Responding to Climate Change in Education Settings

Purpose: To engage with LA's to discuss sustainability proposals and developing policy

DfE Capital

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Part One: The Context [20 mins]

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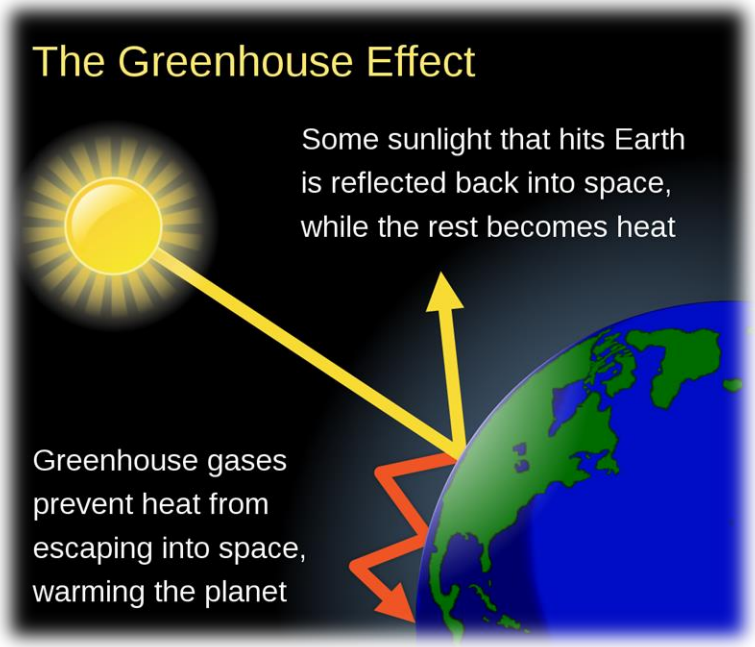
What is Climate Change?

Scientists attribute the global warming trend observed since the mid-20th century to the human expansion of the "greenhouse effect”



Greenhouse gases are gases in Earth's atmosphere that trap heat. They let sunlight pass, but prevent heat that the sunlight brings from leaving the atmosphere

The Earth operates as a balanced eco-system. Without any greenhouse gases, our planet would be too cold and life as we know it would not exist.

However human activity is adding **too many** greenhouse gases into the atmosphere, causing the eco-system to become off-balance

The temperature of the earth is rising to dangerous levels, which is having adverse impacts on our eco-system and the planet.

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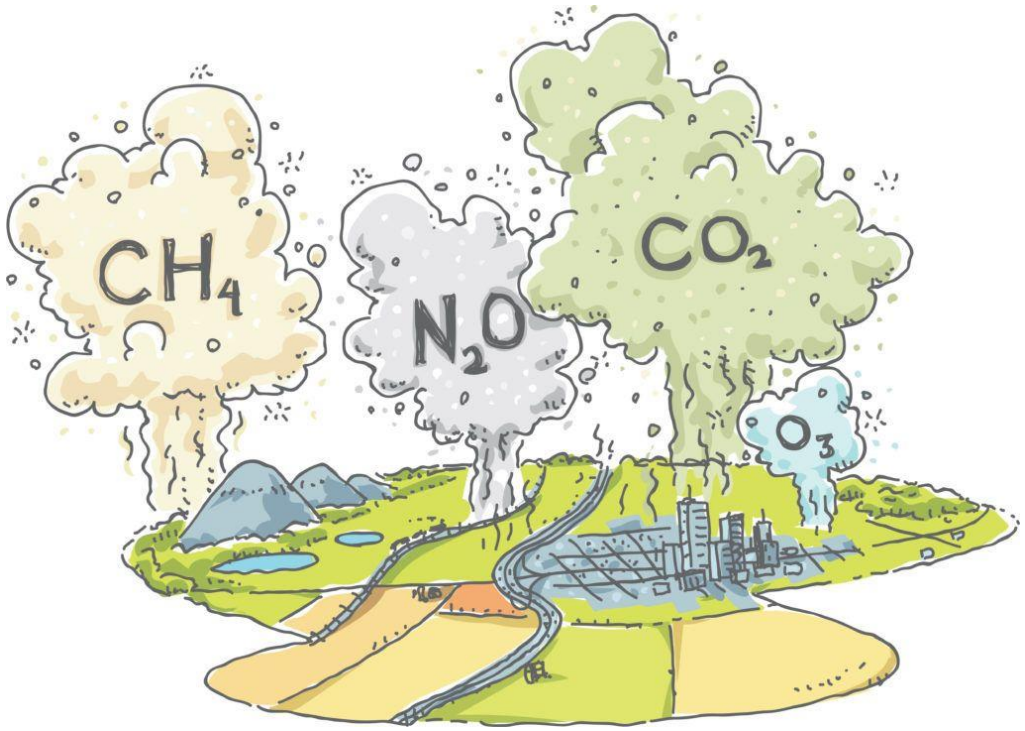
What are the Greenhouse Gases?



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H_2O

Water Vapour

Water vapour increases as the Earth atmosphere warms, so does cloud cover and precipitation.

N_2O

Nitrous Oxide

Produced by the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

CH_4

Methane

Released through the decomposition of wastes in landfills, agriculture, and mature management in domestic livestock.

CO_2

Carbon Dioxide

Humans have increased CO_2 concentration by 47% through deforestation, land use changes, and burning fossil fuels.

What are the facts?

Climate change ***affects virtually all natural and economic systems***. The interaction between climate change and biodiversity, land degradation, forests, chemicals and waste, and international waters means that we must recognise that ***climate change will have implications in everything we do***.

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GLOBAL

The planet's average surface temperature has risen over 1oC since the 19th Century

Global sea level rose at a rate in the last two decades, double that of the last century

By 2050 one in every 45 people in the world will have been displaced by climate change.

