EDRC
Energy Demand Research Centre

The Low Carbon Heat Apprenticeships Challenge: Solutions for quicker, more inclusive workforce development

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Faye Wade, Henry Finn, Long Zhou, Christian Calvillo Munoz

Executive Summary

UK Government's Clean Energy Jobs Plan suggests the need for between 8,500 and 10,000 more plumbers and heating installers 2030. Despite this, apprenticeship start rates (not heating specific) have dropped from 520,600 in 2012 to 337,140 in 2023 and completion rates are low with between 1.5-1.7 million of the 2.4 million starts recorded between 2010 – 2015 actually completing. In response, this report explores who participates in low carbon heating apprenticeships and the motivations underpinning their participation; it asks two questions:

1. Who is undertaking apprenticeships in (and in competition with) low carbon heat, and where are they based?
2. How do young people (16-18 year olds) make the decision to train in low carbon heating, or not?

These questions are answered using quantitative and qualitative approaches. The quantitative analysis uses standard statistical summaries to characterise the volume, demographic composition and geography of apprenticeship starts in core low-carbon and comparator apprenticeships. The included apprenticeships are: Low Carbon Heating Technician (LCHT); Plumbing and Domestic Heating Technician; Refrigeration Air Conditioning and Heat Pump Engineering Technician; Gas Engineering Operative; Domestic Electrician and Installation and Maintenance Electrician. The qualitative included interviewing those undertaking the Low Carbon Heating Technician apprenticeship.

The findings

Capabilities for installing heat-pumps are likely being developed within general Plumbing and Domestic Heating or Installation and Maintenance Electrician courses, rather than on specialised heat pump courses. There is a dominance of younger entrants on the more mainstream apprenticeships, whilst older entrants make up a greater proportion of more specialised apprenticeships like the LCHT.

The LCHT apprentices participating in this research were highly knowledgeable, friendly, excellent advocates of the industry. They were confident about the long-term prospects of this work, and anticipate growth in the low carbon heating sector. The low carbon heating sector and FE Colleges could work more closely with those already in training to showcase the opportunities available. Being able to contribute positively to the environment was noted by a number of participants following the Low Carbon Heating

Technician Apprenticeship. Participants spoke about their role in the green transition with a sense of excitement and pride. In keeping with previous work (MCS Foundation, 2023), this suggests that helping young people to make the connection between the environment and work in the heating sector could help to attract new entrants. This would need support from UK Government and local authorities to **ensure that connections between construction roles like low carbon heating technician and positive environmental contributions are more fully built into the curriculum throughout school.**

Achievement rates for Under 19s on the Plumbing and Domestic Heating Technician apprenticeship are markedly lower than the benchmark for Level 3 apprenticeships, with only 28% completing their qualification in 2023/24 and 24% in 2022/ 23. More research is needed to **explore the reasons for this, and ways to effectively support those in learning to complete their training**. Older entrants, and those pursuing more specific apprenticeships (e.g. Installation and Maintenance Electrician and Gas Engineering Operative), have higher achievement rates. This could indicate that prior learning and experience can be beneficial. **More hands-on construction-centred learning in schools** could help younger people know what to expect from this role. This may also indicate the need to **expand access to entry-level general construction courses in FE colleges** to provide initial training before entrants specialise in heating work.

Women and minority ethnic groups continue to be under-represented across all of the apprenticeships analysed. There is a serious lack of data on achievement rates according to gender and ethnicity. The small number of female interview participants reported generally positive experiences in the sector but also noted persistence of characteristics like competition and banter that may occasionally be perceived as hierarchical or immature. Those with female role models in their firm reported particularly positive experiences. There is stronger inclusion for those with learning difficulties or disabilities in the sector. Participants talked openly and positively about feeling included and having shared experiences of neurodiversity and learning difficulties.

There is a regional skew in where apprentices are starting. London and the North East have relatively modest volumes of apprenticeships despite their size and decarbonisation needs. Overall, all regions have far fewer new starts than projected heat pump workforce requirements suggest are needed, with London, the West Midlands, and East Midlands showing the smaller relative numbers, indicating potential future shortages.

Recommendations

Industry recommendations for recruiting more people into the low carbon heating sector

- Work closely with those in training to showcase low carbon heat training routes.
- More clearly target advertising and information at school leavers if wanting to attract a younger cohort; develop specific work around neurodiversity, gender, and race in the sector if wanting to attract more diverse new entrants.
- Develop the curriculum and early years learning to: a) make clear connections between construction roles like low carbon heating technician and positive environmental contributions; b) provide more hands-on construction-centred learning in schools and c) undo pervasive gender norms around jobs and careers in construction.
- Work with local employers to ensure low carbon heat apprenticeship pipelines; target activity at regions and FE colleges where heat pump apprenticeships are under-represented.

Research and policy for supporting apprenticeship completion

- Monitor the new LCHTA for how progress and attainment compare with established qualifications; ensure close working with these first cohorts throughout their learning journey
- UK Government to establish norms for collecting more detailed data on achievement rates according to specific apprenticeship standards and learner characteristics. Without this it is impossible to evaluate the success of different apprenticeships and identify learners that may need further support.
- UK Government to provide funding to expand access to and support for entry-level general construction courses in Further Education colleges, and subsequent low carbon heating apprenticeships
- Undertake detailed analysis of regional distribution of workers needed for low carbon heat implementation, and implement targeted interventions to boost apprenticeship uptake in certain regions.

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1. Introduction

The UK Government's (2026) Warm Homes Plan has set the target of installing 450,000 heat pumps per year by 2030, and their Clean Energy Jobs Plan (UK Government, 2025) suggests the need for between 8,500 and 10,000 more plumbers and heating installers by the same year.

Apprenticeships have a key role to play in delivering this workforce. An apprenticeship is paid employment and on-the-job learning coupled with classroom-based learning, which results in a recognised qualification (HM Government, 2026). The most direct routes to become a heat pump installer are via the Plumbing and Domestic Heating Technician or the Low Carbon Heating Technician Apprenticeship (LCHTA). The LCHTA is a new UK apprenticeship programme that was established in 2023 by the MCS (Microgeneration Certification Scheme) Foundation as part of a national initiative to train heat pump installers.

However, there are concerning trends in the UK''s national apprenticeship system. For example, the total number of apprenticeship starts (not heating specific) has declined sharply from 520,600 in 2012 to 337,140 in 2023, with the reduction particularly pronounced among younger people (Aldersgate, 2024). Completion rates also remain problematic: of the 2.4 million apprenticeship starts recorded between 2010 and 2015, only an estimated 1.5-1.7 million resulted in completions (Learning & Work Institute, 2024).

In response, this report explores who participates in low carbon heating apprenticeships, and the motivations underpinning their participation. The following section reviews literature on heating apprenticeships. The quantitative and qualitative methods used to explore heating apprenticeships are then detailed. The results section explores the number of people taking up different apprenticeships, where they are located, and how participation and apprenticeship achievement varies by demographic factors.

2. Literature Review

2.1 Challenges in recruiting and supporting apprentices

There is a systemic lack of diversity within the UK heating workforce, which is 98% male and 95% white (Livework, 2023). In addition, the workforce is ageing: more than one third of heat pump installers are over the age of 55,

and 44% expect to leave the sector within the next decade (UK Government, 2023).

Despite this, for younger entrants access to clear and accessible information about apprenticeships remains limited. For example, while 73% of university students report that information about Higher Education is easy to access, only 26% say the same about apprenticeships (Aldersgate, 2024), and routes into clean energy and retrofit occupations remain insufficiently clear to prospective entrants (UK Government, 2025). Young people may also fear social exclusion or missing out on the university experience, including living independently for the first time, if they pursue an apprenticeship (MCS Foundation, 2023). Jobs in construction are sometimes perceived as low-status professions, which can deter prospective entrants (Tallon & Calvert, 2017).

Considering who may be joining the sector, research on apprenticeships and work placements in the UK (not heating specific) found workplace cultures can reinforce harmful gender stereotypes and exclusions. Osgood et al. (2006), for instance, found that many students – particularly girls – undertake placements in gender-traditional sectors, even when they do not align with their stated career aspirations. Inflexible training provision in the heating industry can further disadvantage individuals with caring responsibilities, whilst informal recruitment practices, such as reliance on personal networks or social media channels, can be exclusionary (Livework, 2023).

Further, when people do take up training, there is a potential disconnect between the complex realities of heat pump installation and the skills and experience provided through existing training pathways (Branford & Roberts, 2022). Installers have consequently called for more comprehensive, practice-based training that addresses the installation process holistically, rather than relying on short, manufacturer-led courses (UK Government, 2023). Questions have also been raised about training standards. Some installers – particularly those with longer industry experience – report limited confidence in the quality of provision and in the expertise of trainers themselves (UK Government, 2023).

Financial disincentives are also frequently cited as a significant deterrent to undertaking apprenticeships. The Apprenticeship Levy, introduced in 2017, may have exacerbated shortcomings in the system through its increased rigidity in programme duration, greater administrative complexity, uncompetitive pay rates, and inadequate careers advice (Aldersgate, 2024). Several studies note that low apprentice wages both limit accessibility and

create conditions in which apprentices are treated as a source of cheap labour (Branford & Roberts, 2022). In addition, potential apprentice employers report uncertainty about the return on investment associated with transitioning to low carbon technologies, citing perceived weak consumer demand for heat pumps (Aldersgate, 2025; UK Government, 2023) and the absence of a stable and long-term policy framework (Branford & Roberts, 2022) as key concerns. The traditional heating sector is overwhelmingly composed of small and medium-sized enterprises (SMEs), with 93% employing fewer than ten staff (Gleeson, 2016), although these numbers may be skewed with larger firms moving into heat pump installation. Smaller employers in particular may be deterred by the financial burden of additional wages, limited availability of local college provision, and the risk that newly qualified technicians will leave after completing their training (Nesta, 2025).

2.2 Motivations for participation and predictors of success

There appears to be a disconnect in attitudes toward environmental action: many young people view it as a personal responsibility rather than a professional pursuit, which can reduce interest in low-carbon careers like plumbing and heating (MCS Foundation, 2023). However, young people can be more open to pursuing ‘green construction jobs’ when these roles are presented as flexible pathways that allow them to apply their personal interests within a sustainability context (MCS Foundation, 2023).

Apprenticeships can also foster a strong occupational identity, which has been linked to higher motivation and engagement compared with full-time college students (Reddy, 2014). In the most effective models, employers consistently treat apprentices as learners, both on- and off-the-job (Brockmann et al., 2021). The workplace context and level of support can be decisive: apprentices who experience structured guidance and alignment between work and study are more likely to remain motivated and engaged, whereas those lacking such support risk feeling disconnected, demotivated, and adrift (Fabian, 2022). While existing literature has examined these issues from governmental, employer, and training provider perspectives, the experiences and viewpoints of apprentices themselves remain under-researched.

2.3 Research Questions

WHO IS UNDERTAKING APPRENTICESHIPS IN (AND IN COMPETITION WITH) LOW CARBON HEAT, AND WHERE ARE THEY BASED?

HOW DO YOUNG PEOPLE (16-18 YEAR OLDS) MAKE THE DECISION TO TRAIN IN LOW CARBON HEATING, OR NOT?

3. Method

3.1 Quantitative analysis of apprenticeship data

Scope, identification of relevant standards, and data sources

The quantitative analysis focuses on apprenticeships in England that are most relevant to domestic heating and adjacent trades. Official standard descriptions were used to confirm whether a standard involves domestic heating, heat pumps, gas systems, refrigeration/air-conditioning, or electrical installation work potentially relevant to heat pump installation. The included apprenticeship standards have been chosen to allow comparison between emerging low-carbon pathways and more traditional or adjacent routes into heating-related work; they are:

- Low Carbon Heating Technician (ST1020)
- Plumbing and Domestic Heating Technician (ST0303)
- Refrigeration Air Conditioning and Heat Pump Engineering Technician (ST0322)
- Gas Engineering Operative (ST0155)
- Domestic Electrician (ST1017)
- Installation and Maintenance Electrician (ST0152)

This selection captures both standards whose main purpose is to install, commission, and maintain low carbon heating, and established heating, gas, refrigeration and electrical standards that are not primarily defined as low-carbon, but which either include some low-carbon content or are likely to draw from the same pool of young people[1]. The study concentrates on advanced

[1] Some comparator standards might include low-carbon or energy-efficiency content (for example as low-carbon technologies within electrical standards), but the administrative data do not record which options or technologies an individual

Level 3 standards, because both the core low-carbon heating apprenticeship and the selected comparator apprenticeships are only offered at this level in the current data. The datasets analysed are from the Department for Education's Explore Education Statistics release on apprenticeships (described further in Appendix 1) (Department for Education, 2026). They are official statistics derived from funding and learner records; they provide national administrative data on apprenticeship starts, enrolments, learner characteristics, geography and achievement rates.

