Association of University Engineers

Newcastle University

THE MODERN UNIVERSITY ESTATE

ENGINEERING AND ENVIRONMENTAL COMPLIANCE

ANNUAL CONFERENCE 2025 | 3 - 5 SEPTEMBER

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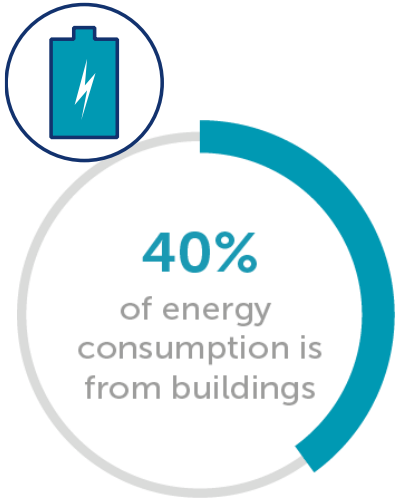
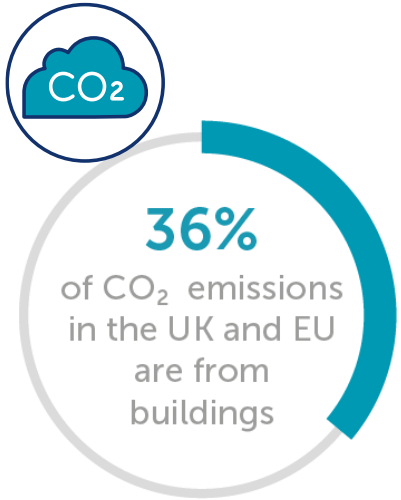
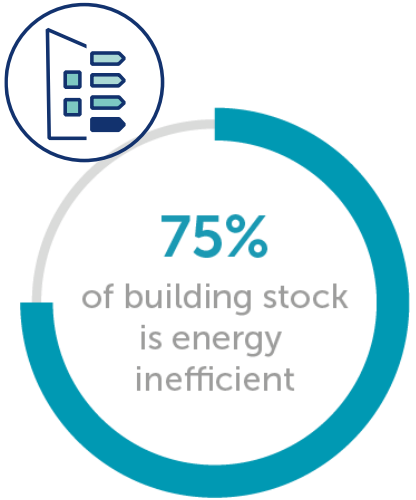
Brian Heron, Operations Director North, SSE

Why is decarbonising buildings important?







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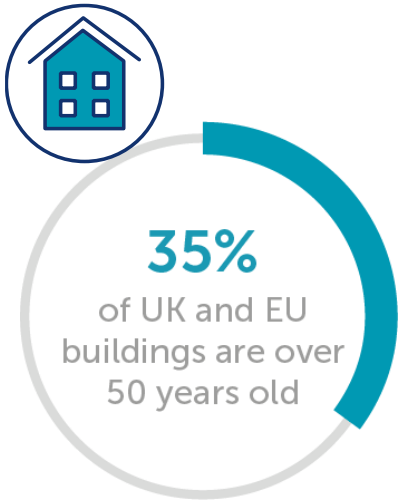
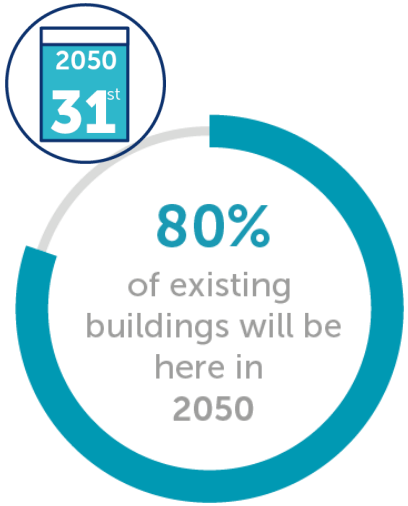
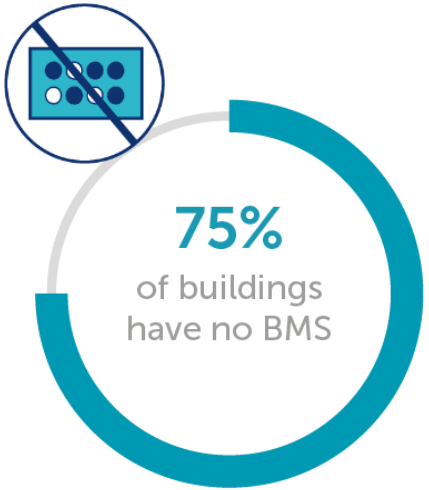






