

## **CORE**

The outline content below relates to the Occupational Specialism. In addition, students will study a series of elements of core knowledge. These are:

- Health and safety in construction
- Construction science principles
- Construction design principles
- Construction and the built environment industry
- Construction sustainability principles
- Construction measurement principles
- Building technology principles
- Construction information and data principles
- Relationship management in construction
- Digital technology in construction
- Construction commercial / business principles
- Building services engineering (BSE) systems
- Maintenance principles
- Tools, equipment and materials

In addition, students will develop the following core (transferable) skills:

- Communication
- Working collaboratively with other team members and stakeholders
- Applying a logical approach to problem solving
- Primary research

Further details on the content can be found in the [outline content](#) document or the [qualification](#) specification.

## Occupational Specialist Content

Specialist content is structured into different Occupational Specialisms, which correspond to the apprenticeship standards listed on the relevant occupational map. The Occupational Specialism content below relates to the Low Carbon Heating Technician apprenticeship standard (ST1020).

Occupational Specialisms ensure students develop the knowledge and skills necessary to achieve a level of competence needed to enter employment and are organised around 'Performance Outcomes' that indicate what the student will be able to do, as a result of learning and applying the specified knowledge and skills.

Each Performance Outcome sets out the knowledge and skills required to meet that Performance Outcome. As a result, the same content areas may appear in more than one Performance Outcome where it would be contextualised to that Performance Outcome.

There are some content areas that are included in both the Core and Occupational Specialism sections; this is intentional. Where in Core, it is because it is content that is applicable to all Building services engineering students, regardless of the Occupational Specialism. If the same content area is also in the Occupational Specialism, it is because the knowledge is needed to achieve the relevant Performance Outcome. In the Occupational Specialism, it is therefore likely to require different content to reflect the Performance Outcome.

There are always fewer skills than knowledge. Skills do not include tasks that demonstrate the application of knowledge. For example, producing a method statement or risk assessment is a task that calls on knowledge of health and safety and how a task is completed, but the skills are in organising that knowledge in a logical way and communicating that effectively through choice of language and also digital skills in presenting.

The T Level should embed English, maths and digital (EMD) skills. As a result, related content has been included which was not in the apprenticeship standard. The focus of EMD skills in the Occupational Specialism are outlined in the wireframe.

# Occupational Specialist Content

## Occupational Specialism: Low Carbon Heating Engineering

**Performance Outcome 1: Design low carbon heating and hot water systems to meet client requirement**

Knowledge Specific to Performance Outcome	Skills
<p><b>Relationship management</b></p> <p>Limits of competence, what not to do, and when to engage a competent electrician as well as other expertise.</p> <p>Expectations and interrelationships of different stakeholders related to low carbon heating and hot water systems design and operation.</p> <p>Principles of effective communication, the methods and styles that can be applied in different situations and their suitability for different audiences and situations.</p> <p>Technical and non-technical vocabulary to achieve particular effects and for different purposes.</p> <p>Principles of collaborative working and their application when designing low carbon heating and hot water systems to meet client requirements.</p> <p>Digital software techniques and applications and their suitability for liaising with key stakeholders at different stages in a construction and built environment project.</p> <p>Online collaboration tools and their application when liaising with key stakeholders of a construction and built environment project.</p> <p><b>Low carbon heating and hot water systems</b></p>	<p>Interpret information provided in a brief.</p> <p>Identify information requirements for the design of a low carbon heating and hot water system.</p> <p>Determine system layout and components for a low carbon heating and hot water system.</p> <p>Apply software functions to enter, collate, analyse and display information and data.</p> <p>Create documents appropriate to purpose and audience.</p> <p>Apply appropriate mathematical techniques to the design of a low carbon heating and hot water system.</p> <p>Model low carbon heating and hot water system using CAD software.</p> <p>Articulate design information to clients using written communication skills.</p>

Components used in different types of low carbon heating and hot water systems (including air source, water source and ground source heat pumps, solar thermal systems, unvented hot water systems, connections to cold water systems, lower temperature wet central heating) their characteristics, function within the system and how they work together to support the operation of the system.

Layout features and working principles of low carbon heating and hot water systems.