Analytical approach

The quantitative analysis uses standard statistical summaries and visualisation to characterise the volume, demographic composition and geography of apprenticeship starts in the core low-carbon and comparator groups. The key outcome measures analysed are:

- **Apprenticeship starts**, defined as the number of apprentices who begin a given standard in a specified academic year. Starts are consistently reported across standards and years and best reflect entry into training, whereas completions for newer standards are not yet fully observable.

- **Apprenticeship enrolments**, defined as the number of apprentices who have been recorded as enrolled, and are still in the learning process in the programme in a specified academic year.

- **Apprenticeship achievement rates,** defined as the number of apprenticeship programmes that were completed in the specified academic year divided by the number started (excluding any learners that transferred onto another qualification within the same institution)[2]. Analysis of achievement rates is on a more aggregated level because data on completion rates for the different apprenticeships is not consistently available (see Appendix 1 for further detail).

For each standard, the demographic composition of apprenticeship starts is calculated by age group, gender, ethnicity and whether students have a

apprentice focuses on. As a result, the analysis can identify apprentices in standards that are relevant to the low-carbon transition but cannot say how many are specialising in low-carbon applications.

[2] The full definition is: 'Achievement rates are based on the individual apprenticeship programmes that were completed in the relevant year. They are calculated as the number of programme aims achieved divided by the number started, excluding the programme aims of any learners that transferred onto another qualification within the same institution.' We recognise some ambiguity in this definition but the inclusion of offboard learners implies that the statistics trace learners through their courses.

declared learning difficulty or disability (LLDD). Time-series analysis has been developed through compiling annual counts of starts for each standard from academic year 2018/19 to 2024/25 (see data in Appendix 4). Geographic mapping of provision and participation has been completed using the geographic starts dataset (see Appendix 1).

3.2 Qualitative evaluation of apprenticeship experiences

The qualitative aspect of this research followed a friendship interviewing approach with those undertaking the Low Carbon Heating Technician apprenticeship. Friendship interviewing (Heron, 2020) is a technique where participants undertake their own recorded conversation without the interviewer present, designed to encourage open conversation between individuals who already know each other. A workshop on communication practices was carried out with participants before each interview to encourage active listening and the handling of potentially sensitive information in ethically responsible ways. Then, for the interviews, participants were provided with a 10-minute hour-glass egg timer and a series of prompts covering: *becoming*, *belonging*, *employability*, *happiness*, and *tradespersonship* (adapted from Heron's method; see Appendix 2 for definitions and interview prompts). Participants were split into groups of 2 or 3 for the conversations, and were asked to spend 10 minutes on each topic. The interviews were audio recorded and transcribed verbatim; pseudonyms are used to protect participant anonymity.

Twenty participants were recruited via colleges delivering the Low Carbon Heating Technician Apprenticeship, or employers working with apprentices following this course (see Appendix 3). The sample focused on those completing the Low Carbon Heating Technician Apprenticeship but in a minority of cases, incorporated those training on the Plumbing and Domestic Heating Apprenticeship, but with a work focus on heat pumps. Engagement in this research from Further Education (FE) colleges delivering the Low Carbon Heating Technician apprenticeship was limited. This was either due to them having limited apprentices in training, or not having enough perceived demand to start delivering the course. Following data collection and secure storage, a thematic analysis approach, informed by Braun et al. (2023), was employed to identify common patterns and draw meta-inferences.

After completing both the quantitative and qualitative analyses, triangulation was used to enable comparison across data sources. The next section presents the findings from both sets of analyses.

4. Results

4.1 Trends in apprenticeship starts and why people might choose low-carbon heating

Figure 1 shows the number of starts for each apprenticeship standard over time, whilst Figure 2 shows the number of enrolments (overall apprentices in learning across all cohorts) for each standard. Installation and Maintenance Electrician is consistently the highest-volume programme among all six apprenticeships, with 5,960 starts in 2018/19 rising to 7,550 by 2021/22. In 2024/25, this programme had 7,130 starts alongside 26,740 enrolments. Similarly, the Plumbing and Domestic Heating Technician Standard has shown significant growth, with starts rising from 250 (2018/19) and peaking at 3,780 (2021/22) before declining to 2,490 in 2024/25. The Plumbing and Domestic Heating Technician had 10,010 enrolments in 2024/25. The sustained high volume implies a large and stable training ecosystem - providers, employers, and learner demand - against which newer low-carbon-specific routes must compete.

More specialised pathways have far fewer new entrants and enrolments. For example, the Domestic Electrician course had 80 starts and approximately 130 enrolments in 2024/25. There has been a gradual increase, with 10 starts in 2022/23, but the lower numbers may reflect the narrower occupational scope and the developing provision of this relatively new pathway, Similarly, the Gas Engineering Operative had 610 starts in 2018/19, a peak at 940 (2021/22) and settled at 760 in 2024/25. The Refrigeration Air Conditioning and Heat Pump Engineering Technician shows gradual growth over time, with 290 starts in 2018/19, a peak at 410 in 2023/24, and 350 starts by 2024/25. This trajectory suggests steady demand but the scale remains an order of magnitude smaller than the Plumbing and Domestic Heating Technician or Installation and Maintenance Electrician routes, highlighting that heat-pump capability is likely being developed within these more general courses. The new Low Carbon Heating Technician course had 80 starts in 2024/25.

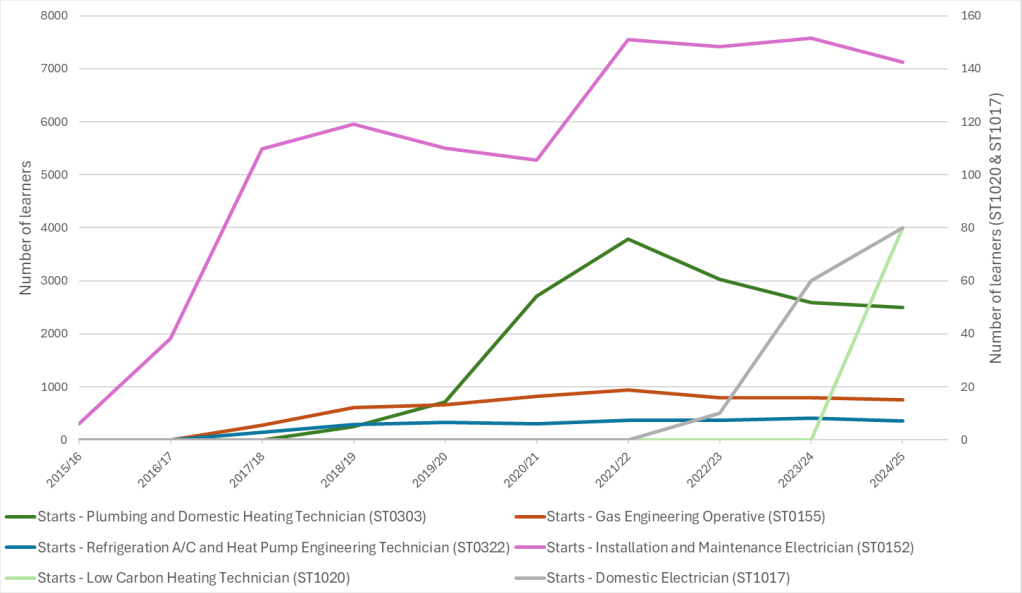

Figure 1: Number of overall starts by apprenticeship.

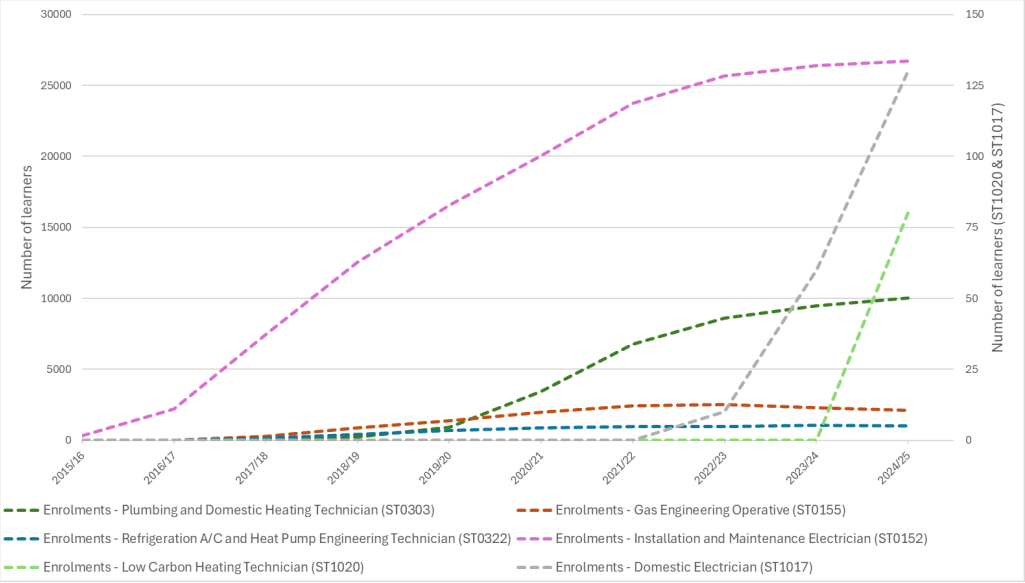

Figure 2: Number of overall enrolments by apprenticeship

Whilst the data highlights the ongoing dominance of the more traditional Plumbing and Domestic Heating Technician, those following the Low Carbon Heating Technician Apprenticeship noted how confident they were in the long-term prospects for this work. Charlie said: “I felt like there's lots of room in the industry to expand and explore, it’s quite a future-proof industry, it’s not going to be like taken over by AI”, whilst Daniel noted: “It's where you know you can have a stable job for at least 30 to 40 years and you know you can make it far”. Several participants expected increasing demand within the sector. For example, Jake suggested that renewable heating “is just gonna grow and grow and grow”, whilst Arthur explained: “the heat pump market is still growing and the work coming in is increasing with every day.” Several individuals

specifically identified the financial opportunities associated with the low carbon heating technician role as a key motivation for taking up the apprenticeship. For example, Charlie said: “with going to uni, you get yourself into a load of debt, which you have to pay off. But with a, an apprenticeship, you get paid to learn. So you earn money whilst gaining a valuable skill”. Several participants highlighted the potential to use their skills as heating technicians to work abroad as a key motivation for pursuing the role, whilst others shared their long-term intentions for career progression. Many apprentices had clear ideas about the managerial roles they hoped to assume later in their careers:

> Sam: Yeah I wanna be self-employed...I want, I want a few lads working for me… And then by the end, it's my company and I'm going to be off the tools at some point.
>
> John: By the time I'm about 40, I'm hoping that I'll be more of a manager, like the operations manager.

Specifically recognising growth in the low carbon heating sector, Daniel pointed to the climate movement as playing a key role: “I chose to become a heating engineer because it's just the way the world's moving at the minute, especially when everybody's just trying to become carbon neutral” Similarly, Riley said he is “very passionate about the low carbon emissions [of heat pumps]", whilst Jake felt that, as a heating engineer, he could help by “giving society a healthier environment to live in.” Apprentices also mentioned being drawn to the sector because of its direct impact on improving people’s quality of life. Several participants emphasised the importance of supporting those most in need of adequately heated homes, particularly individuals at greater risk due to health conditions or older age.

