national identity

The vast majority of Clackmannanshire's population identify as 'white' (96.9%). Within this group, most residents are recorded as White Scottish (84.11%), followed by White British (8.92%), White Other (1.92%), White Polish (1.3%) and White Irish (0.65%). The remaining 3.1% of the population is split main groups of size: Asian, Asian Scottish, or residents account for 1.49%, while those identifying with Other ethnic groups make up the remaining 1.61% (see figure 5).

Regarding to national identity, the population in Clackmannanshire (2022) mainly identify as 'Scottish only' (70.35%). The remaining population identifies as 'British only' (13.42%), 'Scottish and British only' (7.82%), 'English only' (2.14%), 'Scottish and any other identity' (1.48%), 'any other combination of UK-only identities' (1.11%), and 'other identity and at least one UK identity' (0.16%). The remaining 3.52% identify as 'other identity' [6].

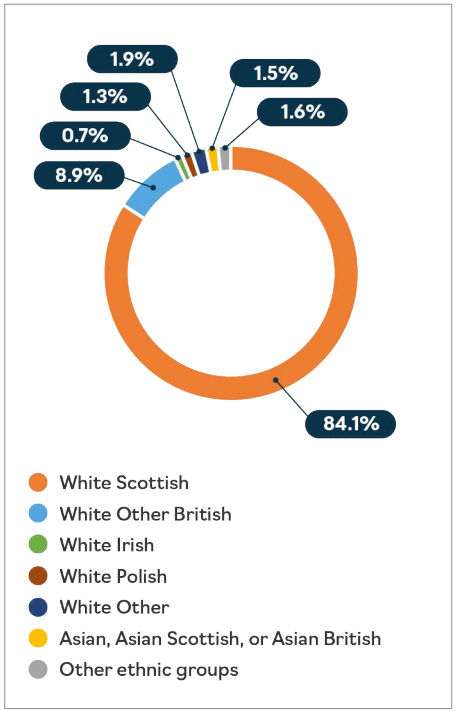


Figure 5: *Share of main ethnicities in Clackmannanshire in 2022 (Own elaborations based on data from Scotland's Census 2022)*

Households

In 2022, Clackmannanshire had 24,072 households with usual residents, representing 0.96% of all occupied households in Scotland [6]. This reflects the council's relatively small size within the national context, while still encompassing a variety of household types.

Regarding household composition, three main types of households can be distinguished: one-person households, one-family households and other household types. One-family households are the most common arrangement, accounting for 60.28% of all households. Within this group, married or same-sex civil partnership couples (with or without children) make up 28.81% of all households, lone-parent families 11.25%, cohabiting couples (with or without children) 10.76%, and one-family households where all members are aged 66 and over a further 9.47%.

One-person households are also a prominent group, together they account for 36.44% of all households: 22.22% consist of a single person aged under 66, while 14.22% are one-person households with a resident aged 66 or over. The remaining 3.28% fall into "other household types" [6], a small but diverse category that includes multi-adult or multi-family households, arrangements with dependent children that do not fit standard family definitions (which represent almost half of this group with 47.66%), all full-time student households and other less common living situations.

Furthermore, when focusing specifically on households with dependent children, married or same same-sex civil partnership couples represent 11.31% of households, while lone parents account for 7.21%, cohabiting couples for 4.47%, and other household types with dependent children for 1.56%. Together, these four subgroups make up 24.55% of all households in Clackmannanshire, reflecting a considerable diversity of family arrangements centred on dependent children.

Religion

In Clackmannanshire, a majority of residents reported having no religion (58.33%), while just over a third of the population (36.23%) profess a religion. Within this group, Christianity is by far the most common: 21.72% of the population identify with the Church of Scotland, 9.09% as Roman Catholic and 4.22% with other Christian denominations, meaning that 34.03% of residents describe themselves as Christian overall. Smaller groups include Muslims (1.21%) and people belonging to other faiths (0.99%), such as Pagan, Buddhist, Hindu, Sikh or Jewish. A further 5.44% of respondents did not state their religion.