Layout features and working principles of cold water systems connected to low carbon heating and hot water systems.

Processes and procedures of electrical supply and control systems applicable to low carbon heating and hot water systems.

Factors affecting the system design to manage the move from higher temperature gas systems to lower temperature low carbon systems including the consideration of hybrid systems.

Factors affecting the choice and suitability of components and layouts to meet client requirements e.g. Building Energy Management Systems (BEMS), requirements of utilities, site features.

Types of control systems required for low carbon heating and hot water systems (including digital controls), their characteristics, operation and suitability for different situations.

Planning, sizing and selecting practices for low carbon heating and hot water systems and components.

Existing systems (including control systems) that can combine with and be upgraded to impact on low carbon heating and hot water systems and contribute to a holistic design solution.

### **Low carbon heating and hot water science**

Applications of scientific principles and concepts to low carbon heating and hot water systems including coefficient of performance (CoP), seasonal coefficient of performance (SCoP) heating, ventilation, electricity, water (drainage and capture), fluid dynamics, drainage.

Types of pipework including different sizes, types of materials and their suitability for different situations (eg insulation, heat loss) and tools equipment (including fixings) required.

International System of Units (SI) applicable to low carbon heating and hot water systems e.g. volume, power, force.

Earth science eg impact of heat pumps on core temperatures in concentrated areas of ground source heat pumps.

### **Legislation, regulations and standards**

Legislative requirements applicable to low carbon heating and hot water system design and operation eg The Water Supply (Water Fittings) Regulations 1999, The Control of Noise at Work Regulations 2005 (Noise Regulations 2005).

National and local planning requirements that can impact on the design, installation and operation of low carbon heating and hot water systems.

Purpose and applications of F-Gas regulations.

Standards (BS) applicable to low carbon heating and hot water system design and operation.

Legislation related to creating, sharing and maintaining information and data (including intellectual property, client privacy, data protection).

### **Sustainability**

Sources of energy used in low carbon heating and hot water systems and implications for meeting UN Sustainability Development Goals.

Principles of sustainability and how the efficient use of resources and control of emissions and waste is applied to the design and operation of low carbon heating and hot water systems, including hybrid systems.

Waste and waste products resulting from the installation and operation of low carbon heating and hot water systems, potential hazards and risks to the environment and user.

Environmental technologies used to mitigate for negative environmental impacts of low carbon heating and hot water systems.

### **Building technology**

Forms of construction (including infrastructure, substructures, superstructures, foundations and external works) and their implications for low carbon heating and hot water systems design and operation.

Principles of heritage and conservation (e.g. listed buildings), reparations required for existing buildings and their implications for low carbon heating and hot water systems design and operation.

<p><b>Design</b></p> <p>Design principles (e.g. buildability, integration of services, whole life cycle) and their application to low carbon heating and hot water systems.</p> <p>Information and data required to support design of low carbon heating and hot water systems.</p> <p>Conventions of construction drawings and associated terminology.</p> <p>Digital engineering techniques and technologies used to support the design and implementation of low carbon heating and hot water systems (e.g. simulation, modelling, workflows), their relevance and application.</p>	
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## Performance Outcome 2: Install low carbon heating and hot water systems