4.2 Geographic distribution of apprenticeships starts

Interview participants generally felt that there would be a lot of low carbon heating work available to them locally upon completion of their apprenticeship. For example, Jake said “there’s going to be tonnes of work... there’s just going to be endless work [fitting heat pumps]”. However, as Charlie pointed out, achieving this would require government support: “there’s no doubt there’ll be lots of work. It’s whether people can afford to have the work done […] So I think there needs to be better government support in order to encourage more people to take up the [Boiler Upgrade Scheme]”.

Quantitative analysis shows a regional skew in where new apprentices are starting (see Figure 3). The South East and North West have the highest absolute numbers across several standards, while London and the North East record relatively modest volumes despite their size and decarbonisation needs.

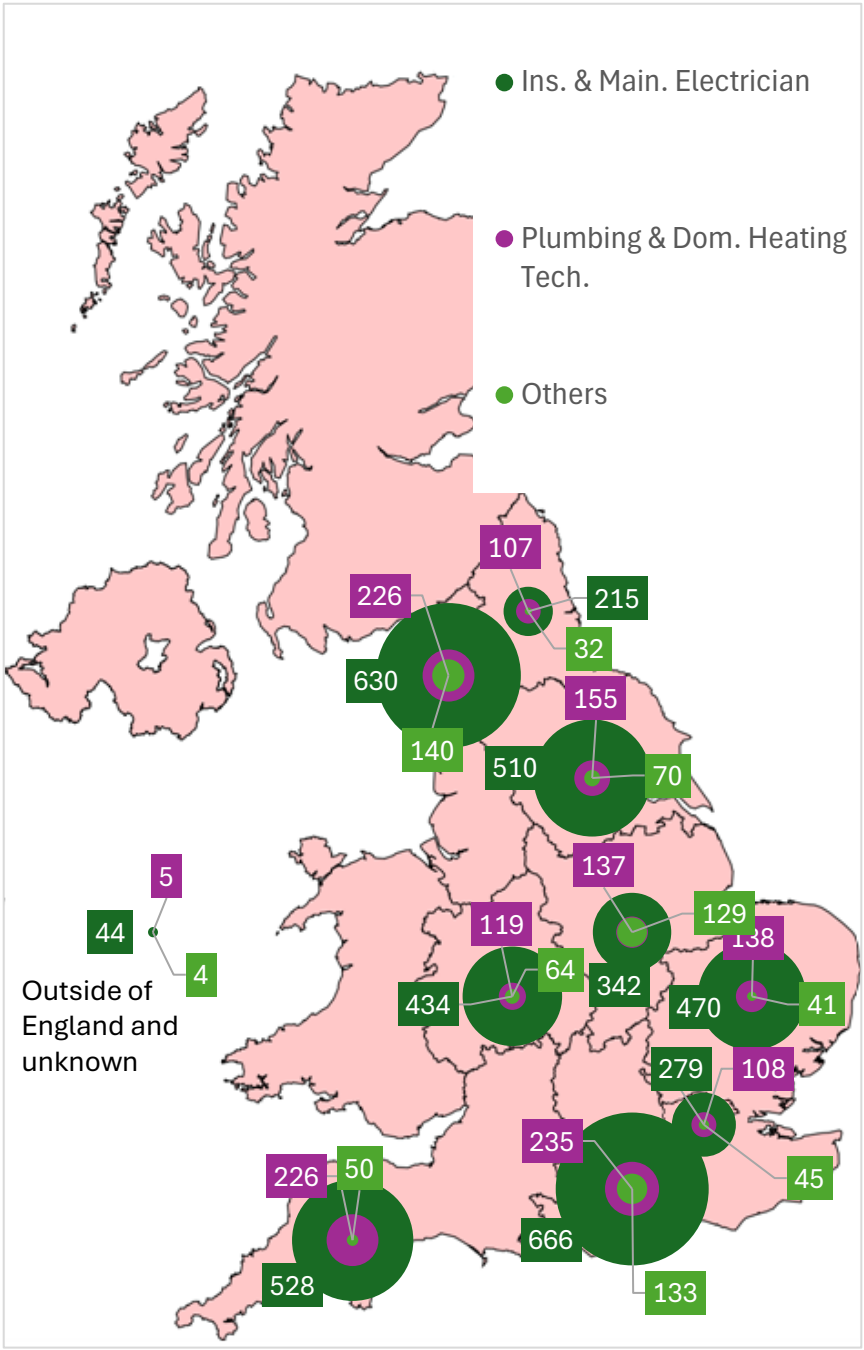

Figure 3: Geographical distribution of apprenticeship starts, academic year 2024/2025. Key: Ins. And Main. Electrician = installation and maintenance electrician; Plumbing & Dom. Heating Tech. = Plumbing & Domestic Heating Technician; Others = all of the other comparator apprenticeships.

To explore whether current training activity is commensurate with the scale of the workforce needed in each region, Figure 4 shows number of apprenticeship starts relative to the estimated regional demand for heat pump related jobs[3]. The North East and Yorkshire and the Humber appear to be "over indexing" slightly, with around 10 per cent of all starts relative to a smaller share of projected jobs. For the North East in particular, the data suggest a comparatively strong apprenticeship effort when measured against projected job needs, which could help the region begin to close its workforce gap. In contrast, London, the West Midlands and East Midlands have fewer new starts than projected workforce requirements suggest are needed, indicating potential future shortages. London shows the lowest apprenticeship start rate relative to estimated job needs, indicating a risk of future capacity constraints in the capital unless apprenticeship volumes and/or midcareer retraining are scaled up. The juxtaposition of these statistics with labour market analysis reinforces the broader conclusion that the heat pump transition is likely to be constrained as much by skills and training as by household demand, and this is likely to be exacerbated if Government targets are to be met (see also, Cotton, 2024).

[3] Estimated regional demand figures are taken from Aldersgate Group's projections of the potential heat pump workforce in 2025–2030 (see Beebee et al., 2025). The report notes that: "Based on current employment trends and assuming no significant policy or behavioural shifts, the potential workforce is projected to grow by 2.9% over the next five years, reaching around 78,300 roles by 2030." See in particular Table 7 on p.14. These projections are based on the Department for Education's baseline labour market and skills projections to 2035, which assume existing technological trends and environmental transitions will continue at a similar pace into the future. The report estimates that England currently has around 76,000 jobs with heat pump relevant skillsets, of which 62 per cent are in installation occupations, and that this "potential heat pump workforce" is unevenly distributed across regions.

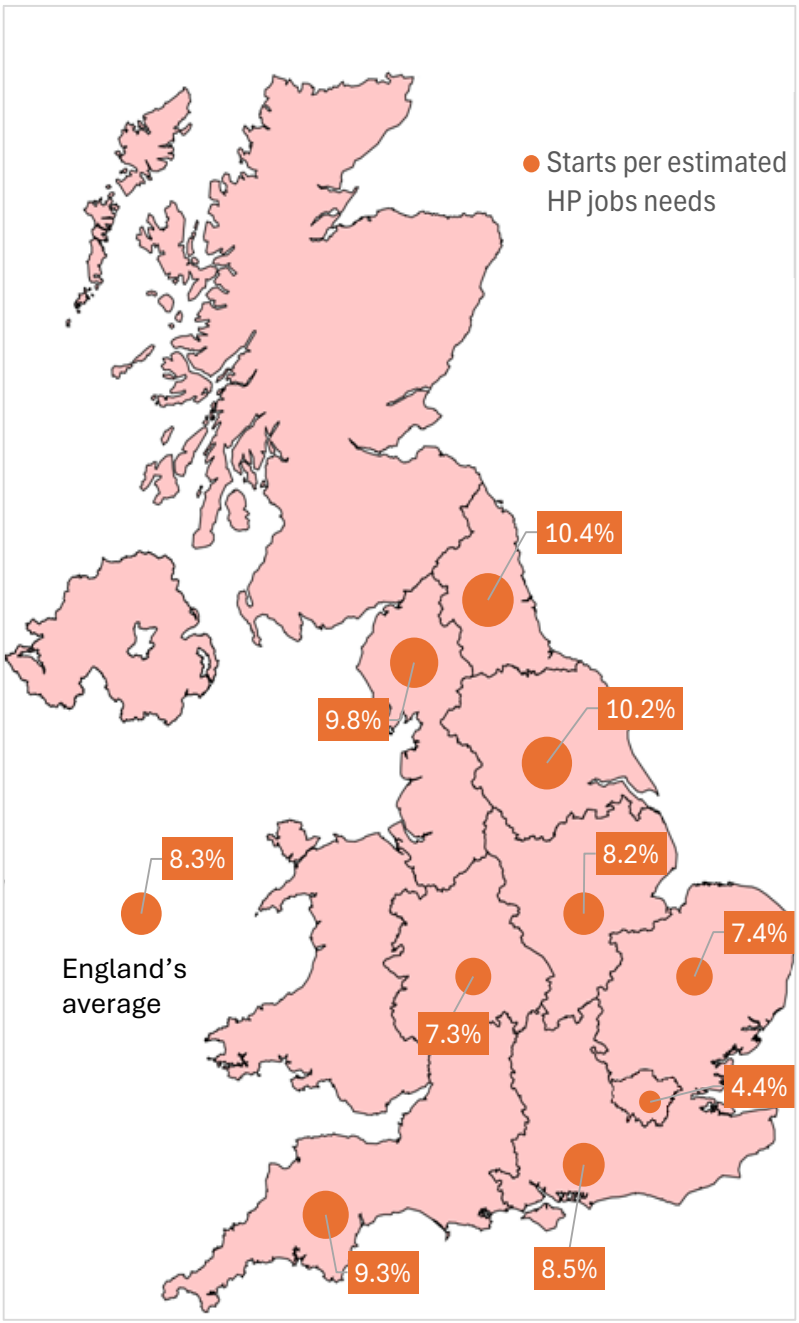

Figure 4: Apprenticeship starts numbers relative to heat pump (HP) related jobs need, across regions.

4.3 Demographic patterns and what they mean for those working in the sector

Age

In 2024/25, roughly two-thirds of starts (1,600 out of 2,490) for the Plumbing and Domestic Heating Technician, and the majority of starts (4,010 out of 7,130) for Installation and Maintenance Electrician were under 19 (see Figure

5). The smaller apprenticeship standards tend to have more new starts from older age groups. For example, Refrigeration Air Conditioning and Heat Pump Engineering Technician has more 19–24 year olds and people over 25 (50 out of 350 in 2024/25). Close to one in five new starts (140 out of 760) were over 25 for the Gas Engineering Operative in 2024/25. This may indicate a stronger role for older entrants and career changers in these more specialised pathways. Low Carbon Heating Technician has only one year history and shows slightly higher (40 out of 80) starts of 19-24 group than that of the under 19 group (30 out of 80), though this should be interpreted cautiously given the small cohort size. The age composition appears broadly stable within each apprenticeship standard over time (see Appendix 4).