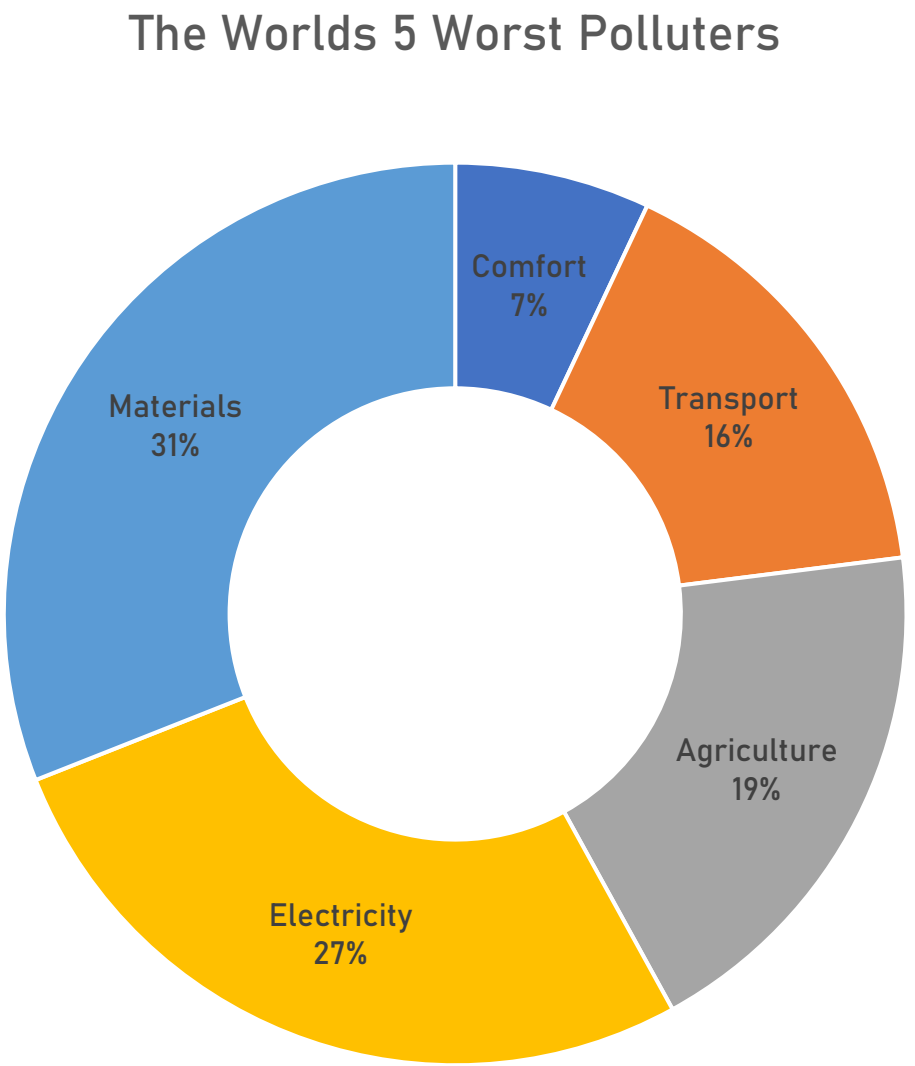
NATIONAL

The UK experienced four all time national maximum temperatures in 2019

UK summers have been on average 11% wetter than 1981–2010

Buildings highly or extremely likely to suffer "shrink-swell" is set to double to 6.5% by 2030

What causes Climate Change?



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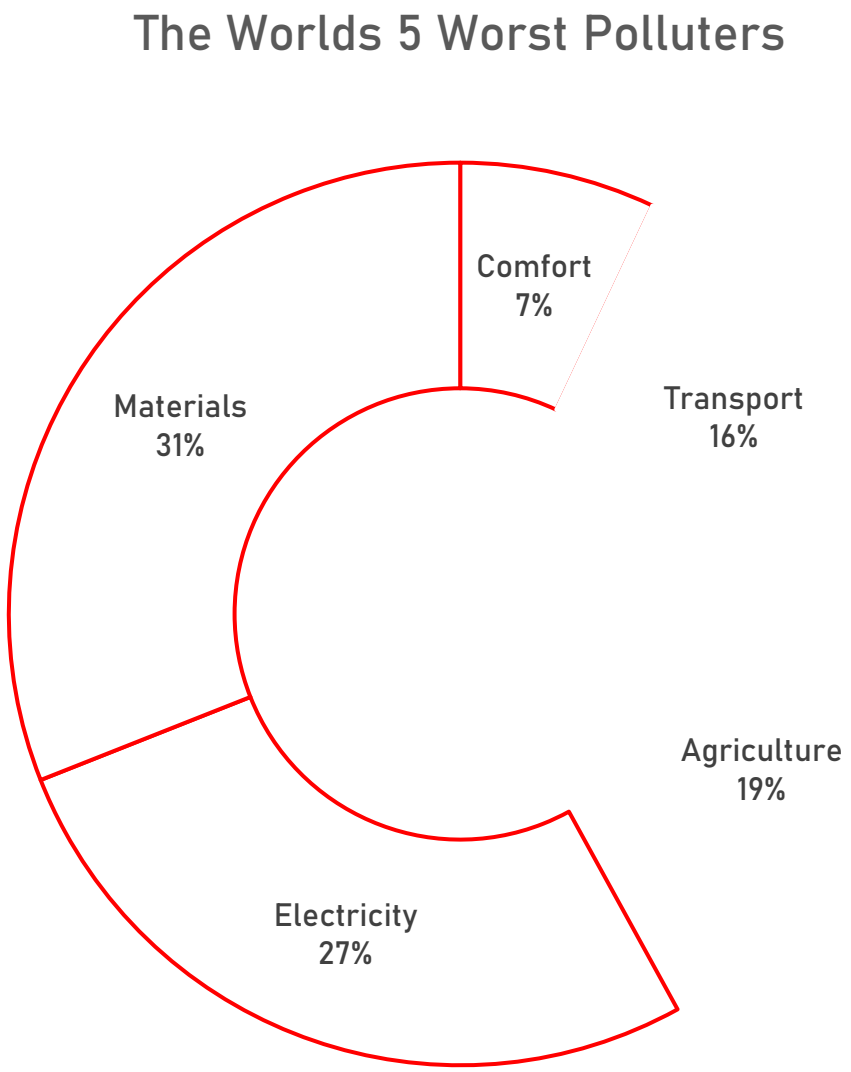
Where do School Buildings come into all of this?