Knowledge Specific to Performance Outcome	Skills
<p><b>Health and safety</b></p> <p>Key requirements of health and safety legislation, regulations and Approved Codes of Practice (CoP) and regulations (e.g. Construction (Design and Management) Regulations 2015, Health and Safety at Work Act) and how they are applied to the installation of low carbon heating and hot water systems.</p> <p>Safe systems of work including company management systems, risk assessments, method statements and permits for work, their purpose, typical format and content and their application to the installation of low carbon heating and hot water systems.</p> <p>Typical hazards and risks associated with the installation of low carbon heating and hot water systems (including working with electricity and electrical components) and the associated controls that need to be in place to mitigate risks, including not engaging with activities beyond scope of competence.</p> <p>Emergency procedures for unsafe situations applied to the installation of low carbon heating and hot water systems.</p> <p><b>Relationship management</b></p> <p>Ethical principles and implications for the installation of low carbon heating and hot water systems.</p> <p>Conventions of construction drawings and associated terminology.</p> <p>Potential impact of installation activities on customer essential services(including gas, water, electricity, telecoms) and how these</p>	<p>Assess risk associated with tasks.</p> <p>Complete activities showing consideration for safety of self and others.</p> <p>Select tools, equipment and materials to complete task.</p> <p>Schedule activities required for installation of a low carbon heating and hot water system.</p> <p>Identify information required to complete tasks.</p> <p>Interpret information and data presented in different formats.</p> <p>Review information to ensure its accuracy and validity, including suitability of equipment being installed.</p> <p>Inspect the suitability of resources for use, including tools, materials and equipment.</p> <p>Prepare the environment for installation of a low carbon heating and hot water system.</p> <p>Establish a safe working environment for the installation of a low carbon heating and hot water system.</p> <p>Apply PPE appropriate to an activity.</p> <p>Apply techniques to move products including lifting, , removal of protective coverings.</p> <p>Mark out the position of installation of low carbon heating and hot water system components.</p> <p>Operate and use tools and equipment safely and effectively to carry out tasks</p>



<p>can be minimised e.g. isolation of services, preparation of temporary services etc.</p> <p><b>Low carbon heating and hot water systems</b></p> <p>Components used in different types of low carbon heating and hot water systems (including air source, water source and ground source heat pumps, solar thermal systems, unvented hot water systems, connections to cold water systems, lower temperature wet central heating), their characteristics, function within the system and how they work together to support the operation of the system.</p> <p>Layout features and working principles of low carbon heating and hot water systems.</p> <p>Layout features and working principles of cold water systems connected to low carbon heating and hot water systems.</p> <p>Processes and procedures of electrical supply and control systems applicable to low carbon heating and hot water systems.</p> <p>Types of control systems required for low carbon heating and hot water systems (including digital controls), their characteristics, operation and suitability for different situations.</p> <p><b>Low carbon heating and hot water science</b></p> <p>Applications of scientific principles and concepts to low carbon heating and hot water systems including heating, ventilation, electricity, water (drainage and capture), fluid dynamics (eg laminar and turbulent flow, viscosity), drainage.</p>	<p>and meet system design requirements in accordance with good practice.</p> <p>Handle materials safely and effectively to meet system design requirements.</p> <p>Make systems safe to work on e.g. safe isolation, discharging stored charge.</p> <p>Install system components to meet design requirements.</p> <p>Decommission system / system components to support new system installation.</p> <p>Confirm existing system decommissioned.</p> <p>Minimise waste.</p> <p>Categorise waste.</p>
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Types of pipework including different sizes, types of materials and their suitability for different situations (eg insulation, heat loss) and tools equipment (including fixings) required.

International System of Units (SI) applicable to low carbon heating and hot water systems e.g. volume, power, force.

### **Gas science and systems**

Characteristics, types and purpose of different types of components and their suitability for different types of domestic systems including Liquid Petroleum Gas (LPG) and Natural Gas.

How components operate and integrate within a gas system to enable the system to operate effectively.

Waste and waste products of gas systems including types of systems, attributes (e.g. Magnetite, corrosion smells, bacteria etc.), hazards to user, interaction with other parties, environmental impact.

Safety devices applicable to gas systems, their characteristics and operation.

Scientific principles and concepts applied to gas systems, including combustion, incomplete combustion, ventilation, fuels, diffusion, combustion analysis, carbon monoxide (CO).

Systems and products, including utilities, incorporated into gas systems.

### **Legislation, regulations and standards**

Legislative requirements applicable to low carbon heating and hot water system installation and operation eg The Water Supply (Water Fittings) Regulations 1999, The Control of Noise at Work Regulations 2005 (Noise Regulations 2005).

Purpose and applications of F-Gas regulations.

Standards (BS) applicable to low carbon heating and hot water system installation and operation.

### **Sustainability**

Principles of sustainability and how the efficient use of resources and control of emissions and waste is applied to the installation and operation of low carbon heating and hot water systems, including hybrid systems.

Waste and waste products resulting from the installation and operation of low carbon heating and hot water systems, potential hazards and risks to the environment and user.