4 Steps to Decarbonising buildings

M&V

Measure Performance

- Energy Benchmarking
- Fiscal and Sub-Metering
- Energy Analytics
- ISO 52120
- Asset Audit

Step 1

Eliminate Energy Waste

- Control Optimisation
- Sensors and Zoning
- Space Management
- Data Analytics
- Plant Efficiency

Step 2

Reduce Demand

- Solar PV
- Battery (BESS)
- LED Lighting
- Plant Replacement
- Demand-Side Flexibility

Step 3

Decarbonise

- Heat Pumps
- Local EV Charging
- Wind Generation
- 100% Renewable Energy
- CPPAs

Step 4

Why do we need a strategy for decarbonising buildings?

- **Decarbonising Buildings is expensive!**
  - The aim is to achieve a reduction in CO_2, not reduce energy cost
    - Electricity is more expensive than gas
- Without measuring energy use and eliminating energy waste and energy demand…
  - Easy to over-spend on plant and future energy bills
- Working through this strategy will help to mitigate the cost of Step-4 (Decarbonisation)

Business Size	Gas Rate (ppkWh)	Electricity (ppkWh)	Cost factor
Small (10,000–50,000 kWh/year)	6.8	24.5	3.6
Medium (50,000–100,000 kWh/year)	6.3	22.5	3.6
Large (100,000+ kWh/year)	6.1	22.3	3.7

Decarbonising Buildings

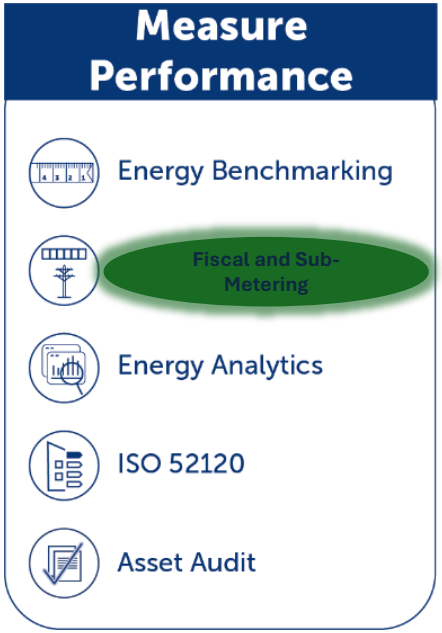
Solution components

GRID ENERGY	SITE GENERATION TECHNOLOGY	SITE MEASUREMENT TECHNOLOGY	SITE CONTROL TECHNOLOGY	SITE ENVIRONMENT TECHNOLOGY
GRID ELECTRICITY	BATTERY SYSTEMS	ELECTRICAL METERING	BEMS	CONNECTED LIGHTING
GRID GAS	SOLAR PV	GAS METERING	DALI CONTROLS	HEAT PUMPS
	WIND	HEAT METERING	IoT LORAWAN	BOILERS
	EV CHARGERS	AM&T ANALYTICS	SMART BUILDING PLATFORM	CONTROLLABLE POWER
	CHP / BIOMASS	DIGITAL TWIN		VENTILATION / AC SYSTEMS
		ISO 52120		DHWS SYSTEMS
				CHILLERS
				SOLAR THERMAL

BUILDING HEAT LOSSES | BUILDING HEAT GAINS

4 Steps to Decarbonising Buildings

Step 1: Measure Performance



- Not just energy metering
  - Water
  - EV
  - Carbon
  - Heat
  - Steam
- Identify usage from specific plant items
- Set alarms to identify when using more than normal

4 Steps to Decarbonising Buildings

Step 1: Measure Performance

Measure Performance

- Energy Benchmarking
- Fiscal and Sub-Metering
- Energy Analytics
- ISO 52120
- Asset Audit