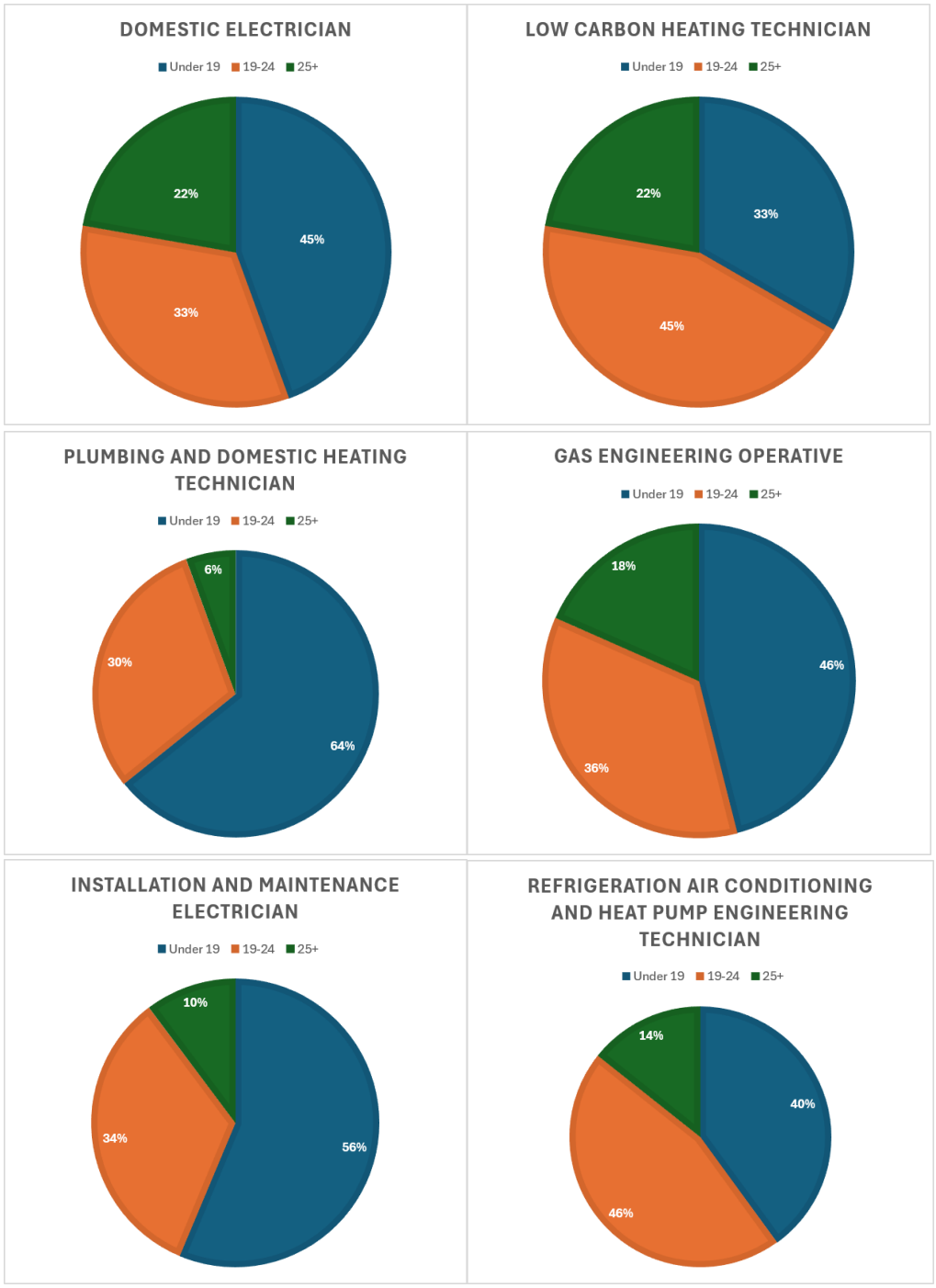

Figure 5: Number of starts by age group for the different apprenticeships in the year 2024/25. Time series data for starts by age group is in Appendix 4.

It is also important to consider how the achievement rates vary by age for the different apprenticeships. As a benchmark, the average achievement rate for a Level 3 apprenticeship is 62% for those starting their training under the age of 19, 63% for 19-23 year olds, and 57% for learners starting above the age of 24 (based on 2023/24 data). Figure 6 indicates the achievement rates for the four more established apprenticeship standards; data for the Domestic

Electrician and Low Carbon Heating Technician apprenticeships is unavailable.

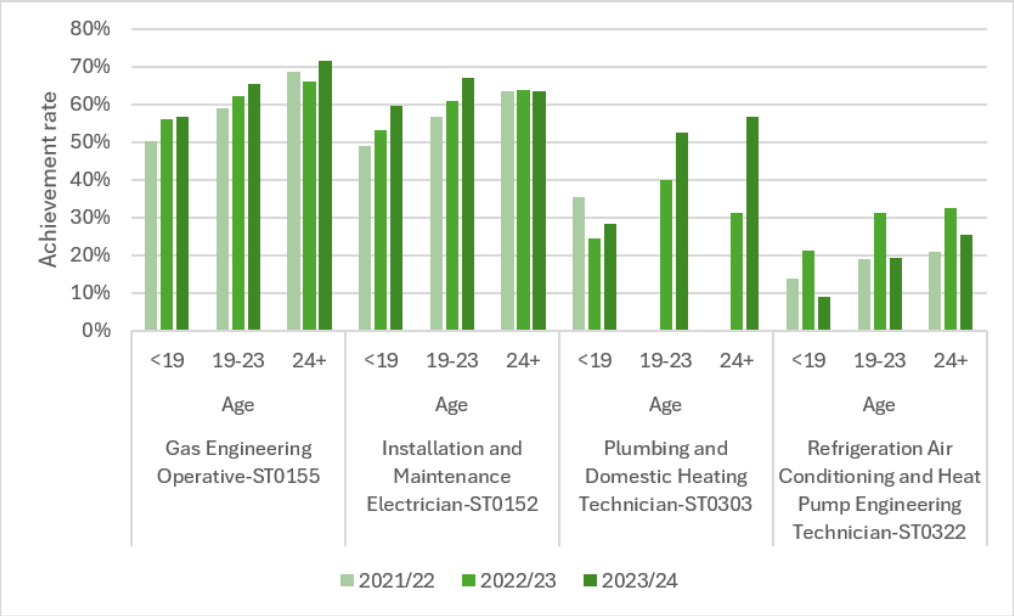

Figure 6: Apprenticeship achievement rates by age group for the four more established apprenticeship standards.

Achievement rates for Under 19s on the Plumbing and Domestic Heating Technician apprenticeship are markedly lower than the benchmark, with only 28% completing their qualification in 2023/24 and 24% in 2022/ 23. Achievement rates improve for older apprentices, with 52% for 19-23 year olds, and 56% of those over 24 completing their qualification (in 2023/24). This pattern may imply general stronger outcomes for the older entrants. By contrast, the Installation and Maintenance Electrician and Gas Engineering Operative are both much closer to the benchmark. For example, Under 19s on the Installation and Maintenance Electrician course have a 59% achievement rate (2023/24) whilst those training as Gas Engineering Operatives have a 57% achievement rate. The two apprenticeships maintain relatively strong performance for 19–23 year olds (65% and 67% for Gas Engineering Operative and Installation and Maintenance Electrician, respectively, in 2023/24). The most striking outlier is the Refrigeration, Air Conditioning and Heat Pump Engineering Technician, where achievement rates are below the benchmark for all age groups. In 2023/24, achievement rates were under 10% for under 19s, under 20% for 19-23 year olds and around 25% for learners above 25.

Gender

The apprentices starting to train in the different standards are overwhelmingly male (see Figure 7). In 2024/25, the proportion of women starting was 2.4%

(60 out of 2,490) for the Plumbing and Domestic Heating Technician, 5.3% (40 out of 760) for the Gas Engineering Operative, 2.9% (210 out of 7,130) for the Installation and Maintenance Electrician, and under 3% (less than 10 out of 350) for the Refrigeration, Air Conditioning and Heat Pump Engineering Technician (although this is a small cohort subject to suppression/ rounding). The smaller standards show higher female proportions in percentage terms (for example, 10 female starts out of 70~80 for both Domestic Electrician and Low Carbon Heating Technician), but these proportions are sensitive to small denominators and should be interpreted cautiously. The time-series evidence indicates that female participation remains in the low single digits across the period, with only marginal year-to-year variation (see Appendix 4).

Achievement rates by gender are not recorded for the specific apprenticeship standards. However, as an indicator, achievement rates at SSA Tier 1[4] level are very similar for male and female apprentices. For Level 3 Engineering apprenticeships in 2022/23, the achievement rate is 64% for women and 62% for men, whilst in Engineering apprenticeships, the achievement rate is 65% for women and 62% for men (see Appendix 5). This indicates that, once women do enter a Level 3 apprenticeship, they tend to achieve at least as often as men at the aggregate level - an important framing point for policy discussions about widening participation.

In keeping with gender imbalance, interview participants had often followed male family members into the profession. For example, Andrew noted that his brother is a plumbing and heating engineer so he “had a little bit of experience prior” and “didn’t really consider any other trades". Similarly, Riley explained that "a lot of my family are tradesmen... they always pushed me towards the heating engineering side”. Participants reflected positively on this; Andrew highlighted the “common ground” he feels with others when on training courses, whilst Tom emphasised the atmosphere on site:

> When you're working on site, you all get […] quite chatty. [...] when you get like that, it's quite helpful cause you can all just help each other with everything you do.

[4] Sector Subject Areas (SSAs) in England is a two-tier classification system used by the Department for Education to categorise qualifications by subject. Tier 1 represents 15 broad subject areas – including *Construction, Planning and Built Environment* and *Engineering and Manufacturing Technologies*, while Tier 2 provides more detailed sub-categories. Low Carbon Heating Technician, Plumbing and Domestic Heating Technician, and Domestic Electrician all belong to SSA Tier 1 *Construction* whilst Refrigeration, Air Conditioning and Heat Pump Engineering Technician, Gas Engineering Operative and Installation and Maintenance Electrician all belong to *Engineering.*

In contrast, one of the few women who took part in the interviews indicated she had at times felt like an outsider within the sector. She explained: “I do normally feel quite welcome, but then occasionally I do get asked why I decided to choose this apprenticeship as a woman”. Some of the reasons for this contrasting sense of belonging were hinted at when participants alluded to the prevalence of ‘banter’ in the workplace. In one case, the presence of “unspoken competition” between colleagues, and “beating others” was mentioned. In another instance, a participant described one of the worst parts of being an apprentice as getting “picked on”, in a way that could be “quite sensitive to some”. However, other participants suggested that workplace dynamics within the sector are inclusive, and that all should feel welcome, for example Daniel highlighted: “I think anyone belongs in the heating industry [...] The industry's a place which is meant for everyone. It's like you may hear stereotypes, but it's not true”.

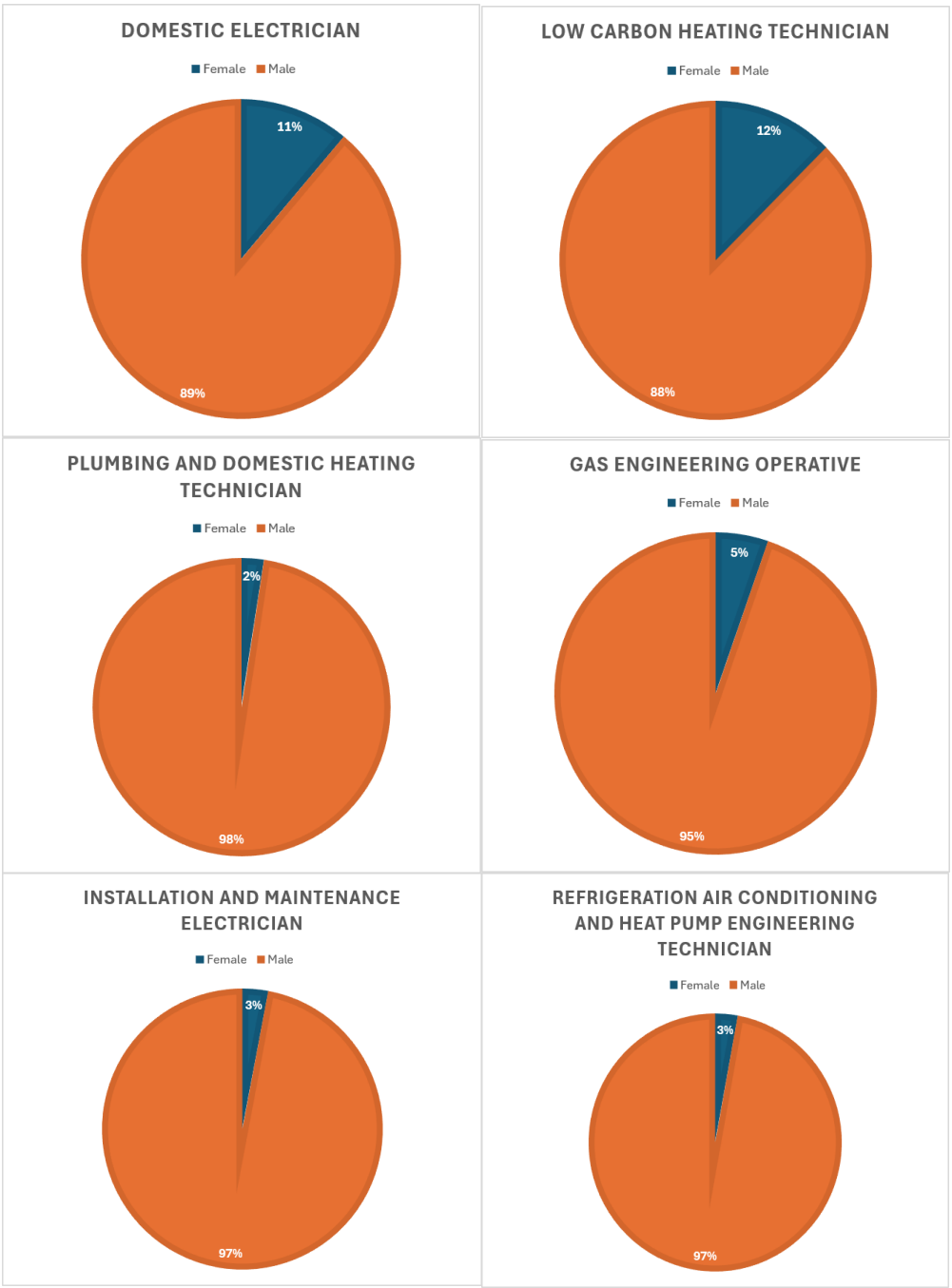

Figure 7: Number of starts by apprenticeship and gender, for the year 2024/25. Full time series data is in Appendix 4.