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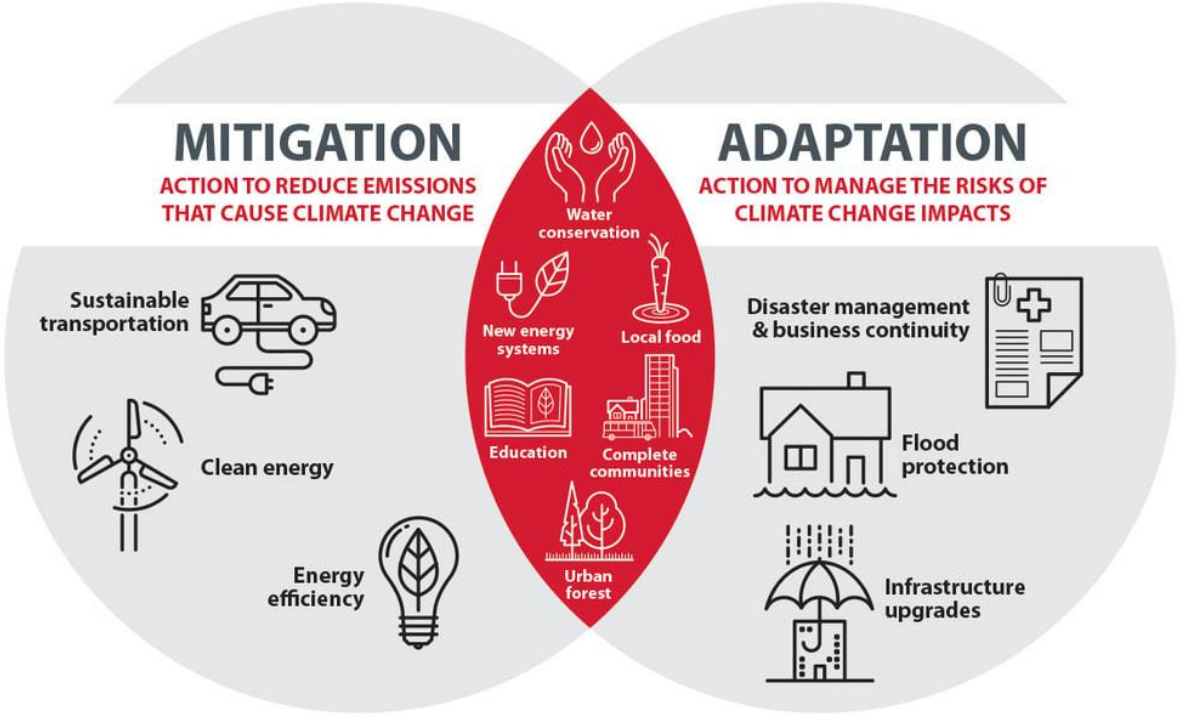
How can we tackle Climate Change?



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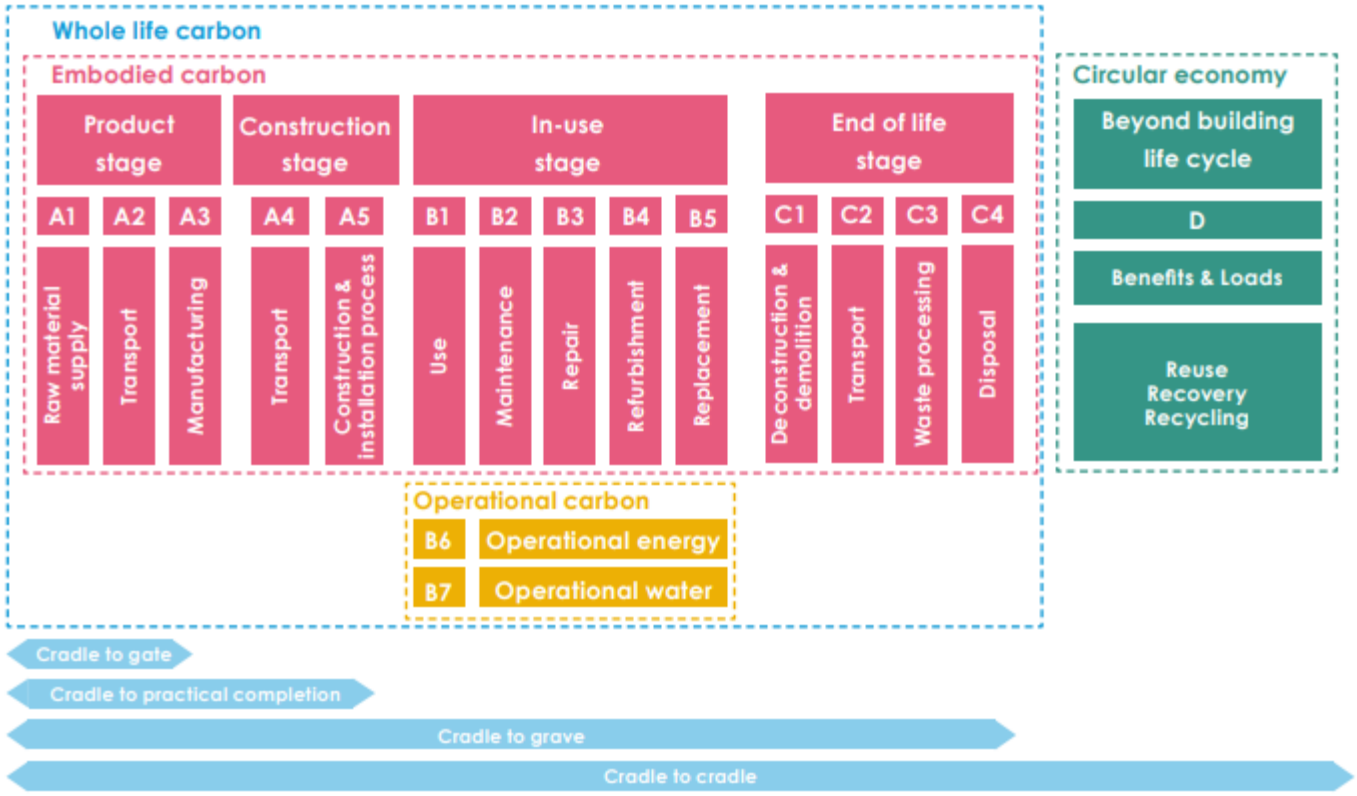
Mitigation

Measures or strategies that aim to limit or prevent emissions of greenhouse gases that **cause** climate change

Adaptation

Measures or strategies that aim to limit the negative **impacts** of climate change

Carbon in Buildings



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Operational Carbon

is the carbon load created by the use of energy to heat and power a building

Embodied Carbon

the carbon released in the manufacturing, production, and transportation of our building materials

Whole Life Carbon

carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal.

Mitigation

UK Built Environment Risks and Opportunities

Committee on Climate Change Report 2017 details risks and opportunities attributed to the Built Environment.

The CCRA Evidence Report highlights the **need for additional action in the next five years in England** to address the risks to health and wellbeing from heat, cold, and flooding.