Environmental technologies used to mitigate for negative environmental impacts of low carbon heating and hot water systems.

### **Building technology**

Forms of construction (including infrastructure, substructures, superstructures, foundations and external works) and their implications for low carbon heating and hot water systems installation.

### **System installation**

Common installation practices and techniques used in the installation and of low carbon heating and hot water systems (air source, water source and ground source heat pumps, solar thermal systems, unvented hot water systems, connections to cold water systems, lower temperature wet central heating).

Common installation practices and techniques of electrical and electronic

<p>control systems applicable to low carbon heating and hot water systems.</p> <p>Procedures and processes for penetrating building structure and fabric and their suitability for different situations.</p> <p>Tools, equipment and materials used for the installation of low carbon heating and hot water systems, their purpose, characteristics, operation, handling and maintenance requirements.</p> <p>Component manufacturer's installation requirements and their importance to the installation and operation of low carbon heating and hot water systems.</p> <p><b>Decommissioning</b></p> <p>Common decommissioning practices and techniques used for gas and other fuel systems.</p> <p>Common decommissioning practices of electrical and electronic control systems applicable to heating and hot water systems.</p> <p>Requirements for recording, labelling and reporting decommissioned systems including warning notices and labels to prevent use of decommissioned appliances.</p>	
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### Performance Outcome 3: Commission low carbon heating and hot water systems

Knowledge Specific to Performance Outcome	Skills
<p><b>Health and safety</b></p> <p>Key requirements of health and safety legislation, regulations and Approved Codes of Practice (CoP) and regulations (e.g. Construction (Design and Management) Regulations 2015, Health and Safety at Work Act) and how they are applied to the commissioning of low carbon heating and hot water systems.</p> <p>Safe systems of work including company management systems, risk assessments, method statements and permits for work, their purpose, typical format and content and their application to the commissioning of low carbon heating and hot water systems.</p> <p>Typical hazards and risks associated with the commissioning of low carbon heating and hot water systems (including working with electricals) and the associated controls that need to be in place to mitigate risks, including not engaging with activities beyond scope of competence.</p> <p>Emergency procedures for unsafe situations applied to the commissioning of low carbon heating and hot water systems.</p> <p><b>Relationship management</b></p> <p>Conventions of construction drawings and associated terminology.</p> <p>Ethical principles and implications for the commissioning of low carbon heating and hot water systems.</p> <p><b>Low carbon heating and hot water systems</b></p>	<p>Interpret task requirements from a risk assessment and method statement.</p> <p>Interpret information and data presented in different formats.</p> <p>Complete activities showing consideration for safety of self and others.</p> <p>Inspect the suitability of resources for use, including tools, materials and equipment.</p> <p>Prepare the environment for commissioning of a low carbon heating and hot water system.</p> <p>Establish a safe working environment for the commissioning of a low carbon heating and hot water system.</p> <p>Apply PPE appropriate to an activity.</p> <p>Apply techniques to move products including lifting, stowage, removal of protective coverings.</p> <p>Inspect a low carbon heating and hot water system for compliance with design requirements.</p> <p>Test low carbon heating and hot water systems for compliance with design requirements.</p> <p>Operate and use tools and equipment safely and effectively to carry out commissioning activities.</p> <p>Create and edit documents using digital software.</p> <p>Determine variances in test data outcomes and system requirements.</p> <p>Enter data into digital software.</p>

Components used in different types of low carbon heating and hot water systems (including air source, water source and ground source heat pumps, solar thermal systems, unvented hot water systems, connections to cold water systems, lower temperature wet central heating), their characteristics, function within the system and how they work together to support the operation of the system.

Layout features and working principles of low carbon heating and hot water systems.

Layout features and working principles of cold water systems connected to low carbon heating and hot water systems.

Processes and procedures of electrical supply and control systems applicable to low carbon heating and hot water systems.

Types of control systems required for low carbon heating and hot water systems (including digital controls), their characteristics, operation and suitability for different situations.

### **Low carbon heating and hot water science**

Applications of scientific principles and concepts to low carbon heating and hot water systems including heating, ventilation, electricity, water (drainage and capture), fluid dynamics, drainage.