Language

English is overwhelmingly dominant in Clackmannanshire. In 2022, 98.29% of residents reported that they were able to speak English, a slightly higher share than for Scotland as a whole (98.04%). A minority also reported speaking Scots, with 33.58% of the population being able to speak the language. When compared to the share of Scots speakers nationally (28.49%), this higher share of speakers may suggest a somewhat stronger attachment to the language and local identity. By contrast, 0.8% of residents said they were able to speak Gaelic, below the Scottish figure of 1.32%. Despite the high prevalence of English, 3.13% of people in Clackmannanshire reported that their main language was not English, compared with 5.53% across Scotland [6], indicating a smaller proportion of minority-language speakers than at the national level.

3.3. Economy

Economic trends

The transformation from an industrial and manufacturing hub in Scotland to an area with a shrinking population and a labour market characterised by relatively low employment and a workforce now concentrated in service-sector jobs can be further understood in terms of recent economic trends. At present, Clackmannanshire has a relatively modest economic output within Scotland. In 2024, its Gross Value Added (GVA) was around £1,150 million, accounting for 0.8% of Scotland's total output. This contribution emphasises the need to diversify and develop a more resilient local economy, better aligned with current economic opportunities.

3.3. Economy continued

Economic trends continued

Labour market indicators reinforce the need to adapt the range of opportunities available to residents, revealing a relatively weak economic participation. Between April 2024 and March 2025, only 66.1% of people aged 16-64 in Clackmannanshire were economically active, a rate significantly below Scotland (76.6%) and Great Britain (78.5%) over the same period. This gap is evident for both men and women. Among males aged 16-64, 67.8% were economically active, compared with 79.7% in Scotland and 82.1% in Great Britain; of these, 62.6% were in employment [7]. For females, the pattern is similar, with 64.5% of women aged 16-64 reported as economically active, compared with 73.6% in Scotland and 75% in Great Britain; of these, 62.8% were in employment [7].

Economic inactivity is accordingly high. In the same period, 33.9% of people aged 16-64 in Clackmannanshire were economically inactive, compared with 23.4% in Scotland and 21.5% in Great Britain [7]. Among this inactive group, the most common reasons were long-term sickness (48.1%) and retirement (21.8%). A separate breakdown shows that 91.2% of economically inactive people stated that they do not want a job, indicating that only a small minority are actively seeking to re-enter the labour market. This points to a considerable group of adults whose non-participation in the labour market is strongly linked to long-term health conditions, early retirement and caring or lifestyle choices, rather than short-term unemployment alone. A further layer is added by the student population, which in 2022 totalled 1,314 full-time students aged 18-74, of whom 37.52% were economically active in employment, 10.5% were economically active but unemployed and 52.11% were economically inactive [6]. These patterns provide important context for the structure of employment in Clackmannanshire, which is examined in more detail next.

Employment and labour market

Clackmannanshire's labour market mirrors its broader economic challenges. As noted above, the area has relatively modest economic output within Scotland, this is reflected in lower levels of employment and participation among working-age residents. Between April 2024 and March 2025, 62.7% of people aged 16-64 in the area were in employment, compared with 74.0% in Scotland and 75.4% in Great Britain. Within this group, 58.4% of the 16-54 population were employees, implying that only a small minority are in working as self-employed.