UK-CCRA-2017-England-National-Summary-1.pdf (theccc.org.uk)

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RISKS

- Health and Wellbeing from high temperatures
- Flood Risk for peoples communities and buildings
- Risks to building envelopes from increase extreme weather
- Health risk from changes in Air Quality

OPPORTUNITIES

- Increased outdoor activities from higher temperatures

Adaptation

Part Two: The School Estate [20 mins]

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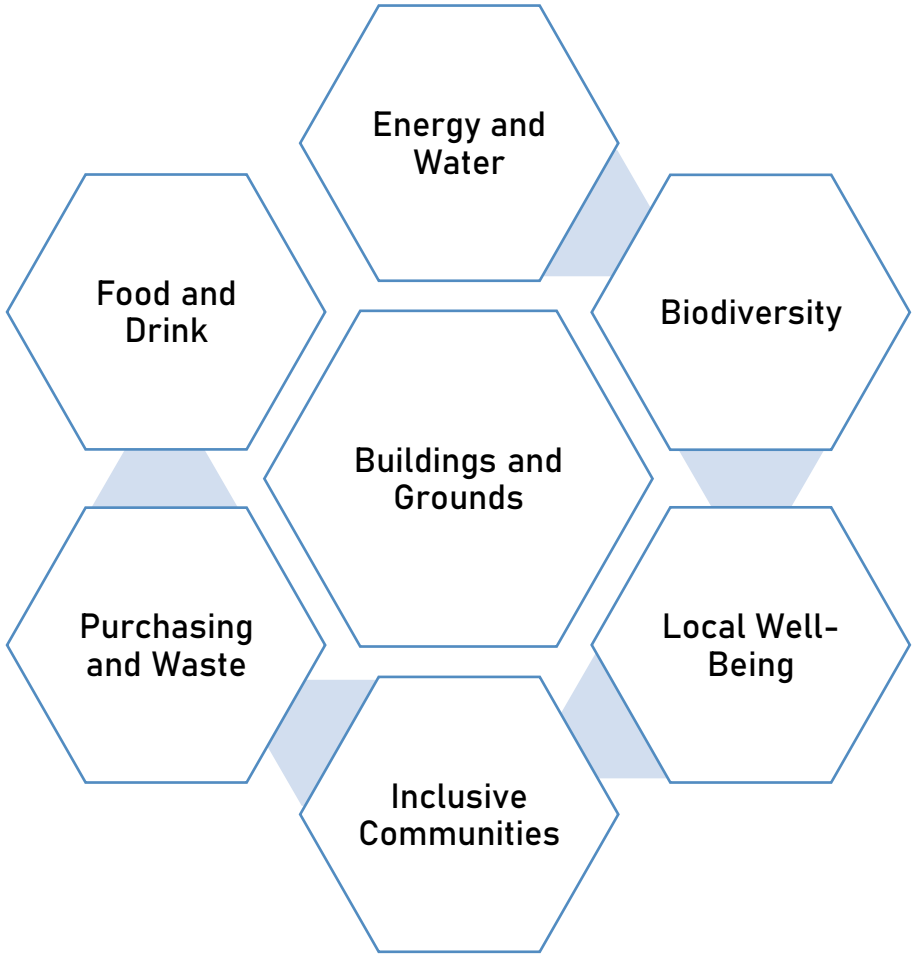
What impact can Schools have?

To meet national climate-change targets, the energy efficiency of ***new and existing school buildings*** needs to improve.



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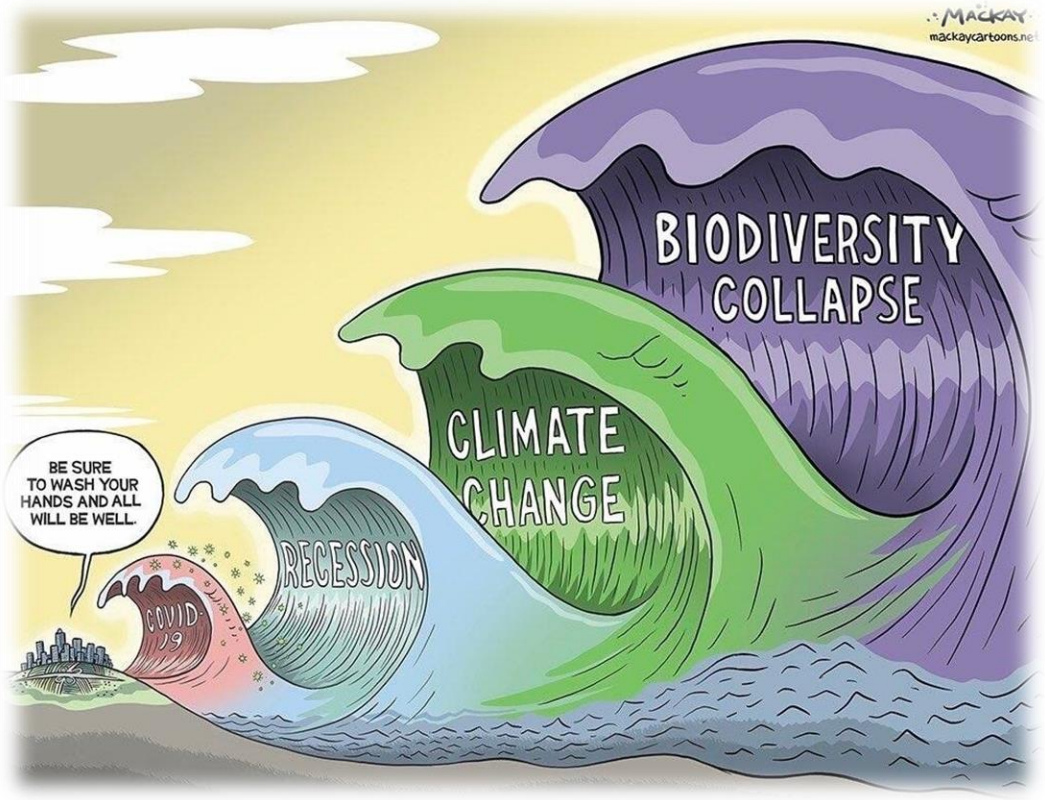
UK Carbon Emissions

Schools contribute to 2% of total UK carbon emissions[1]

Public Sector Carbon Emissions

Schools contribute to 40% of total UK public sector building emissions[2]

The New Build Standards



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CLIMATE MITIGATION

Operational Carbon

Low energy fossil fuel free buildings which are net zero carbon in operation

Embodied Carbon

Quantified impacts of embodied carbon on the school estate

CLIMATE ADAPTATION

Climate Resilience

Healthy and productive buildings which are safe, long lasting and respond to user needs