Energy Assessment using ISO 52120

ISO 52120-1:2021

Assign Ratings to Drive Energy Efficiency

Class

A

Corresponds to high energy performance BACS and TBM

- Networked room automation with automatic demand control
- Scheduled Maintenance
- Energy Monitoring
- Sustainable energy optimization

B

Corresponds to advanced BACS and some specific TBM functions

- Networked room automation with automatic demand control
- Energy Monitoring

C

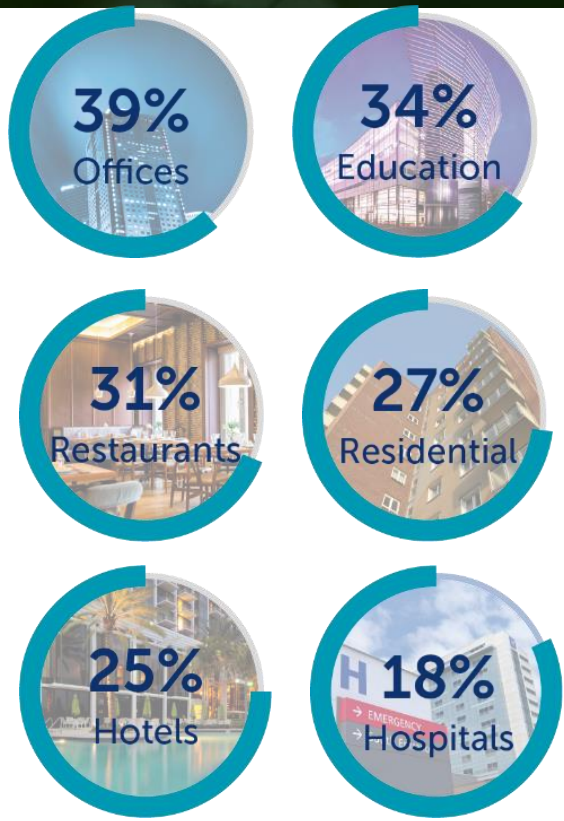
Corresponds to standard BACS

- Networked building automation of primary plants
- No electronic room automation, thermostatic valves for radiators
- No energy monitoring

D

Corresponds to non-energy efficent BACS

- Without networked building automation functions
- No electronic room automation
- No energy monitoring



ISO52120 Assessment

Through the assessment, opportunities were identified to improve heating and air ventilation control strategies, which included:

- Bringing the low-temperature hot water boiler control into the existing BMS
- Adding passive infrared sensors to fan coil units to enable them to operate only when needed, and,
- The installation of CO_2 sensors to terminal units to reduce the amount of fresh air needed to be provided by the main AHU fans than 1 year.

C → B

Floorspace of **6,340** m²

Investment of £50k

Saving of **£56k** on energy costs — 9% Overall

10 year projected saving of **£581k- £722k** (based on 5% fuel price annexation)

Return On Investment approximately one year

Reduction in CO_2 emission of **225,251** kg/year — 8% CO_2

4 Steps to Decarbonising Buildings

Step 1: Measure Performance

Measure Performance

- Energy Benchmarking
- Fiscal and Sub-Metering
- Energy Analytics
- ISO 52120
- Asset Audit

- Combination of both
  - Physical assets
    - AHU's, boilers, etc.
  - Control assets
    - Panels, Head End, software, operating systems
- Looking at
  - Age
  - Maintenance schedules
  - Software versions
  - Security

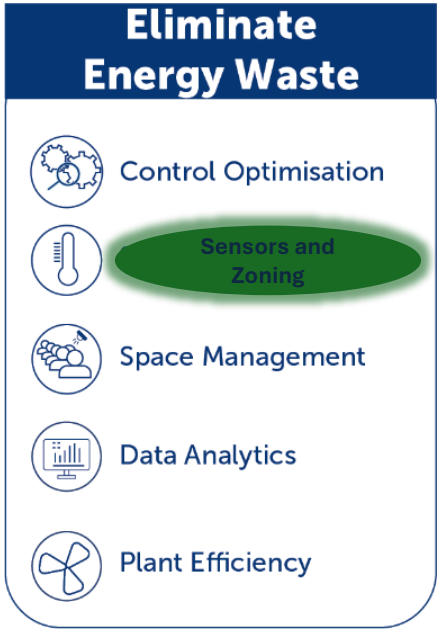
4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste

- An effective control strategy is one of the simplest and most cost-effective ways to eliminate waste
  - Appropriate timing schedules
  - Appropriate temperature set points
  - Summer and Winter optimisation and testing
- No capital investment required
- Easy to adapt as situations change

4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste

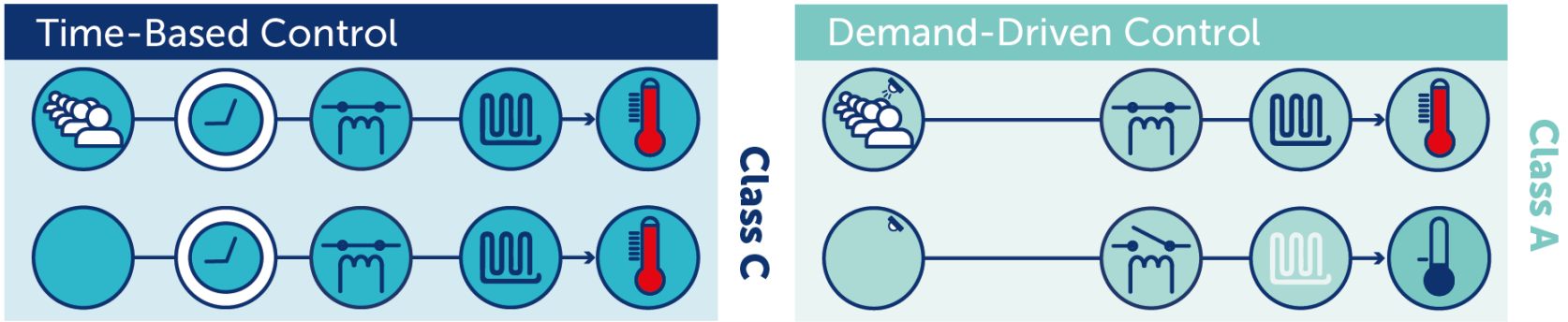


Sensors are the eyes and ears of the building, collecting data in real time on how the space is being used and how the systems are performing

Type	Measures	Impact
Occupancy	Presence or number of people	Adjust HVAC and lighting to match actual usage
Temperature	Room or zone temperatures	Improve thermal comfort and HVAC efficiency
CO_2 / Air Quality	Indoor air quality (CO_2, VOCs, etc.)	Ventilation control based on demand, not constant flow
Humidity	Moisture levels	Optimise comfort and reduce energy used for dehumidifying
Light	Natural vs artificial light levels	Dim or switch off lights based on daylight availability
Energy	Power usage by systems/appliances	Identify high energy use and inefficiencies

Demand-Driven Control

Of Heating and Cooling



Demand-Driven Control

Of Ventilation

- As more people enter a room the CO_2 level increases
- The fan speed remains on minimal until the sensor detects that the CO_2 has reached a set point
- Fan speed is increased in response until the level falls
- Fan speed is reduced back to minimal

4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste

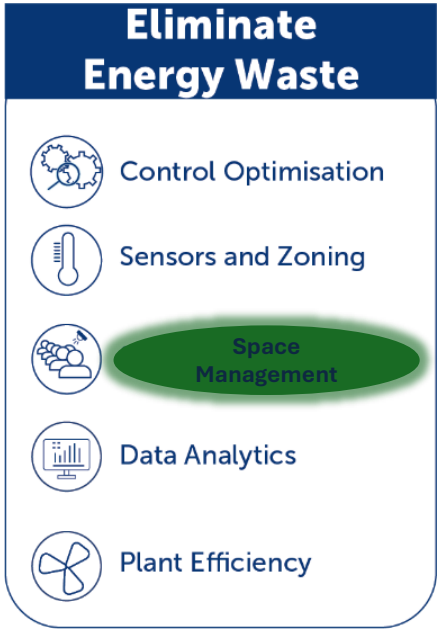
Eliminate Energy Waste

- Control Optimisation
- **Sensors and Zoning**
- Space Management
- Data Analytics
- Plant Efficiency