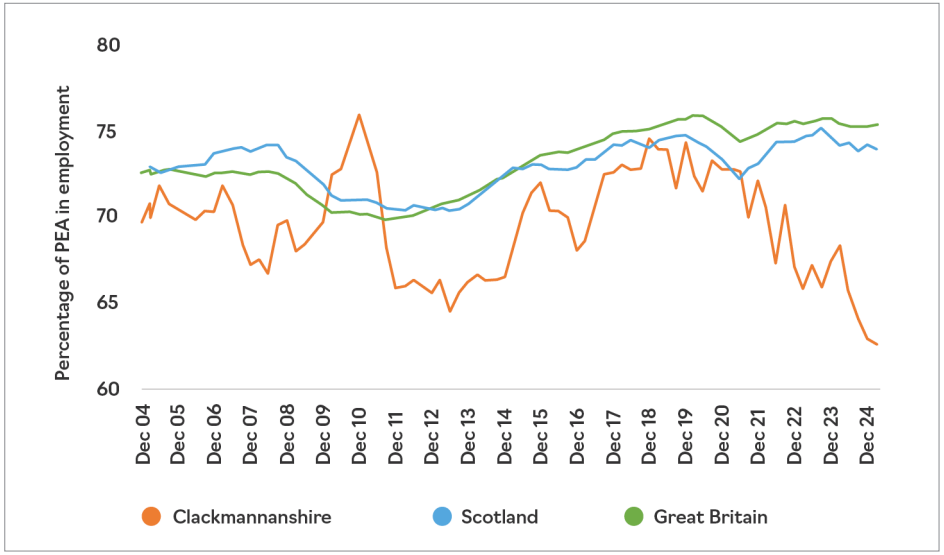


Figure 6: *Evolution of people economically active in employment in Clackmannanshire between January 2004 and March 2025 (Own elaboration based on data from ONS)*

Headline unemployment, by contrast, is relatively close to national benchmarks. The unemployment rate for people aged 16 and over was 3.8%, similar to Scotland (3.3%) and Great Britain (3.9%) [7]. The fact that Clackmannanshire's rate fares marginally better than that of the whole of Great Britain suggests that the central labour-market challenge in the region lies more in the low employment and high economic inactivity among those of working age, rather than unusually high unemployment among jobseekers.

The structure of employment in Clackmannanshire can be further understood through the Standard Occupational Classification 2020 (SOC 2020), which divides jobs into nine major groups and hour broad bands [1-3,4-5,6-7 and 8-9]. 41.9% of all people in employment in Clackmannanshire fall into the first band, which includes managers, directors and senior officials (8.4%), professional occupations (16.7%) and associate professional occupations (16.8%). The second band, which accounts for 20.8% of those in work, includes administrative and secretarial occupations (9.6%) and skilled trades occupations (11.2%).

Employment and labour market continued

The third band reports 19.1% of the employed population and mainly includes caring, leisure and other service occupations (11.4%), while the fourth band comprises 18.2%, with the majority working in elementary occupations (9.4%) [7]. Figure 7 shows how the percentages of people in employment in Clackmannanshire compare to those of Scotland and Great Britain between April 2024 and March 2025.

When looking at forecast demand in key sectors, the picture is dominated by services. For 2025-2028, social care and tourism each account for 200 jobs, with childcare, construction and health care each contributing a further 100 jobs. In this period, most of the demand in social care, tourism and health care is for replacement rather than new posts, whereas construction is notable for having both expansion demand and replacement demand in its workforce.

Over 2028-2035, the same sectors are expected to drive labour demand, but at higher levels. Social care and tourism are each forecast to require around 400 jobs, followed by construction (300 jobs), health care (200 jobs) and childcare (100 jobs). Much of this requirement reflects replacement demand, especially in social care and tourism (around 300 jobs each), with additional expansion in construction (around 100 jobs) and more modest replacement needs in health care and childcare (around 100 jobs each) [1].

The combination of lower employment, high inactivity and a relatively small pool of active jobseekers have direct implications for the prospects of a just energy transition, particularly when it comes to creating new climate jobs to address labour shortages and reduce regional inequalities. Forecasts of future labour demand further suggests that green and climate-related employment in Clackmannanshire is unlikely to centre on high-tech or energy sectors alone but will need to be closely aligned with the care, tourism and construction sectors.