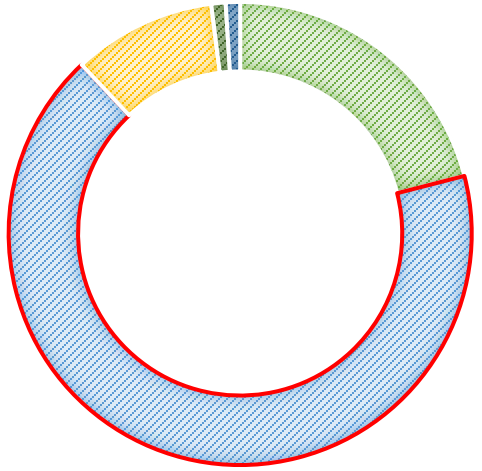
Biodiversity Net Gain

Resilient sites that achieve a biodiversity net gain in response to the 25 Year Environment Plan[3]

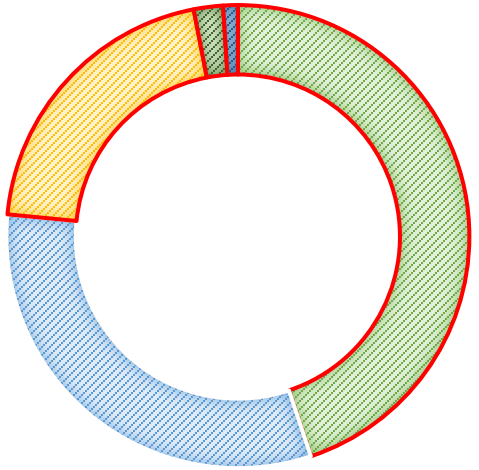
The Longer Term Vision: 2025

Materials [A1 – A3]
Operational Energy [B6]
Maintenance [B1 – B5]
Construction [A5]
End of Life [C1 – C4]

New School Standards to focus on reducing the Operational Energy (67%)



As Operational Energy decreases the focus shifts to Whole Life Carbon (68%)



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Whole Life Carbon

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Mitigation

What does the Step Change look like?

The school estate presents perfect opportunities to evoke change amongst communities. **S21** is currently being implemented on School Rebuilding Programme scheme, to pilot developing policy. This is based on our recommended option as part of current discussions with HMT.

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New Build School Specification

Standards	Climate Change Mitigation				Climate Change Adaptation			Carbon Targets
	Thermal Performance	**Heat Source**	**Generate Energy**	**Ventilation**	**Overheating Standard**	**Flood Resilience**	**Biodiversity Net Gain**	
Current Delivery (OS 2017)	Building Regulation	Gas Boiler	Planning Requirement Only	Single Sided Ventilation	2020 Weather Compliant	Planning Requirement Only	Planning Requirement Only	No Requirement
Typical New Build Scheme (S21)	**DfE Fabric Energy Efficiency Standards**	**Heat Pump Application**	**On-site renewables to meet Operational Energy Consumption**	**Cross Ventilation**	**2080 Weather Comply with 2oC Adapt to 4oC No Cooling***	**Site Specific Sustainable Drainage System (ie. Green Roofs)**	**Local Green Infrastructure to provide net gain**	**Net Zero Carbon in Operation + Quantify Embodied Carbon**
Future Direction (circa S25)	DfE Passivhaus Fabric Standards	Heat Pump Application	On-site and off-site renewables to meet Whole Life Carbon	Cross Ventilation	2080 Weather Comply with 4oC No Cooling*	Site Specific Sustainable Drainage System (ie. Green Roofs)	Local Green Infrastructure to provide net gain	Whole Life Net Zero Carbon (Embodied + Operational)

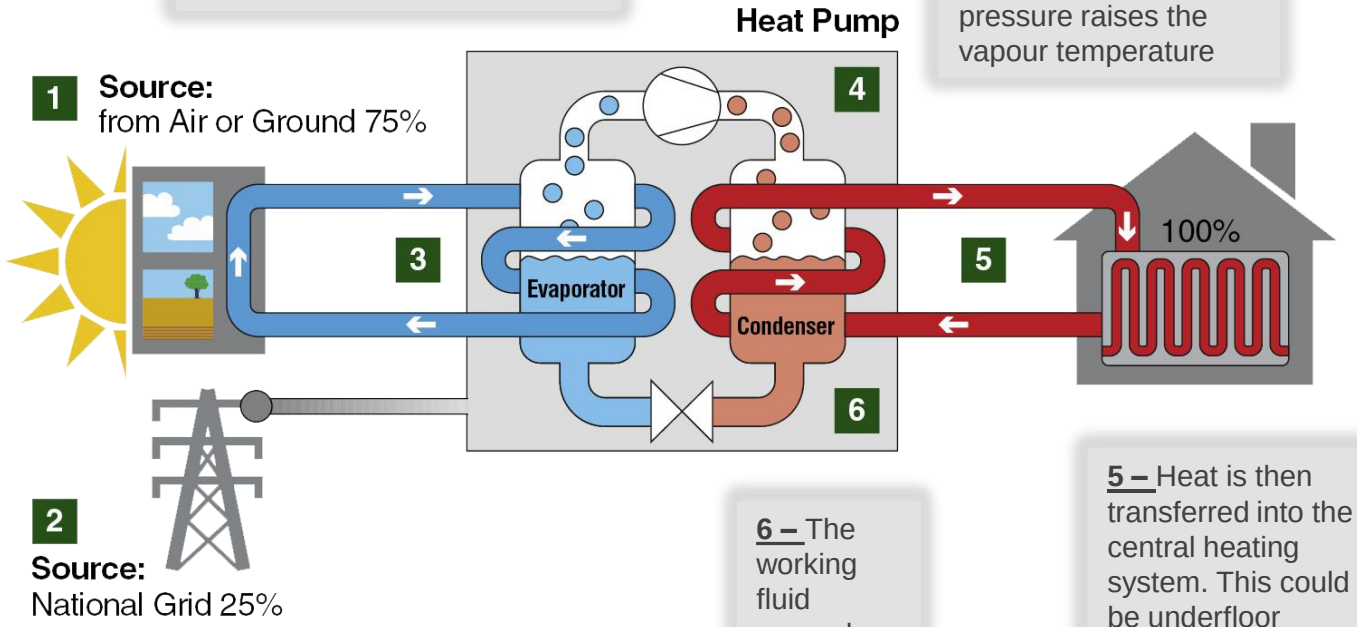
What is a heat pump?

Air Source Heat Pump – External Plant

Ground Source Heat Pump – External Plant

1 – Either outside air, or ground temperature air is blown across an evaporator and heat is absorbed by a fluid refrigerant.