Learning difficulties and disabilities

The data suggest comparatively stronger inclusion from those with declared learning difficulties or disabilities (LLDD), but with clear differences between standards (see Figure 8). In 2024/25, those with declared learning difficulties or disabilities made up 16.5% (410 out of 2,490) of Plumbing and Domestic Heating Technician starts, 8.6% (30 out of 350) Refrigeration, Air Conditioning and Heat Pump Engineering Technician starts, and 11.8% (90 out of 760) Gas

Engineering Operative starts. LLDD shares appear reasonably consistent from year to year (see Appendix 4), providing a clear baseline for monitoring whether new low-carbon routes replicate (or fall short of) the inclusion patterns of established programmes. Achievement rates by LLDD are not recorded for the specific apprenticeship standards. However, as an indicator, in the 2023/34 academic year the generalised achievement rate for those completing Level 3 apprenticeships is 57% for those with LLDD and 63% for those without. Similarly narrow gaps are present in the SSA Tier 1 level data, with an achievement rate of 56% for those with LLDD and 64% for those without on Engineering courses, and an achievement rate of 58% for those with LLDD and 60% for those without on Construction courses (see Appendix 5 for achievement rates over time).

Different approaches to learning, along with learning difficulties and disabilities, were discussed multiple times by the interview participants. Some noted that school was a difficult place to be. For example, Freya highlighted that she' "always learned better through hands-on work" whilst Tom explained "a trade suited me more because it was more hands-on". Charlie noted that school was sometimes a "bit overwhelming... with my learning difficulties". Similarly, Tom explained that he found school stressful, with his dyslexia meaning that "making notes and trying to memorise things was an absolute pain". Participants indicated that this was quite a common shared experience:

> Sam: Well, I'm riddled with ADHD, aren't I? So-
> Simon: Yeah, I think everyone here's got a bit of something.
> Steve: Hahaha, that's why we're in the trade!

The majority of the sample suggested their skills and aptitudes are more well suited to practical, active, and hands-on work. However, the diverse demands and complexity of the low carbon heating engineer role was also recognised by two participants with, for example, Andrew highlighting the electrical, refrigerant, plumbing and building work involved with heat pumps. He concluded: "I think for anybody coming through as an apprentice, wanting to work with heat pumps, you've got to have such a broad range of trade skills, right?".

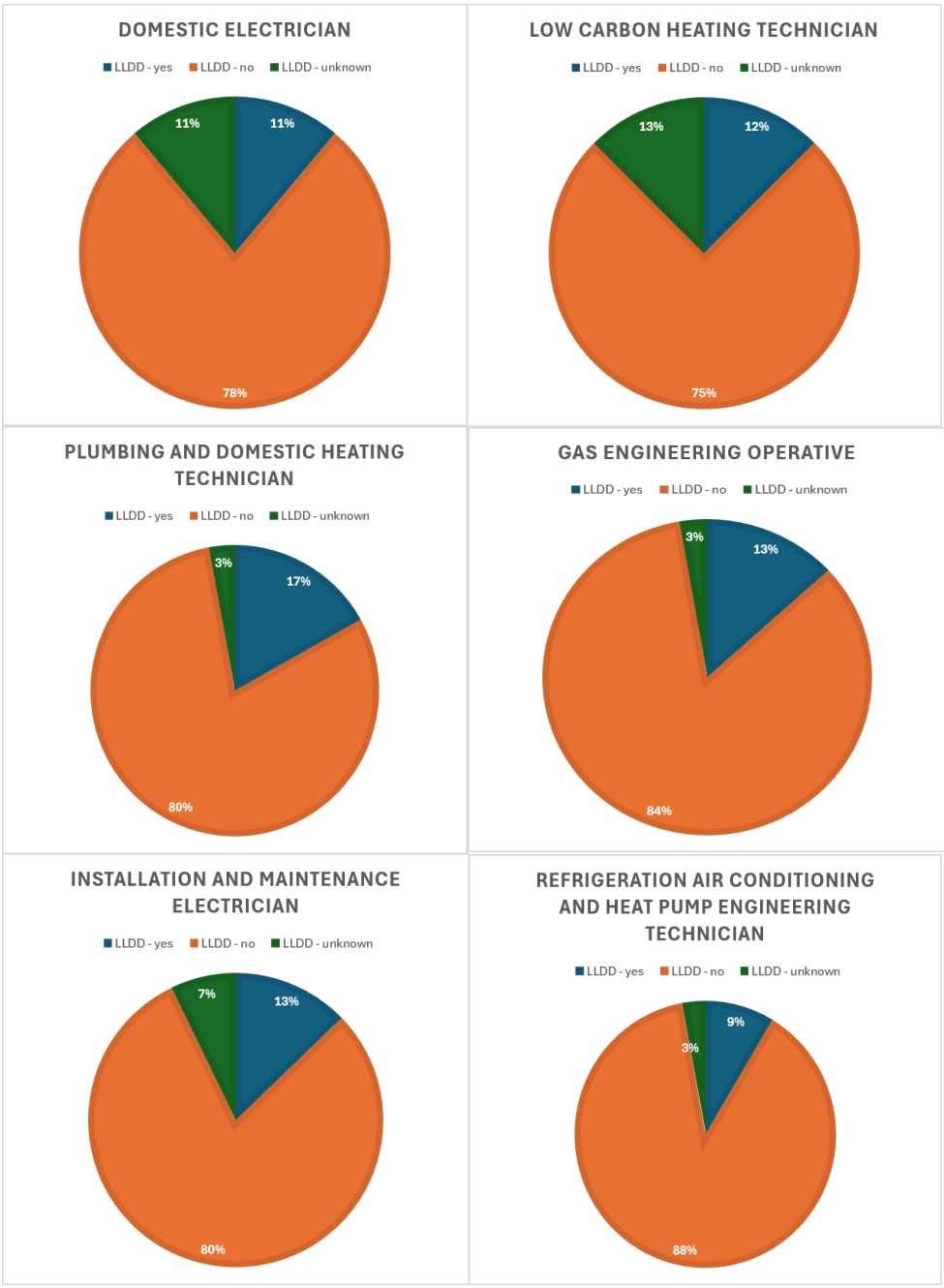

Figure 8. Number of starts by apprenticeship and presence of learning difficulties/disabilities. Full time series data is in Appendix 4.

Ethnicity

Minority ethnic representation is around 6~7% in the majority of apprenticeships, with 7.3% (180 out of 2,480) for the Plumbing and Domestic Heating Technician, 7.2% (510 out of 7,130) in the Installation and Maintenance Electrician, and 5.7% (20 out of 350) for the Refrigeration, Air Conditioning and Heat Pump Engineering Technician, in 2024/25 (see Figure 9). The Gas Engineering Operative stands out with a higher share at around 10.5% (80 of 760). The time-series evidence suggests that minority ethnic representation is relatively stable within each standard (see Appendix 4). This is significant because it implies that growth in apprenticeship numbers alone is unlikely to deliver proportional diversity gains unless growth is accompanied by targeted outreach and structural changes in access pathways.
Achievement rates by ethnicity are not recorded for the specific apprenticeship standards. However, as an indicator, in the 2023/24 academic year the achievement rates for those completing Level 3 apprenticeships is lower for those identifying as an ethnic minority than those identifying as white. The achievement rate in 2023/24 is 49% for ethnic minorities and 60% for white apprentices undertaking Construction courses, and it is 56% for ethnic minorities and 63% for white apprentices undertaking Engineering courses (see Appendix 5).

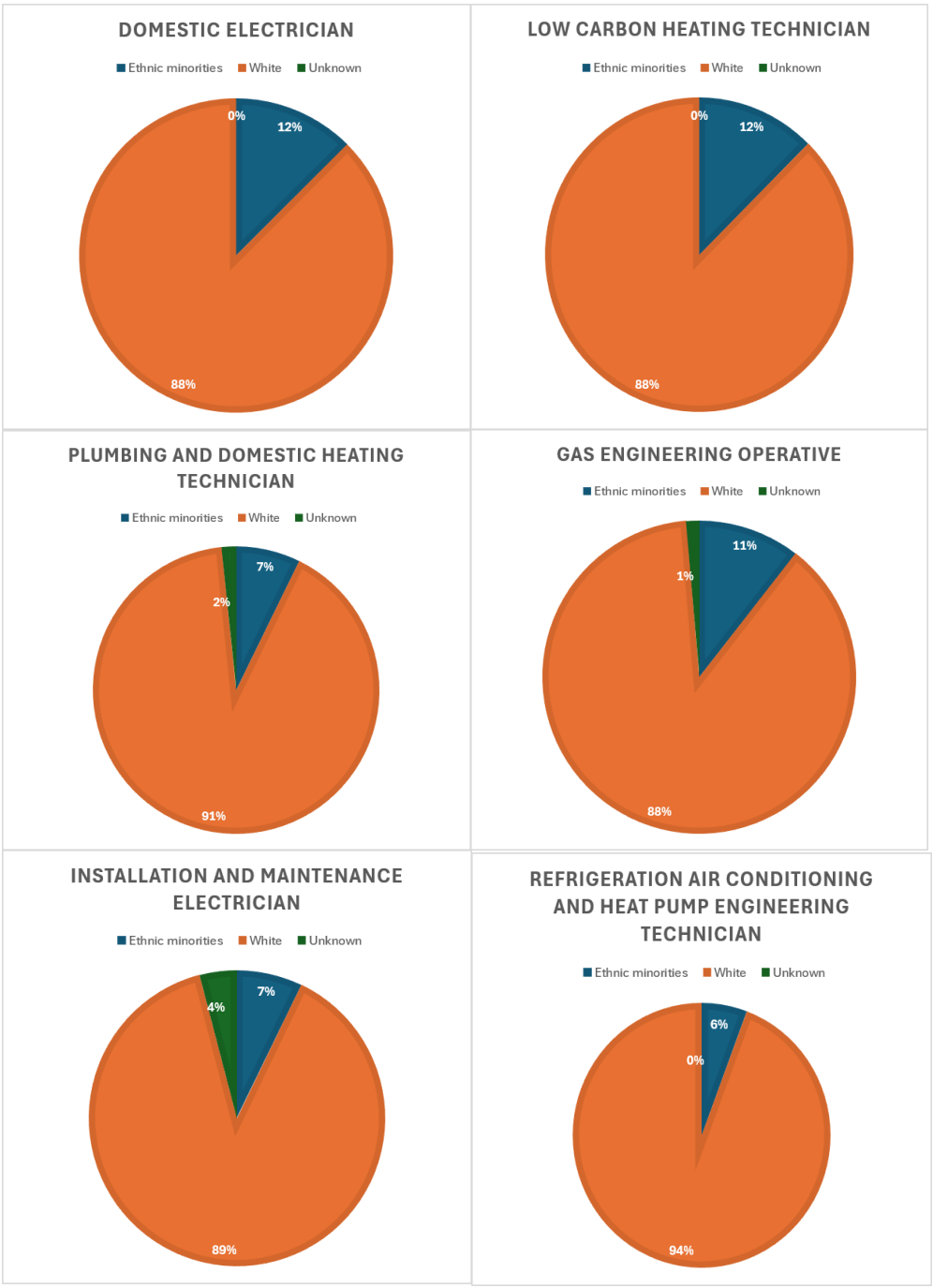

Figure9. Number of starts by apprenticeship and ethnicity for the year 2024/25. Full time series data is in Appendix 4.