Income

Income patterns in Clackmannanshire are characterised by a marked gender disparity and by contrasts between what residents earn overall and what is paid in jobs located within the council area. In 2024, among Clackmannanshire residents in full-time work, median gross weekly earnings were slightly higher

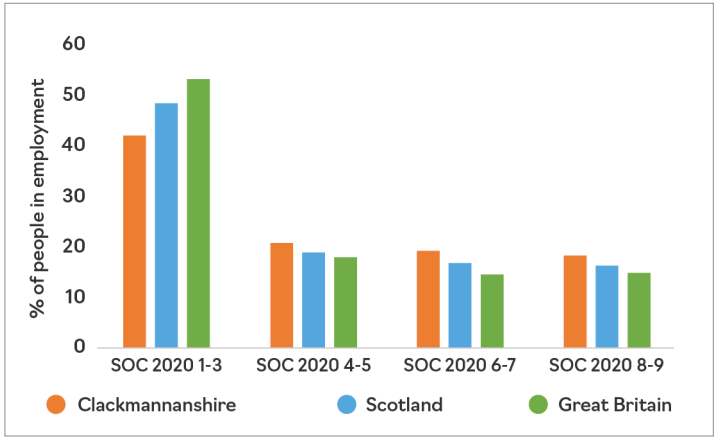


Figure 7: *Comparison of percentages of people in employment in the four SOC 2020 categories between Clackmannanshire, Scotland, and Great Britain (Own elaboration using data from the Office for National Statistics, 2025)*

than the Scottish and Great Britain averages: £752.2 for those residing in Clackmannanshire, compared with £740.1 in Scotland and £730.6 in Great Britain [7]. However, there is an underlying gender pay gap in the region that is worth noting. Full-time employed men living in Clackmannanshire earn a median of £800.5 per week, while their female counterparts earn £665.7, which represents a wider disparity than in both Scotland (men £767.5, women £701.5) and Great Britain (men £778.7, women £674.3) [7].

When earnings are considered by place of work rather than place of residence – a telling indicator of the type of jobs dominating the labour market locally – a different picture emerges. In 2024, full-time employees working in Clackmannanshire had median gross weekly earnings of £659.6, notably below the Scottish (£739.7) and Great Britain (£730.4) averages [7]. The gender gap was again pronounced, with men earning a weekly median of £742.4, compared with £618.4 for women [7]. Taken together with the lower employment rates and higher economic inactivity discussed above, these figures suggest a local economy in which many households – and women in particular – are managing with relatively constrained resources, even where higher-earning residents compare reasonably with national averages. This contrast signals a concentration of lower-paying jobs within the council area, with some residents likely commuting elsewhere for better-paid employment opportunities.

3.4. Housing and homelessness

While Clackmannanshire's Local Housing Strategy (LHS) is currently outdated – the last instalment of this plan spans 2018-2023, the council's Strategic Housing Investment Plan (SHIP) sets out Clackmannanshire's approach to housing development and retrofit. This plan is intended to work in conjunction with other strategic planning documents such as the Local Outcomes Improvement Plan (LOIP) and guide the development of an updated LHS.

The housing landscape in Clackmannanshire is characterised by a high rate of homeownership alongside a significant social housing sector. Out of the 24,072 resident households in the region (2022), the majority (62.99%) are owned, while 26.78% are categorised as social rented properties [6]. Private rentals account for 8.85% of the market, with a small minority of 1.39% consisting of rent-free occupiers [6].

Despite these figures, homelessness remains a challenge for the area. Currently, one person in every 100 in Clackmannanshire is experiencing homelessness. This high prevalence gives the council the second-highest regional homelessness rate by population in the country.

Fuel poverty

Between 2017 and 2019, fuel poverty affected 24% of households in Clackmannanshire, a figure that mirrored the national rate for Scotland during the same period [9]. While the proportion of households in extreme fuel poverty was slightly lower than the Scottish average (standing at 9% compared to 12%) the data highlights vulnerabilities based on the age and tenure of local housing [9].