3 – The cycle can be reversed in the summer to provide cooling if necessary



4 – Increasing the pressure raises the vapour temperature

2 – Electrical input is required from the National Grid (or through on-site PV generation)

6 – The working fluid expands, causing it to cool.

5 – Heat is then transferred into the central heating system. This could be underfloor heating, radiators or forced air systems.

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Mitigation

The Benefits of Mitigation Strategies

Delivering low energy, fossil fuel free buildings to **support grid capacity** through reduced energy demand and delivering healthy resilient and affordable buildings which put **users at the centre of all decisions**

Reduced Energy Bills

An average **primary school could typically save £13,000** in energy costs which is the equivalent of £30/per pupil and 41 tonnes of carbon every year.

An average **secondary school could typically save £63,000** in energy costs which is the equivalent of £56 per pupil and 172 tonnes of carbon every year.

This will provide our end users with more operational budget in the short term, and support a longer term objective to **reduce the operational cost across the national school estate**.

Resilient Buildings

Driving low energy solutions **supports a balance of delivering on-site net zero carbon**, and ensures that capital is invested within the superstructure of the building which will last 60+ years thus **improving the build quality of schools.**

Schools should focus on education, not carbon. By **delivering comfortable and controllable environments** with simple control which are easy to maintain and operate allows the **focus to centre in delivering world class education**.

Grid Decarbonisation

By investing in our school buildings and delivering operational net zero carbon through on-site solutions we will be **supporting the wider decarbonisation of the grid** and supporting local communities with clean solar energy.

A low energy focus takes a holistic approach to sustainability and supports a **reduction in cost of upgrade to the UK national grid.**

Education buildings **can act as support anchors for their local infrastructure** and community**.**

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Mitigation

The Benefits of Adaptation Strategies

Building **resilience within the school estate** and ensuring a minimum level of ‘greenery’ on each site. Using the younger generation and our national **school estate as a catalyst to evoke change** amongst local communities

Reduced Flood Risk

Global warming scenarios predict that winter precipitation may be up to 33% wetter and the number of schools at significant flood risk would increase from **10,700 to 16,600** by 2050.

If we don’t act now, this can result in:

- Educational days lost
- RPA costs and insurance premiums
- School maintenance costs
- Mental health costs
- Disruption to the wider community

Increased Bio-diversity

Climate is expected to become the **biggest driver of biodiversity loss** this century. Proposed interventions, not only **minimise the impact of climate change**, but also increase the variety of plants and animals at a school, helping to **boost biodiversity,** building resilience in ecosystems. Schools are spread nationally and are well placed to deliver large scale resilience across the UK.

Wider benefits include:

- Improved mental health
- Improved productivity
- Improved cognition
- Free cooling

Reduced Overheating Risk

The **majority of schools** had a proportion of classrooms that **failed to meet the minimum overheating performance threshold**. In a 4ºC global warming scenario, summer temperatures may be up to 5.8ºC warmer and **every school** had a proportion of classrooms that failed to meet the minimum threshold.

If our new schools do not incorporate these measures, the **cost of adapting in the future to overcome overheating risks** will be c.£105k and c.£360k, in a primary and secondary school respectively .

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Adaptation

Benefits of Biophilia in School Design

Attention and Focus increases and **reduced scores for ADHD** and inattention symptoms.

Physical activity. Improved access to outside enables outside activity **improved the academic achievement**.

Natural materials **reduce heart rate/stress levels by 30%** in formal environments.

Improves verbal memory and performance of automated tasks completed in nature.

Learning landscapes. Best academic results are achieved when there is **a mix of different learning spaces that combine nature and interesting architecture.**

Access to quality outdoor green space, **closes the attainment gap between underperforming children** and their equally intelligent peers.

Visual exposure to the natural environment can **reduce blood pressure and heart rate** following exposure to a stressor.

13% increase in student attentional function in rooms with views of nature as opposed to views of built space and windowless rooms.

Up to **10% reduction** in ill health absences where staff have sight of green spaces and natural light.

Adaptation

Why is Adaptation so important?

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We rely on biodiverse habitats and nature to survive. Tesco wanted to show their customers how it would look like if all bees and butterflies would become extinct.

Part Three: The Evidence [10 mins]

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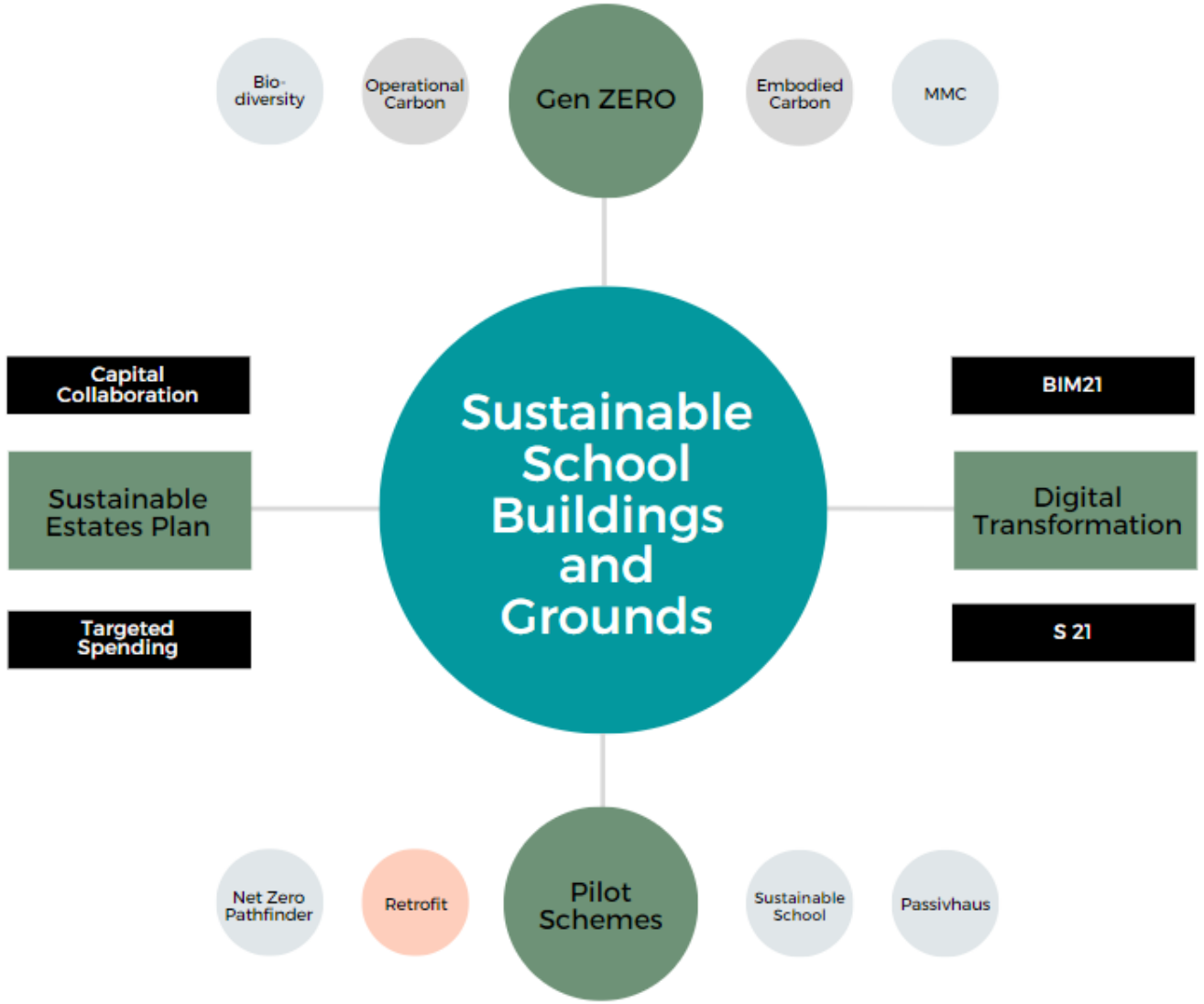
What is the Evidence behind our new build standard?