Types of pipework including different sizes, types of materials and their suitability for different situations and tools equipment (including fixings) required.

International System of Units (SI) applicable to low carbon heating and hot water systems e.g. volume, power, force.

**Legislation, regulations and standards**

Legislative requirements applicable to low carbon heating and hot water system commissioning.

Standards (BS) applicable to low carbon heating and hot water system commissioning.

**Sustainability**

Principles of sustainability and how the efficient use of resources and control of emissions and waste is applied to the commissioning of low carbon heating and hot water systems, including hybrid systems.

Waste and waste products resulting from the installation and operation of low carbon heating and hot water systems, potential hazards and risks to the environment and user.

Environmental technologies used to mitigate for negative environmental impacts of low carbon heating and hot water systems.

**System commissioning**

System operation requirements to be inspected when commissioning low carbon heating and hot water systems.

Inspection techniques (including visual inspection) applicable to commissioning low carbon heating and hot water systems and their suitability and application in different situations.

Testing techniques applicable to commissioning low carbon heating and hot water systems and their suitability and application in different situations.

Tools, equipment and materials used for the commissioning of low carbon heating

<p>and hot water systems, their purpose, characteristics, operation, handling and maintenance requirements.</p> <p>Component manufacturer's installation requirements and their importance to the commissioning of low carbon heating and hot water systems.</p> <p>Information and data required to support commissioning of low carbon heating and hot water systems.</p> <p>Documentation required for commissioning and verification of commissioning, purpose, format and typical content.</p>	
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## Performance Outcome 4: Maintain low carbon heating and hot water systems

Knowledge Specific to Performance Outcome	Skills
<p><b>Health and safety</b></p> <p>Key requirements of health and safety legislation, regulations and Approved Codes of Practice (CoP) and regulations (e.g. Construction (Design and Management) Regulations 2015, Health and Safety at Work Act) and how they are applied to the installation of low carbon heating and hot water systems.</p> <p>Safe systems of work including company management systems, risk assessments, method statements and permits for work and their application to the maintenance of low carbon heating and hot water systems.</p> <p>Typical hazards and risks associated with the maintenance of low carbon heating and hot water systems(including working with electricals) and the associated controls that need to be in place to mitigate risks, including not engaging with activities beyond scope of competence.</p> <p>Emergency procedures for unsafe situations applied to the maintenance of low carbon heating and hot water systems.</p> <p><b>Relationship management</b></p> <p>Limits of competence, what not to do, and when to engage a competent electrician as well as other expertise.</p> <p>Expectations and interrelationships of different stakeholders related to low carbon heating and hot water systems maintenance.</p> <p>Principles of effective communication, the methods and styles that can be applied in</p>	<p>Interpret task requirements from documents presented in a range of formats.</p> <p>Interpret information and data from a range of sources including oral information presented by the client representative.</p> <p>Identify additional information requirements.</p> <p>Identify questions to ask client.</p> <p>Complete activities showing consideration for safety of self and others.</p> <p>Communicate with clients to obtain information required to support problem solving and / or decision making.</p> <p>Inspect the suitability of resources for use, including tools, materials and equipment.</p> <p>Prepare the environment for commissioning of a low carbon heating and hot water system.</p> <p>Establish a safe working environment for the commissioning of a low carbon heating and hot water system.</p> <p>Apply PPE appropriate to an activity.</p> <p>Apply techniques to move products including lifting, stowage, removal of protective coverings.</p> <p>Inspect the suitability of resources for use, including tools, materials and equipment.</p> <p>Analyse information to identify problems.</p> <p>Apply problem solving, fault finding techniques to identify potential issues.</p>