5. Conclusion

The established Installation and Maintenance Electrician and Plumbing and Domestic Heating standards still dominate in terms of apprenticeship starts and enrolments. More specialised courses have fewer new entrants. However, apprentices following the Low Carbon Heating Technician route were confident about a pipeline of future work. This, coupled with limited engagement in this research from FE colleges, indicates a mismatch between those who are training to be low carbon heating apprentices and an education system that perceives a lack of demand from new entrants.

Geographical analysis indicated a strong volume of training for apprenticeships relevant to low carbon heat in the North East. This is potentially positive for filling employment gaps in the region, and needs to be sustained through continued engagement between FE colleges, employers and the low carbon heating sector. In contrast, London, the West Midlands and East Midlands had smaller numbers relative to potential workforce needs. These regions may therefore require **targeted** interventions from several actors: the low carbon heating sector could prioritise stronger relationships with FE colleges and employers in these regions to support course development and outreach; local and combined authorities could provide or coordinate funding for FE capacity, employer engagement and learner travel; and UK Government could target apprenticeship and clean-skills funding towards regions where starts are low relative to projected heat pump workforce demand. Such interventions should aim to increase both apprenticeship availability and employer demand, rather than relying on learner recruitment alone.

Achievement rates are low, especially for younger learners on the Plumbing and Domestic Heating apprenticeship To ensure the success of the Low Carbon Heating Technician Apprenticeship, it will be important to **work closely with these first cohorts on the qualification throughout their learning journey**. This is essential to ensure that low achievement rates are not replicated, and to work out what tailored support may be needed to ensure that people can complete their qualification. Low achievement rates could also indicate a need to support employers hiring apprenticeships, although this has not been the focus of the current study. For example, tailored guidance and advice may help those that have concerns about their apprentices, but **further research is needed to understand employers' experiences,** for example why apprenticeships might break down.

There is a dominance of younger entrants on the more mainstream apprenticeships, whilst older entrants make up a greater proportion of more specialised apprenticeships like the Low Carbon Heating Technician. This indicates that the low carbon heating sector could **more clearly target their advertising and information at school leavers if wanting to attract a younger cohort**.

There is a persistent under-representation of women and ethnic minorities in the heating industry, and the data analysed here shows little change in that over time. However, analysis of the quantitative data available indicates that women following Construction and Engineering apprenticeships tend to achieve at the same rates as men. There is a **need for more detailed data on achievement rates for specific apprenticeship standards**, but this could indicate that once in post female apprentices tend to do well, and **actions should focus on supporting women to take up the apprenticeships in the first place**. This might include working with children in their early years to undo pervasive gendering of roles and aspirations, for example. Ethnic minorities showed slightly lower achievement rates which may indicate the need for more targeted support for these groups.

The data available on learning difficulties and disabilities (LLDD) indicates that those with LLDD achieve at similar rates to those without across Construction and Engineering apprentices. Again, **more granular data on achievement rates for specific qualifications is needed**. However, the qualitative interviews with Low Carbon Heating Technician apprentices showed positive experiences for those who learn in a hands-on way and/ or have different forms of neurodiversity. The ability of the Low Carbon Heating Technician apprenticeship to accommodate LLDD and neurodiversity has not specifically been discussed, and the low carbon heating industry **could develop specific work around neurodiversity in the sector if wanting to attract more new entrants**.

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Appendices

Appendix 1: Datasets used for quantitative analysis

Apprenticeship starts, enrolments and demographic analysis. All data used comes from the Department of Education (2026) apprenticeships collection, available at: Releases - Apprenticeships - Explore education statistics - GOV.UK Two datasets were used to analyse recent trends in apprenticeship participation by individual standard. They are: **Dataset 'app-subject-standards-202425-q4' (academic year 2024/25 release, coverage 2018/19 to 2024/25)** and **Dataset 'app-subject-standards-2021-q4' (academic year 2020/21 release, coverage 2015/16 to 2020/21)**. These datasets provide annual counts of starts, enrolments and achievements by standard, alongside demographic details. They are used to identify the six focal Level 3 (Advanced) standards, compare their relative scale, and examine patterns by age, gender, ethnicity and declared learning difficulty and/or disability (LLDD). The two datasets provide the same data for different timeframes; they were analysed together to provide analysis of trends from 2015/16 – 2024/25 (see Appendix 4). The analysis of these datasets uses the following variables:

- std_fwk_name_stcode - framework or standard title together with the ST code; used to identify the apprenticeship standards included in the analysis.
- apps_level_detailed - detailed apprenticeship level; used to identify advanced Level 3 standards.
- ssa_tier_1 - broad sector subject area; used to help identify standards relevant to heating, engineering and building services.
- learner_characteristic - learner characteristic category, including age group, gender, ethnicity and LLDD.
- starts – number of apprenticeship starts in the academic year; the main indicator used in the report to capture entry into training.
- enrolments – number of apprentices recorded as in learning; used to show the size of the wider training pipeline.
- achievements – number of apprenticeships achieved in the academic year.

Geographic analysis. The dataset used to examine regional patterns in participation across the six selected standards is: **Dataset 'app-underlying-**

data-starts-202425-q4' (academic year 2024/25 release, coverage 2019/20 to 2024/25). This dataset records apprenticeship starts by both the apprentice's home location and the training provider's delivery location. We use the training provider's delivery location as the analysis focus. Key variables used from this dataset are:

- delivery_region/delivery_lad - the provider delivery region or local authority district; used to show where training is delivered.
- st_code/std_fwk_name - apprenticeship standard code and title; used to isolate the six standards included in the report.
- starts - number of apprenticeship starts; the measure used for geographic mapping and comparison.

Achievement rate analysis. Achievement rates are not recorded alongside all demographic information for all of the apprenticeship standards. Apprentice age is recorded alongside achievement rate for four of the apprenticeship standards (see analysis on Demographic patterns and what they mean for those working in the sector and Appendix 5). Data from broader Sector Subject Areas (SSAs) are used to provide indicative benchmarks of achievement rate for other demographic variables. Sector Subject Areas (SSAs) in England is a two-tier classification system used by the Department for Education to categorise qualifications by subject. Tier 1 represents 15 broad subject areas – including the two relevant to this report: *Construction, Planning and Built Environment* and *Engineering and Manufacturing Technologies*, which further extends to the two relevant Tier 2 SSAs respectively: *Building and Construction* and *Engineering*.

The datasets used for analysis of achievement rates are: **Dataset 'app-narts-subject-and-level-detailed' (academic year 2024/25 release, coverage 2021/22 to 2023/24), Dataset 'app-narts-learner-detailed' (academic year 2024/25 release, coverage 2021/22 to 2023/24), Dataset 'achievement-rates-ssat1-demographics-2021' (academic year 2021/22 release, coverage 2018/19 to 2020/21)**. The first dataset provides apprenticeship achievement-rate information for three most recent academic years by subject area, level, standard, and age as the only demographic characteristic reported. It is used to benchmark achievement patterns for the selected standards, where data are available, against wider apprenticeship averages and related subject areas. It is particularly useful for understanding how the focal standards compare with broader Level 3 (Advanced) and sector-level outcomes in terms of age. The second two datasets provide apprenticeship achievement-rate information by all four learner characteristics. They are used to examine whether achievement outcomes differ by age, gender, ethnicity and declared learning difficulty and/or disability, and therefore explore wider

equality and inclusion patterns in apprenticeship outcomes. However, the second dataset covers only for the broad apprenticeship Level 3 (Advanced) for the 3 most recent academic years. The final dataset is used to extend the achievement-rate analysis to earlier years with a granularity level available at SSA Tier 1. Key variables from these datasets are:

- std_fwk_name_stcode - framework or standard title together with the ST code; used to identify achievement-rate information for the relevant standards.
- std_fwk_flag - indicates whether the record relates to a standard or a framework.
- level/detailed_level - apprenticeship level and detailed level; used to compare outcomes at advanced Level 3.
- ssa_tier_1/ssa_tier_2 - sector subject area classifications; used for benchmarking against broader subject groups.age_group/age_youth_adult - age categories; used to compare outcomes for younger and older learners.
- achievement_rate - overall apprenticeship achievement rate
- age_group/age_youth_adult - age categories; used to compare outcomes by stage of life.
- demographic/group - demographic category and group label, including gender, ethnicity and LLDD.
- apprenticeship_level - apprenticeship level; used to retain comparability with Level 3 analysis.
- sector_subject_area - broad subject area classification; used for benchmarking against relevant sectors.

Across the data, it is important to note that for confidentiality, cell counts are rounded to the nearest 10 and very small numbers are reported as “low” or suppressed altogether. This means that figures for very small groups, such as early cohorts on new standards should be treated as indicative rather than exact.

Appendix 2: Interview prompts

Part A: Introduction
Once audio recording has begun, please start the conversation by stating your names and the apprenticeship programmes that you are enrolled on.

Part B: Main conversation
For the main conversation, please explore the 5 following cue card prompts. You can choose the order in which you cover them. Take it in turns to go first for each prompt. Start by reading out the prompt and discussing what the word means to you in the context of your experience as an apprentice. There are some additional questions listed under each prompt to help guide you through the conversation.

BECOMING. *This theme sought to explore whether people feel welcome in the heating industry and connected to those around them. Prompts included:*

Why did you choose to become a heating engineer? Maybe there are a few reasons you can think of...What other options did you consider?

What was your experience like at school? What did you like/ dislike about school? What were your favourite subjects?

Are there any memorable conversations from the time when you were deciding to do a heating apprenticeship? You might talk about conversations with family, close relations, friends or teachers.

BELONGING. *This theme encouraged participants to consider the things that happened before the apprenticeship and contributed to the decision to do an apprenticeship. Prompts included:*

To what extent do you feel as though you belong within the heating industry? What are the reasons you do, or don't, feel welcome?

What are the people like in the heating industry? You might think about whether they are fun to be around, chatty, or serious, for example. Are they like you?

Why do you think the sector is made up of people like this?

EMPLOYABILITY. *This theme was about looking ahead and what career options apprentices saw for themselves. Prompts included:*

What are your career intentions for the longer-term? Would you consider working in any different industries? What would they be?

Where would you like to work after your apprenticeship? You might talk about whether you would stay local or move away for work, and why...

How much heating installation work do you think will be available locally when you finish your apprenticeship?

TRADESPERSONSHIP. *This theme sought to understand what it meant to the apprentices to be a tradesperson, particularly in terms of their values and role in society. Prompts included:*

What skills do you hope to develop in the years ahead? Is your apprenticeship equipping you with these?

What contribution do you think you might make to society as heating engineer?

In what ways do you take pride in your work?

What do you think others will value about your work?

HAPPINESS*. This theme recognises that happiness is central to lived experience and sought to understand what made for a happy apprenticeship. Prompts included:*

What is the best thing about being an apprentice? What is the worst thing about being an apprentice?

What is your best story from being a heating apprentice so far?

Part C: Review and final thoughts
Before closing, please reflect on the following prompts:

What are your main reflections after having taken part in this conversation? Did anything new come to mind?

Are there any other things about your experience as an apprentice that you have not yet talked about, but would like to share?