We have, and continue to **work with our delivery partners and supply chain** to develop standards using a mix of **research** and **pilot projects to gather evidence**.

We currently have circa. 36 new build pilots across various programmes and project stages.



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Case Study Portfolio: Pilot Projects

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GenZero Protective Landscape

Case Study 1

SKY Academy

West Carclaze
Cornwall

Net Zero Carbon Primary School
Fabric first approach
Low embodied carbon
Maximised tree planting
Sensitive bio-diverse planting
Natural materials
School design for outdoors
Promoting Active Travel

Case Study 2

Merstham Park Academy

Redhill
Surrey

Low carbon school
Biophilic landscape
Focus on stress and anxiety
Absorbs 16% CO_2 (L2)
Trees manage solar gain
Woodland
Orchard
Calming garden on arrival

Case Study Portfolio: Research Projects

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Case Study 1

GenZero
New standard secondary school

Whole Life Zero Carbon
Ultra-low embodied carbon
Timber Superstructure
Standardised Layouts
Modern methods of Construction
Maximising off-site solutions
Green Infrastructure providing; local free cooling
Integrated SUDs

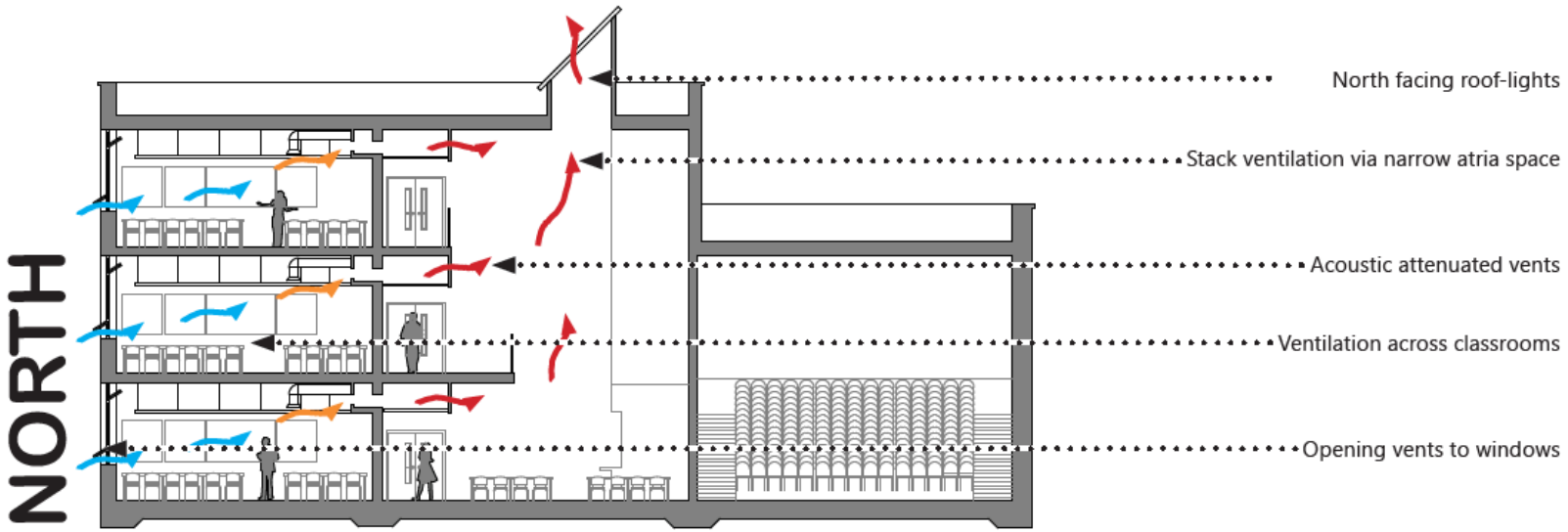
Case Study 1

Resilient School Buildings

A research study and report looking into the impact of climate change on the superstructure and resilience of our school buildings such as overheating, increased rainfall and future resilience techniques