Zoning divides a building into separate controlled areas (zones) that can operate independently based on their specific usage, conditions, or occupancy

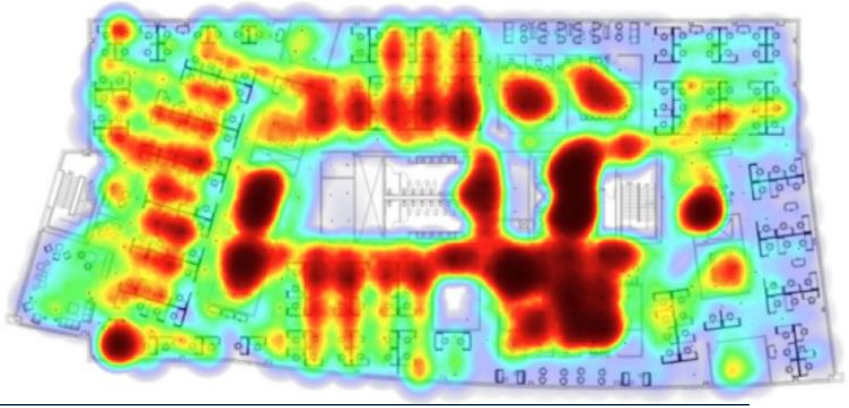
4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste



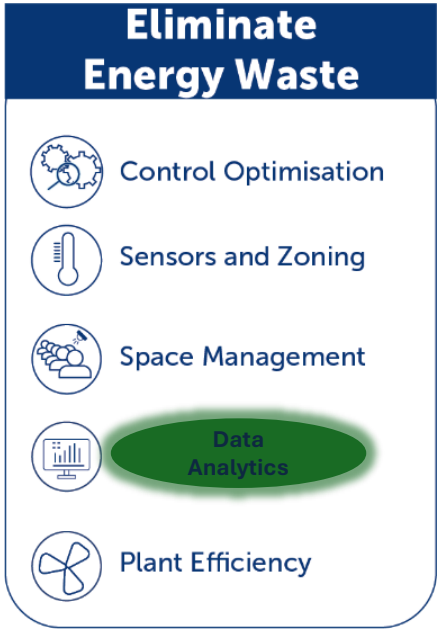
the process of monitoring, controlling, and optimising how physical space is used within a building. It involves:

- Tracking occupancy and utilisation
- Allocating or repurposing space based on need
- Managing changes to layouts, furniture, or usage patterns
- Using tools like
  - space sensors
  - digital twins, and
  - Integrated Workplace Management Systems (IWMS)



4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste



The collection, processing, and interpretation of data from various building systems to drive automated decision-making

- Understand how buildings perform
- Identify inefficiencies and waste
- Support predictive control and optimisation
- Benchmark against targets or peers

Using tools such as

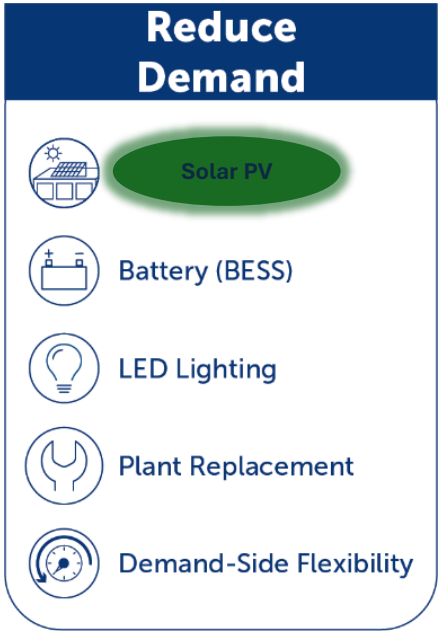
- IoT sensors
- Building Management Systems (BMS)
- Smart meters
- Energy dashboards
- AI/ML models for prediction and optimisation