Appendix 3: Friendship interview participants

Pseudonym	Recruited via college or company	Apprenticeship (e.g. Low Carbon Heating Technician (LCHT) or other)
Steve	College	LCHT
Simon	College	LCHT
Sam	College	LCHT
Daniel	College	LCHT
John	College	LCHT
Jabari	College	LCHT
Pete	Company	Plumbing and Domestic Heating Technician
Tom	Company	Plumbing and Domestic Heating Technician
Oliver	Company	Plumbing and Domestic Heating Technician
Andrew	Company	Plumbing and Domestic Heating Technician
Jake	Company	LCHT
Charlie	Company	LCHT
James	Company	LCHT
Riley	Company	LCHT
Noah	Company	LCHT
Freya	Company	LCHT
George	Company	LCHT
Arthur	Company	LCHT
Katherine	Company	LCHT
Lucy	Company	LCHT

Appendix 4. Time series of apprenticeship starts by demographic groups

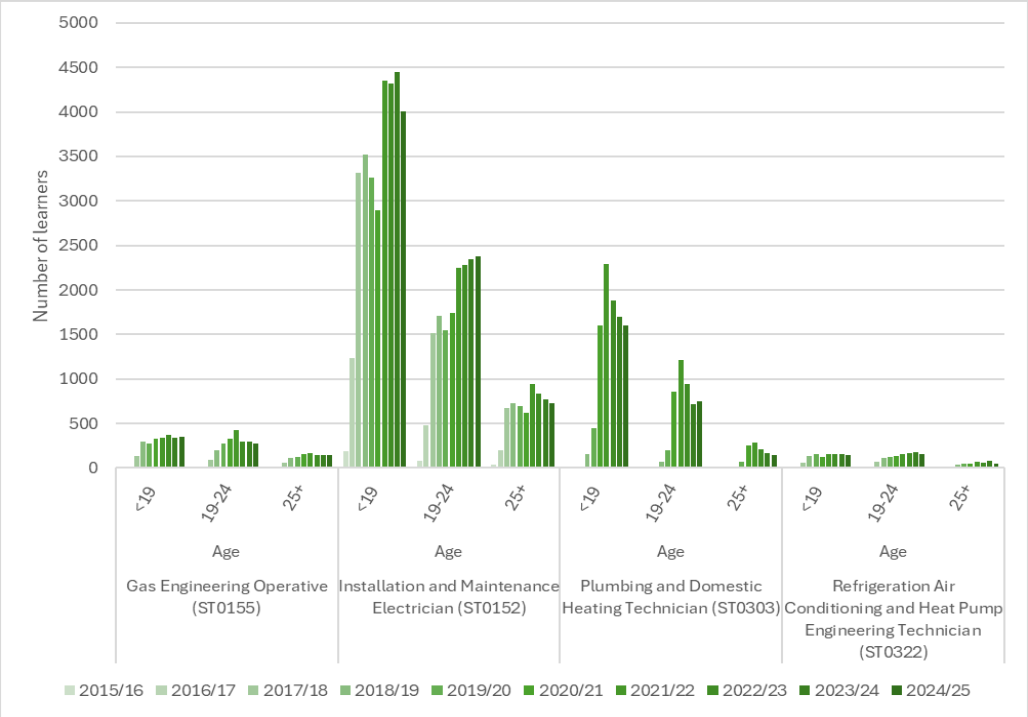

Figure a: Time series of starts of Gas Engineering Operative, Installation and Maintenance Electrician, Plumbing and Domestic Heating Technician and Refrigeration, Air Conditioning and Heat Pump Engineering Technician apprenticeships by age

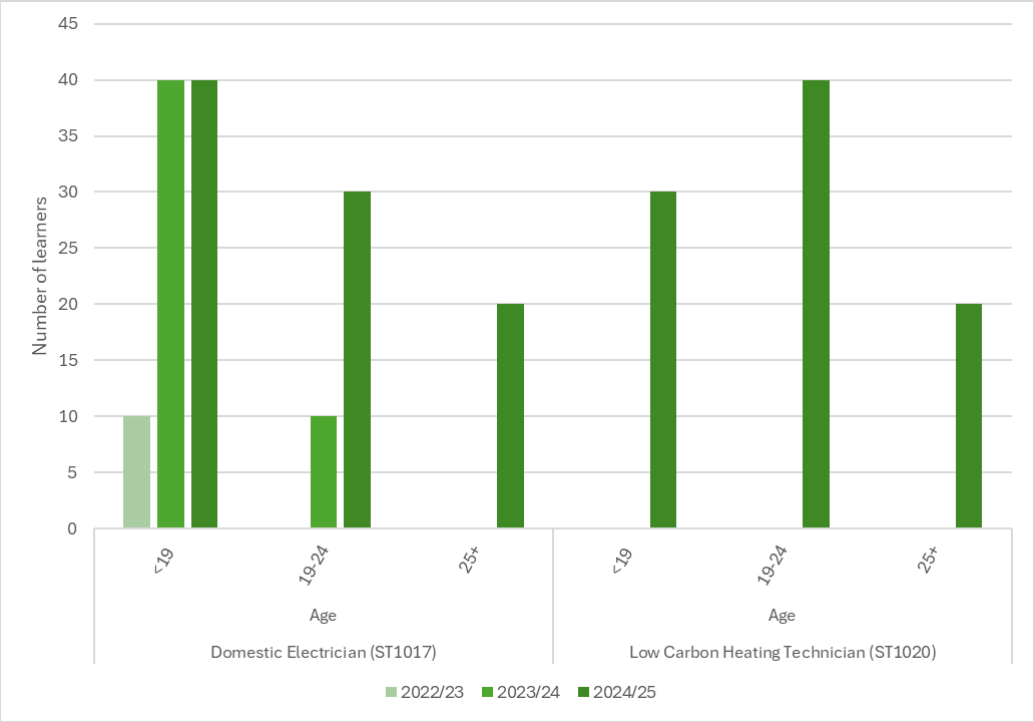

Figure b: Time series of starts of Domestic Electrician and Low Carbon Heating Technician new apprenticeships by age

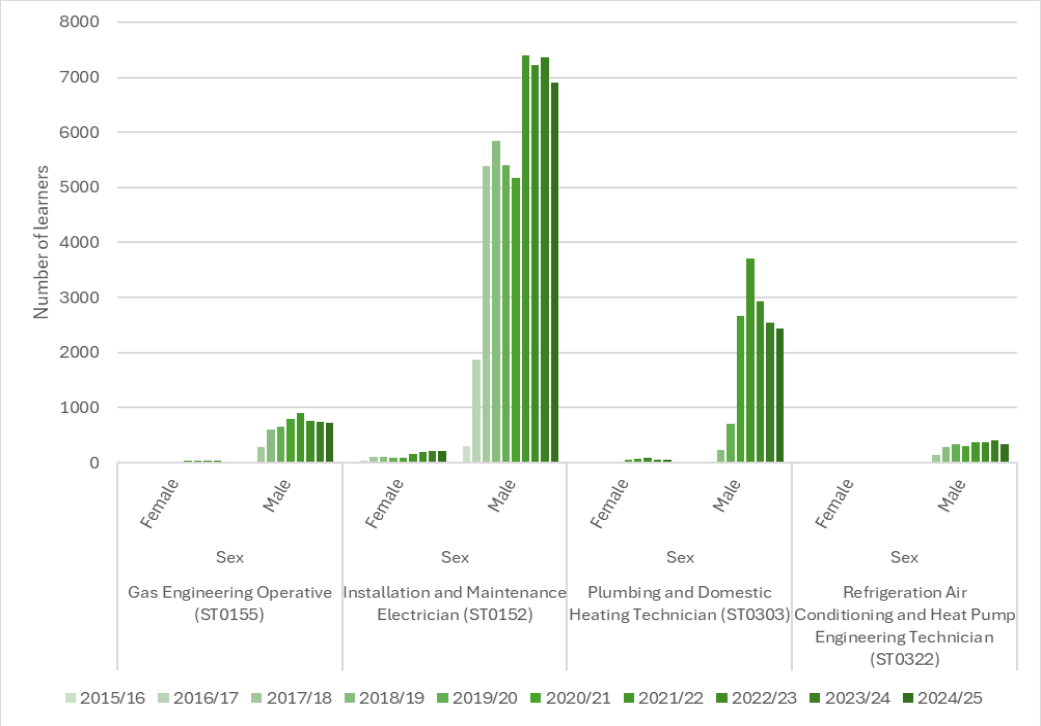

Figure c: Time series of starts of Gas Engineering Operative, Installation and Maintenance Electrician, Plumbing and Domestic Heating Technician and Refrigeration, Air Conditioning and Heat Pump Engineering Technician apprenticeships by gender

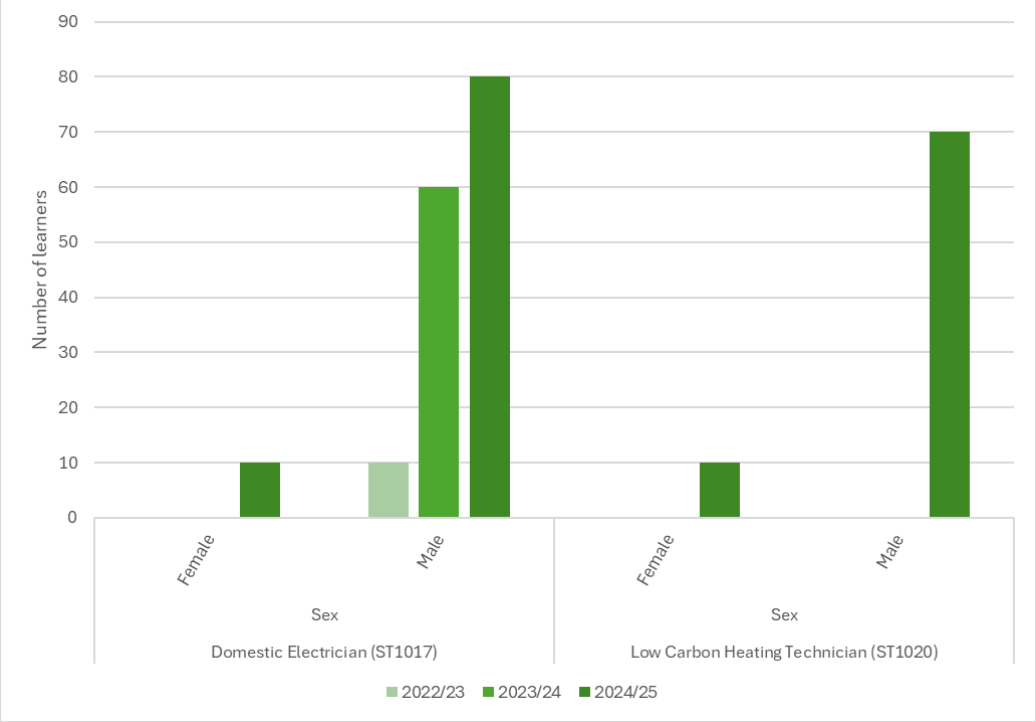

Figure d: Time series of starts Domestic Electrician and Low Carbon Heating Technician apprenticeships by gender