<p>different situations and their suitability for different audiences and situations.</p> <p>Ethical principles and implications for the maintenance of low carbon heating and hot water systems.</p> <p>Technical and non-technical vocabulary to achieve particular effects and for different purposes.</p> <p>Conventions of construction drawings and associated terminology.</p> <p>Potential impact of maintenance activities on customer essential services and how these can be minimised e.g. isolation of services, preparation of temporary services etc.</p> <p>Techniques involved in management of data including classification, organisation, storage, protection, accessibility, interoperability, sharing.</p> <p><b>Low carbon heating and hot water systems</b></p> <p>Components used in different types of low carbon heating and hot water systems (including air source, water source and ground source heat pumps, solar thermal systems, unvented hot water systems, connections to cold water systems, lower temperature wet central heating), their characteristics, function within the system and how they work together to support the operation of the system.</p> <p>Layout features and working principles of low carbon heating and hot water systems.</p> <p>Layout features and working principles of cold water systems connected to low carbon heating and hot water systems.</p> <p>Processes and procedures of electrical supply and control systems applicable to</p>	<p>Apply appropriate mathematical techniques to the maintenance of a low carbon heating and hot water system</p> <p>Service a low carbon heating and hot water system in line with planned maintenance requirements.</p> <p>Rectify faults in a low carbon heating and hot water system.</p> <p>Disassemble a low carbon heating and hot water system.</p> <p>Assemble a low carbon heating and hot water system.</p> <p>Produce written report to stakeholders about work completed.</p> <p>Create and edit documents using digital software.</p> <p>Enter data into digital software.</p> <p>Problem-solving (defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution).</p> <p>Summarise information and data to meet audience needs.</p> <p>Adapt language to meet audience needs.</p> <p>Apply oral communication techniques to obtain and clarify information and data.</p>
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low carbon heating and hot water systems.

Types of control systems required for low carbon heating and hot water systems (including digital controls), their characteristics, operation and suitability for different situations.

### **Low carbon heating and hot water science**

Applications of scientific principles and concepts to low carbon heating and hot water systems including heating, ventilation, electricity, water (drainage and capture), fluid dynamics, drainage.

Types of pipework including different sizes, types of materials and their suitability for different situations (eg insulation, heat loss) and tools equipment (including fixings) required.

International System of Units (SI) applicable to low carbon heating and hot water systems e.g. volume, power, force.

Systems and products, including utilities, incorporated into low carbon heating and hot water systems.

### **Legislation, regulations and standards**

Legislative requirements applicable to low carbon heating and hot water system operation and maintenance.

Standards (BS) applicable to low carbon heating and hot water system operation and maintenance.

Legislation related to creating, sharing and maintaining information and data (including intellectual property, client privacy, data protection).

### **Sustainability**

Principles of sustainability and how the efficient use of resources and control of emissions and waste is applied to the maintenance and operation of low carbon heating and hot water systems, including hybrid systems.

Waste and waste products resulting from the operation and maintenance of low carbon heating and hot water systems, potential hazards and risks to the environment and user.

Environmental technologies used to mitigate for negative environmental impacts of low carbon heating and hot water systems.

### **Building technology**

Forms of construction (including infrastructure, substructures, superstructures, foundations and external works) and their implications for low carbon heating and hot water systems maintenance.

### **System maintenance**

Information and data required to support maintenance of low carbon heating and hot water systems.

Routine service and maintenance practices and techniques applicable to low carbon heating and hot water systems.

Routine service and maintenance practices and techniques applicable electrical and electronic control systems.

Types of fault finding and diagnosis techniques (including testing and questioning), their suitability for different situations and how they are applied in practice.

Typical faults in low carbon heating and hot water systems, including electrical and

<p>electronic control systems, their causes and symptoms.</p> <p>Assembly and disassembly techniques applied to low carbon heating and hot water system maintenance and their suitability for different situations and systems.</p> <p>Types of actions required when faults cannot be rectified and implications to client and business including time and costs.</p> <p>Planning, sizing and selecting practices for low carbon heating and hot water systems and components.</p> <p>Tools, equipment and materials used for the maintenance of low carbon heating and hot water systems, their purpose, characteristics, operation, handling and maintenance requirements.</p> <p>Component manufacturer's installation requirements and their importance to the maintenance and operation of low carbon heating and hot water systems.</p> <p>Documentation required for the maintenance of low carbon heating and hot water systems, their purpose, format and typical content.</p> <p><b>Design</b></p> <p>Conventions of construction drawings and associated terminology.</p> <p>Digital engineering techniques and technologies used to plan for construction and the built environment projects (e.g. simulation, modelling, workflows), their relevance and application.</p>	
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