Older properties face a higher risk, with 39% of those built before 1945 experiencing fuel poverty, compared to 20% of those built after 1945 [9]. The disparity is even sharper regarding extreme fuel poverty, which affects 22% of pre-1945 households but only 6% of newer homes [9]. Furthermore, a clear divide exists between different types of occupancy; 40% of social housing residents live in fuel poverty, with 15% in the extreme category, whereas these rates drop to 13% and 5% respectively for those in owner-occupied homes [9].

Environmental data from 2023 shows that Clackmannanshire's total estimated emissions reached 480ktCO2e, accounting for 1.27% of Scotland's overall footprint [11]. The largest contributors to these greenhouse gas emissions are industrial sources at 34%, followed by commercial activity at 26%, transport at 15%, and domestic use at 14% [11]. On an individual basis, the region's impact is high; per capita emissions were estimated at 9.2tCO2e, notably exceeding the averages for Scotland (6.9tCO2e) and Great Britain (4.7tCO2e) [11, 8].

Domestic energy usage in 2023 suggests a different pattern of consumption compared to the rest of the country. The median electricity consumption for a household in Clackmannanshire was 2,338.4kWh, which is lower than the British median of 2,586.6kWh [8]. Conversely, median gas consumption was slightly higher than the national figure, at 9,935.3kWh compared to 9,925.1kWh for Great Britain [8].

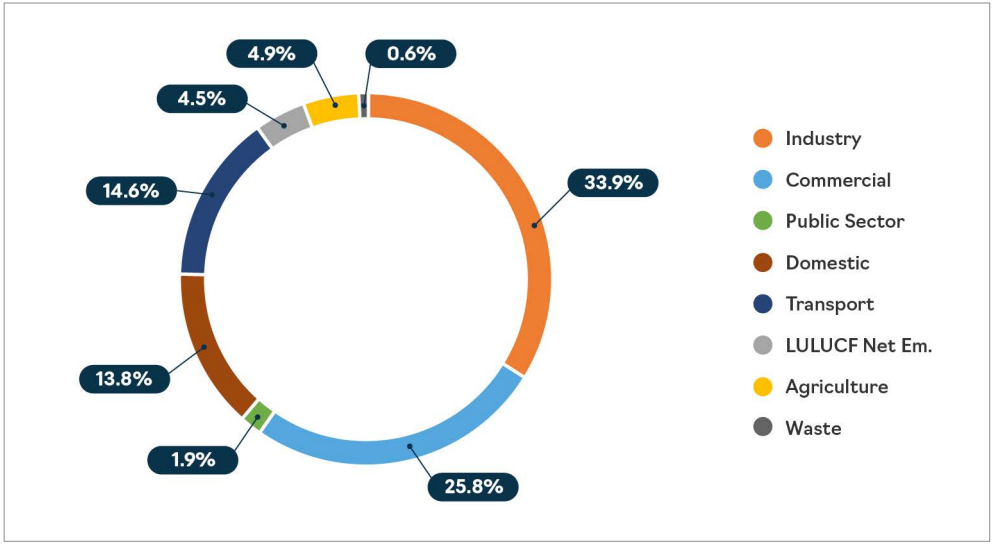


Figure 8: *Share of sources of greenhouse gas emissions in Clackmannanshire (Own elaboration based on data from the Department of Energy Security and Net Zero, 2025)*

3.5. Communities and place

Deprivation

In 2020, seven data zones in Clackmannanshire were classified among the 10% most deprived in Scotland, out of a total of 697 such data zones across the country [1]. By June 2025, 1,035 people in the region were claiming benefits, with males representing most claimants at 625 individuals [7]. Over the period 2017–2019, the mean household income in Clackmannanshire was £27,500, slightly below the Scottish average of £29,500 [9].

Food poverty

Clackmannanshire faces challenges regarding food insecurity. This is common in regions with high rates of fuel poverty, often leading to "heat or eat" scenarios. This is reflected in demand for food assistance. In 2023/2024 the Clackmannanshire Citizens Advice Bureau referred 776 families to local food banks and £14,270 of food vouchers for local supermarkets [13].