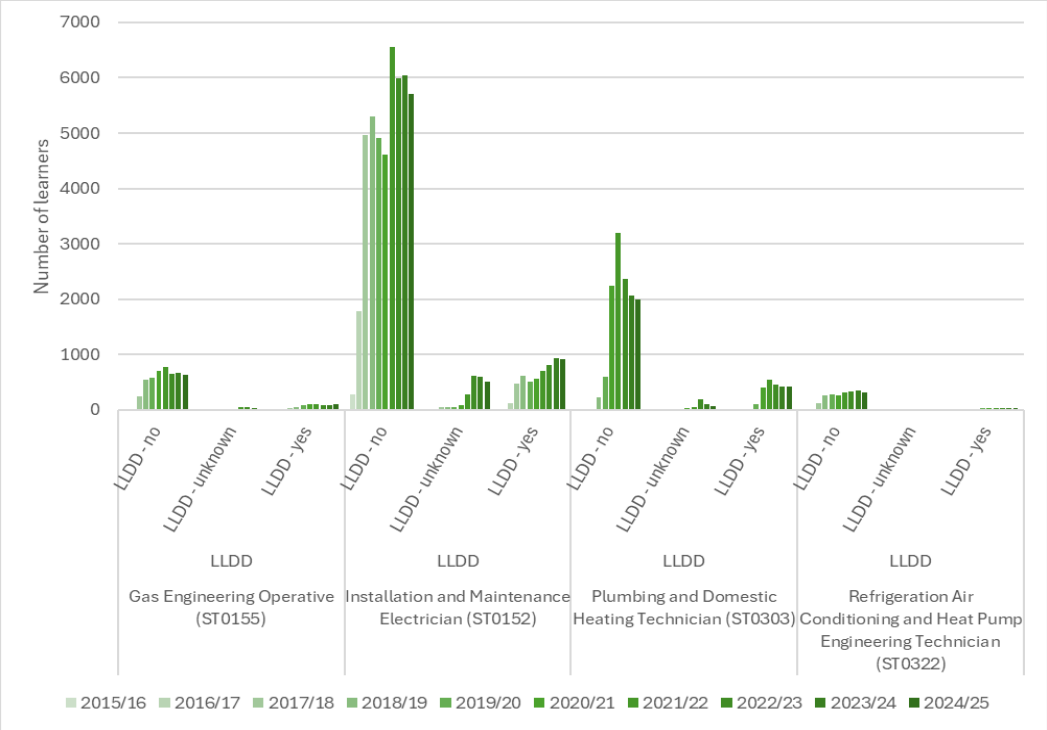

Figure e: Time series of starts of Gas Engineering Operative, Installation and Maintenance Electrician, Plumbing and Domestic Heating Technician and Refrigeration, Air Conditioning and Heat Pump Engineering Technician apprenticeships by declared learning difficulties/disabilities

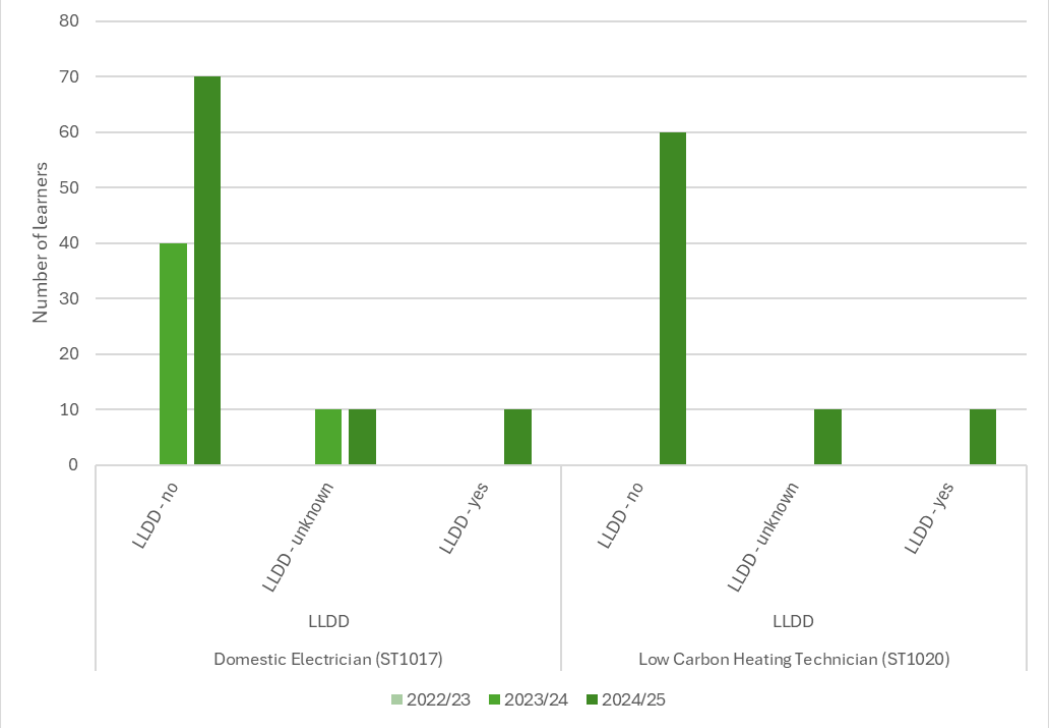

Figure f: Time series of starts Domestic Electrician and Low Carbon Heating Technician apprenticeships by declared learning difficulties/disabilities

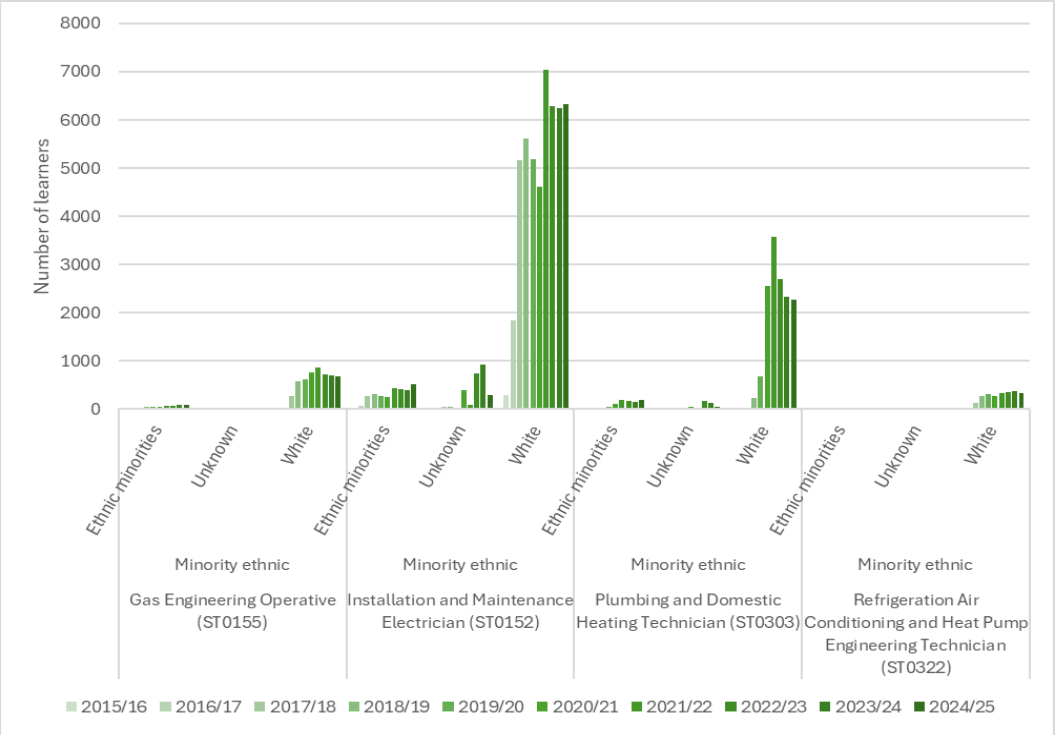

Figure g: Time series of starts of Gas Engineering Operative, Installation and Maintenance Electrician, Plumbing and Domestic Heating Technician and

Refrigeration, Air Conditioning and Heat Pump Engineering Technician apprenticeships by ethnicity

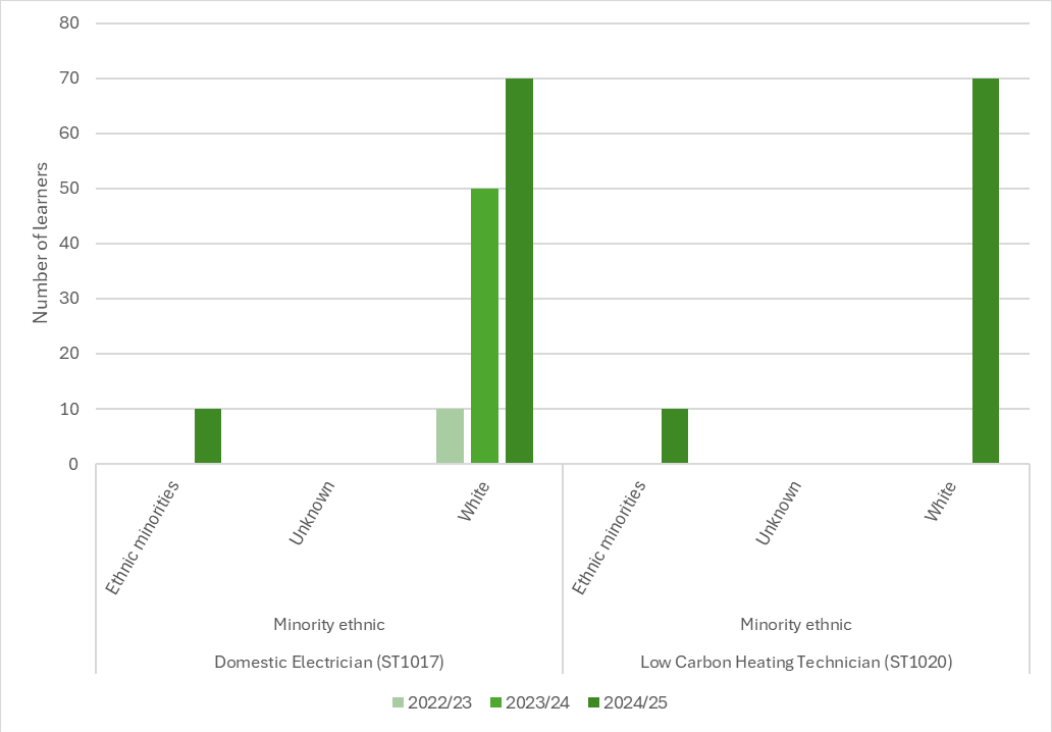

Figure h: Time series of starts of Domestic Electrician and Low Carbon Heating Technician apprenticeships by ethnicity

Appendix 5. Achievement rates by LLDD, ethnicity and gender

Declared learning difficulty or disability (LLDD)

Year	Total (all SSA Tier 1)		Construction Planning and Built Environment		Engineering and Manufacturing Technologies	
	LLDD - yes	LLDD- no	LLDD - yes	LLDD- no	LLDD - yes	LLDD- no
2018/19	48.1%	49.4%	52.9%	63.6%	47.8%	67.2%
2019/20	43.4%	46.4%	59.0%	52.6%	53.1%	53.6%
2020/21	48.7%	53.4%	54.1%	57.5%	38.7%	49.4%
2021/22	55.4%	60.7%	56.5%	62.8%	55.0%	60.3%
2022/23	53.8%	60.4%	55.8%	62.2%	54.8%	61.1%
2023/24	57.5%	63.7%	58.8%	60.4%	55.8%	64.0%

Gender

Year	Total (all SSA Tier 1)		Construction Planning and Built Environment		Engineering and Manufacturing Technologies	
	Female	Male	Female	Male	Female	Male
2018/19	49.0%	48.8%	59.5%	63.8%	64.6%	64.7%
2019/20	46.3%	45.6%	63.4%	51.1%	51.9%	53.1%
2020/21	54.1%	51.2%	60.6%	56.4%	50.9%	48.1%
2021/22	57.0%	60.3%	62.3%	61.9%	58.0%	59.6%
2022/23	58.1%	59.8%	61.5%	61.7%	61.3%	60.2%
2023/24	64.1%	62.5%	62.4%	60.0%	65.5%	62.6%

Ethnicity

Year	Total (all SSA Tier 1)		Construction Planning and Built Environment		Engineering and Manufacturing Technologies	
	Ethnic minority	White	Ethnic Minority	White	Ethnic Minority	White
2018/19	41.9%	50.1%	28.0%	68.0%	78.4%	64.1%
2019/20	37.8%	47.4%	40.0%	54.3%	45.5%	54.1%
2020/21	47.2%	53.8%	36.0%	58.3%	42.2%	48.8%
2021/22	50.1%	61.0%	49.5%	62.9%	50.1%	60.3%
2022/23	51.0%	60.5%	53.7%	62.2%	52.9%	60.9%
2023/24	57.4%	63.5%	49.0%	60.9%	56.3%	63.4%

About EDRC

The Energy Demand Research Centre (EDRC) undertakes research for an affordable and secure low energy future. Our interdisciplinary research programme identifies evidence-based energy demand reductions for a sustainable and more equitable future. We work closely with partners from policy, industry, civil society and academia.

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hello@edrc.ac.uk

www.edrc.ac.uk

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