4 Steps to Decarbonising Buildings

Step 2: Eliminate Energy Waste

- Right-sizing equipment
  - Oversized systems cycle on/off inefficiently.
  - Correctly sized plant improves performance and lifespan.
- Regular maintenance and tuning
  - Dirty filters, fouled heat exchangers, or mis-calibrated sensors all reduce efficiency.
  - A well-maintained system can perform 10–30% better than a neglected one.
- Upgrading old equipment
  - Newer boilers, chillers, and especially heat pumps can be 2–4x more efficient.
  - Smart controls improve part-load performance (when systems aren't at full demand).
- Demand-side optimisation
  - Link plant operation with real-time demand (e.g., from sensors/zoning).
  - Only run systems when and where needed.
- Use of heat recovery
  - Systems like heat recovery or waste heat reuse improve efficiency dramatically.

Step 3: you're now managing existing assets optimally! Can you reduce baseload?

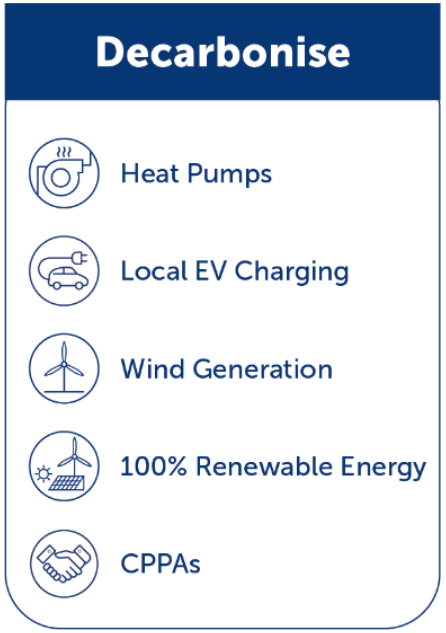


Local energy generation can reduce dependence and cost when compared against Grid-supplied energy or can time shift cost by utilising stored energy generation during times of peak demand or cost

- **Solar PV** The installation of solar or photovoltaic (PV) panels on your site means that, in addition to reducing cost and demand from the grid, your organisation could also get paid for excess electricity that you don't use. SSE also has fully funded off balance sheet solutions for solar installations
- **Battery Storage (BESS)** Storing excess solar generation, or charging batteries at off peak tariffs ensures continuity of supply and can reduce or mitigate electrical energy supplied by the grid
- **LED Lighting** Compared to fluorescent bulbs, LED lights are up to 80% more efficient because as they convert 95% of their energy into light and only 5% is wasted as heat; while still using far less power to provide a strong and consistent light output at a lower wattage
- **Plant replacement** Organisations with a requirement for high heat and high electricity demand in their manufacturing processes can reduce energy costs by up to 40% by switching to Combined Heat and Power (CHP) systems
- **Demand-Side Flexibility** If your organisation is able to change when peak energy consumption is taken from the grid, it may benefit from demand-side flexibility incentives

4 Steps to Decarbonising Buildings

Step 4: you've maximised your energy savings – time to decarbonise!



Decarbonisation could be expensive because it means the electrification of everything and may require infrastructure improvements. Following the 4 steps means optimising the return on capital deployed

- **Heat Pumps** Unlike a boiler, where one unit of energy produces approximately one unit of heat, a heat pump delivers more heat than the energy supplied, typically up to three times the heat per unit of energy, and provided that the electricity is from on-site renewables or guaranteed 24/7 green electricity, the heat will be net zero carbon
- **EV** A major source of carbon emissions in any organisation is transport so hybrid and the use of all-electric vehicles represent an important path to decarbonisation
- **Wind Generation** ground mount turbine or rooftop with solar (**Hover Energy**)
- **100% Renewable Energy** It is essential at this stage in decarbonisation to ensure that the energy you purchase is 100%, 24/7 renewable electricity. All of SSE's 100% renewable electricity is sourced from our own UK wind and hydro assets
- **Corporate Power Purchase Agreements** (CPPA's) are becoming an increasingly popular choice for companies wanting to reach net zero, as they offer up to 100% renewable power and much-needed addition to the grid

Questions?

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