Education and qualifications

In terms of education and qualifications, a notable proportion of the population in Clackmannanshire continues to face barriers to formal attainment. In 2022, 19.15% of people aged 16 and over in the region held no formal qualifications, a figure that remains higher than the Scottish average of 16.65% [6].

The remaining 80.85% of the adult population is distributed across various levels of educational achievement. Degree-level qualifications or higher represent the largest segment at 25.97%, followed by lower school qualifications at 21.66% [6]. Further education and sub-degree Higher Education qualifications account for 14.33%, while 10.11% of residents hold upper school qualifications [6]. Finally, apprenticeship qualifications are held by 8.78% of those aged 16 and over in the area [6].

Health and life expectancy

The health and well-being of the population in Clackmannanshire presents a varied picture based on 2022 self-assessment data. A total of 44.87% of residents reported feeling in very good health, while 32.14% felt good and 15.36% described their health as fair [6]. Conversely, a smaller portion of the community reported poorer health outcomes, with 5.89% feeling bad and 1.74% feeling very bad [6]. Physical limitations also affect a significant minority, with 25.98% of the population reporting some type of limitation, including 11.68% who are limited a lot and 14.3% who are limited a little [6].

Life expectancy in the region reflects these challenges, as both genders trail the national averages. For the period between 2021 and 2023, life expectancy for females in Clackmannanshire was 80 years and for males was 75.8 years, compared to Scottish averages of 80.8 and 76.8 respectively [10].

Work patterns and transport habits also shape the daily lives of residents. In 2022, 28.27% of employed people aged 16-74, excluding full-time students, worked mainly at or from home, which is slightly lower than the 31.48% recorded across Scotland [6]. For those who do commute, the car remains the primary mode of transport, used by 59.84% of the working population, including passengers and those in carpools or taxis [6]. Other commuting methods are significantly less common, with 5.89% traveling on foot, 2.59% by bus, 1.44% by train, and 1.96% using other means of transport [6].

4. Policy Snapshot

Regionally, Clackmannanshire is part of the Stirling & Clackmannanshire City Region Deal and the joint Regional Energy Masterplan (REM). The Masterplan sets out Stirling and Clackmannanshire's joint response to the Scottish Government's requirement for local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES) as their primary place-based, locally led response to the energy transition. With a clear ambition of achieving net zero by 2045, the plan lays out a series of objectives and outcomes that link the need for decarbonising the energy supply infrastructure, homes and buildings, with tackling fuel poverty and creating new green jobs in the region.

At the local authority level, Clackmannanshire has declared a climate emergency and adopted a Climate Change Strategy and the Climate Emergency Action Plan that commit the council to net zero by 2040 and the wider area by 2045. The strategy, which is developed around six thematic areas, encompasses key interconnected systems such as energy, heat and buildings, low-carbon transport and waste, and recycling and circular economy. In turn, it recognises the role of technological, natural, social and economic aspects of the transition such as biodiversity, carbon storage, agriculture, adaptation, planning and organisational capacity, and economic development and sustainable procurement. In addition, governance arrangements, including the establishment of community-based Climate Change Forums in each of the five wards of the council, are intended to encourage public engagement and oversight over these topics, further complementing the local response to net zero.

The Clackmannanshire Housing Strategy (CHS) 2012-2017 and Strategic Housing Investment Plan (SHIP) 2026-2031 prioritise increasing affordable and specialist supply, making best use of the stock, tackling homelessness and, crucially, improving energy efficiency and reducing fuel poverty across all tenures. Through these strategies, the council has begun to take steps towards a more coherent, multi-perspective approach to housing needs, linking issues such as fuel poverty and homelessness. When considered alongside the REM, these documents emphasise the role of housing – particularly owner-occupied and social housing – as a key lever for both decarbonisation and social justice.