Further Information

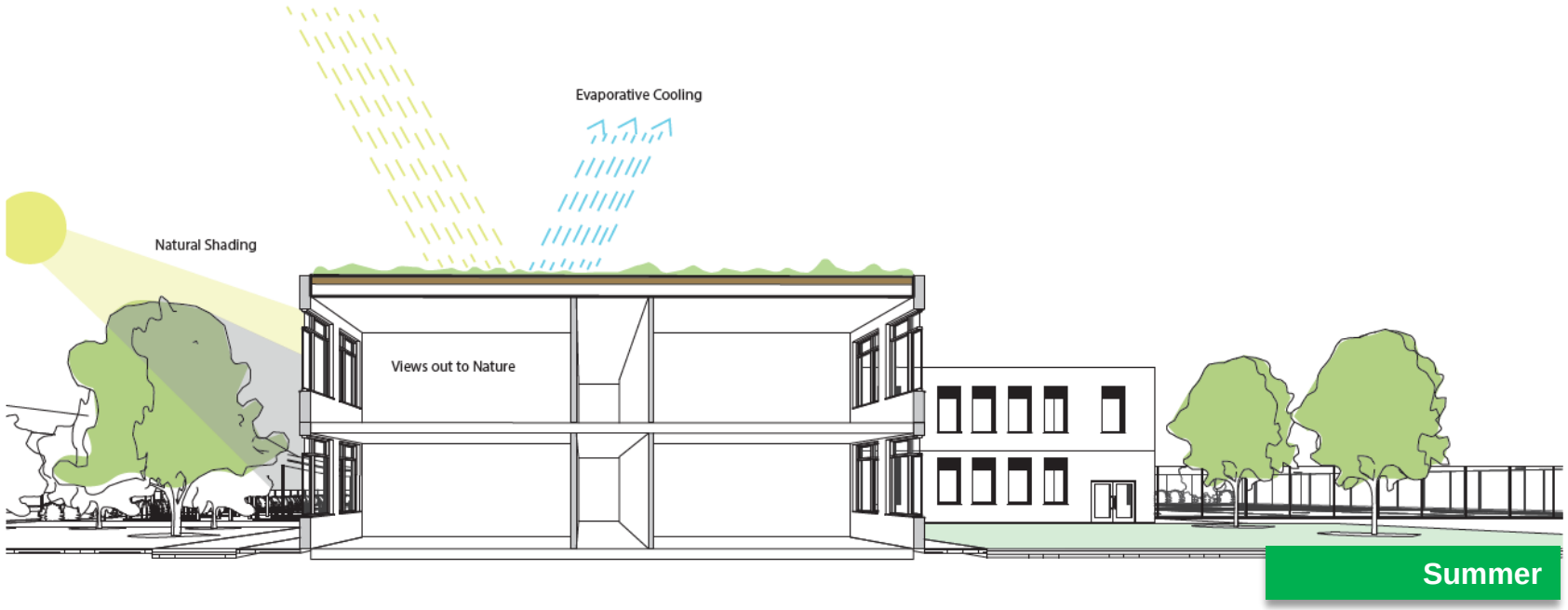
Natural Cross Ventilation //

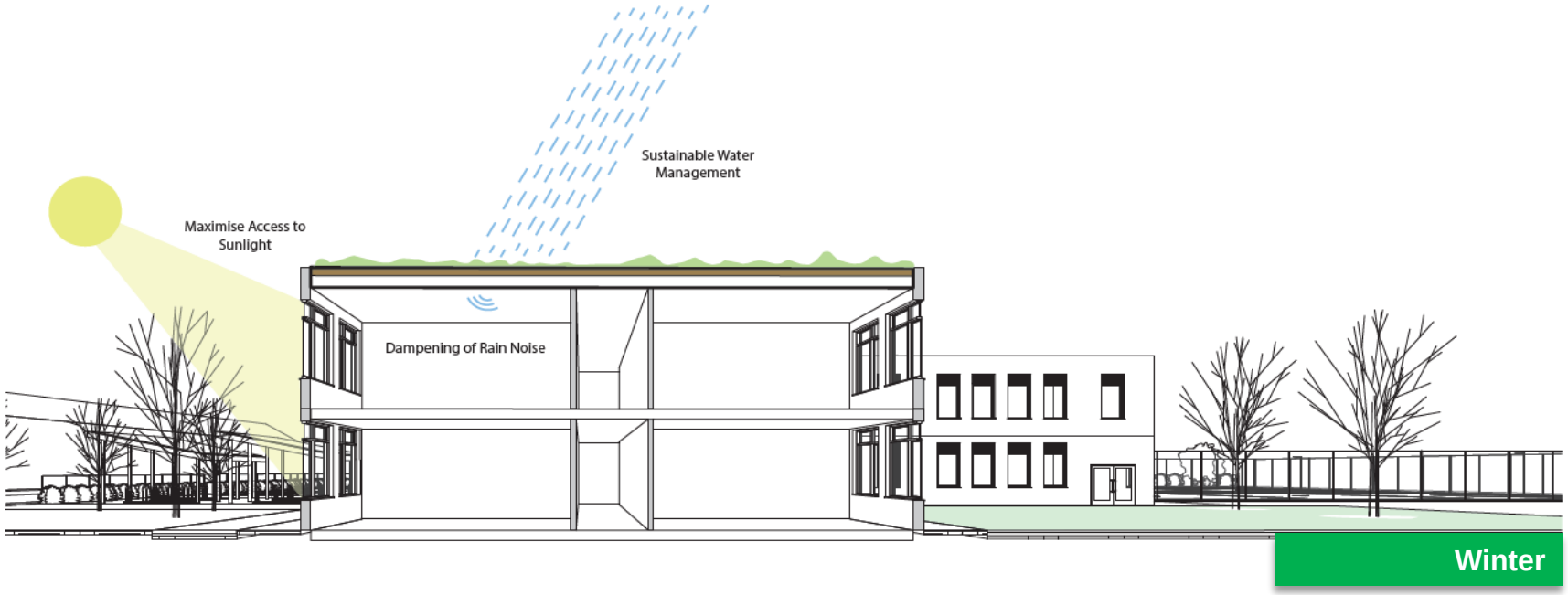


Case Study 2

Resilient School Sites

A research study and report looking into the benefits and evidence behind integrated landscape and school design, extending the focus beyond the building line to maximise the site potential.





Part Three: What about the existing estate? [5 mins]

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What about the other 20,000 schools?

"Re-build the worst, Retrofit the rest"

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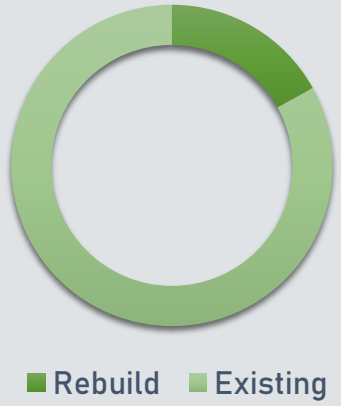
The Retrofit Challenge

We know the proportion of re-build and projects delivered each year, which leaves over 80% of our estate untouched before 2050. Therefore, the largest challenge in meeting 2050 legislation is the retrofit of our existing estate; the **schools that will not require re-building between now and 2050**.

We are looking to find ways to secure funding so we can **build a solid evidence base for future programmes** with tried and tested solutions. The scale and immediacy of the challenge required for retrofit by 2050 is shown below;



Are any of you doing anything in this area? We'd love to hear from you!

Questions?

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