Third-sector work at the local level has also emphasised how the quality of the housing stock, user practices and the design of energy-provider support programmes all have an impact on the incidence and effects of fuel poverty in the region. Clackmannanshire Citizens Advice Bureau's Local Energy Advice Project (LEAP), for example, provided rich lived-experience evidence on the value of locally based, targeted energy advice in alleviating the immediate consequences of high energy costs, debt and poor housing. An updated CHS (2012-2017) and Housing Need and Demand Assessment (2014), incorporating more recent developments in net zero and energy transition policy at a regional and national scale, are now long overdue.

Finally, Clackmannanshire had undertaken shifts towards implementing a community wealth building strategy – a central principle to guide wider council decision-making towards anchoring of local wealth. Community wealth building may provide a promising frame through which to encourage and distribute the benefits of new energy technologies in the region.

5. System Challenges for a Just Transition to Net Zero

The backdrop to Clackmannanshire's net zero transition is a historically shaped socioeconomic system characterised by vulnerability, institutional fragmentation, and interrelated energy, health and housing issues. Decarbonisation in the region is therefore more than a sectoral challenge – a more just transition contends with post-industrial legacies, demographic change, and uneven adaptive capacities across communities. Whilst these issues reflect a substantial challenge to address, they simultaneously demarcate an opportunity space for a more just transition.

The regions-post-industrial legacy poses a significant challenge. The decline of coal, manufacturing and wider industry has contributed to long term patterns of economic inactivity, deprivation and limited diversification. Participation in the labour market remains below the national average. This is reflected by the regions long-term sickness and aging demographic trends. A net zero transition will therefore unfold in a region already struggling to adjust to prior energy and industrial transitions – there is little in the way of resilience in this system to absorb unintended shocks from widespread change. This prescribes a net-zero transition that is sensitised to these disparities such that the transformations it prompts responds to rather than exacerbate these issues.

Another systemic constraint is the tight coupling between energy use, housing conditions, health outcomes and social vulnerability. High rates of fuel poverty, particularly in old housing stock and social rented accommodation, are linked to health inequalities and economic inactivity. Poor housing efficiency increases exposure to energy costs, which in turn reinforces financial strain and health-related vulnerability, limiting households' capabilities to participate in the transition. Outcomes from a transition to net zero are therefore closely tied to multiple systems and sectors.

The structure of the local economy presents further challenges. Employment demand is concentrated in service sectors such as care, tourism and construction, with much of future labour demand associated with replacement rather than expansion. This economic profile suggests that the transition is unlikely to be driven by the emergence of new energy industries, but rather by incremental change within existing sectors, particularly housing retrofit, care-related resilience, and local service provision – the transition may change how existing work is done but may face challenges in new jobs creation. This creates a risk of misalignment between national green growth narratives and locally feasible employment avenues. This may pose a barrier to a more just transition – which are often associated with the development of new industries.

As with many regions, Clackmannanshire may face challenges from institutional and governance fragmentation. A critical systems approach captures how vulnerabilities emerge from intersecting systems, yet in practice, the governance of these systems is often fragmented and siloed. Pursuing a more just transition therefore poses an institutional challenge: *how can segmented modes of governance be coordinated to pursue a shared agenda?* Key enabling frameworks are aligned with the notion of a net zero transition to varying extents. For example, the regional energy masterplan, discusses community benefits in a variety of forms but says little on community owned energy. National, regional, local and community scale decision-making represent a coordination challenge but more fundamentally, may create spaces where priorities and agendas may sit in tension.

Finally, the transition is likely to unfold in a landscape of uneven adaptive capacity across communities. Variations in income, health status, transport dependence and housing quality produce mediate exposure to both the costs and benefits of decarbonisation. Social renters, older households, and residents in more deprived localities face higher energy vulnerability and reduced capacity to engage in and inform how the transition is shaped. These disparities indicate that transition processes risk reproducing or intensifying existing inequalities unless explicitly designed to address Clackmannanshire's place-specific vulnerability.

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