

ZERO CARBON BUILDING RESEARCH & PRACTICE IN THE UK

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September 2014



Recent comments from Paul Chan

- The ZCB is the first zero carbon building in Hong Kong. It enhances people's knowledge on the sustainable life-style. The ZCB is focused on the harmony between natural ecological environment and buildings. Its main features can be summarised in four "E's":
 1. Educating: open to the public
 2. Evaluating: 2 800 intelligent monitoring devices;
 3. Experimenting: The most advanced design and technology for environmental friendly building and sustainable life style;
 4. Evolving: responding to the ever evolving technology and requirements in low carbon and green building.



Climate Change Summit – September ‘14

- Obama said America had a “mission” to act and help smaller countries in the fight against climate change. He added: “That’s what big nations have to do.
- “Today I call on all countries to join us, not next year or the year after that but right now, because no nation can meet this global threat alone.
- "We are the first generation to feel the effect of climate change and the last generation who can do something about it."



Climate Change Summit – September '14

- Mr Cameron UK Prime Minister said: "We cannot put this off any longer. To achieve the deal we need all countries to make commitments to reduce emission.
- "Our agreement has to be legally binding, with proper rules and targets to hold each other to account. And we must provide support to those who need it, particularly the poorest and most vulnerable."
- Mr Cameron said it was unrealistic to expect undeveloped countries to forgo the economic growth enjoyed by nations which had benefited from carbon



Climate Change Summit – September ‘14

- The most important statement came from China's Vice Premier Zhang Gaoli. China, he said, would publish “as early as possible” a date at which it expected its greenhouse gas emissions to peak.
- Since China is now by far the world's largest emitter of greenhouse gases, averting dangerous climate change will only be possible if its emissions stop rising within the next ten years and then begin to fall. Previously China had not committed to any timetable for this and are now expect it to do so in the next few months.
- President Obama called on China, as a fellow “big country”, to show joint leadership with the US. If China publishes an early date for its emissions to peak, it will be America which comes under the greater pressure to fulfil its global obligations.

WHO WE ARE WHAT WE DO

The Road to Zero Carbon

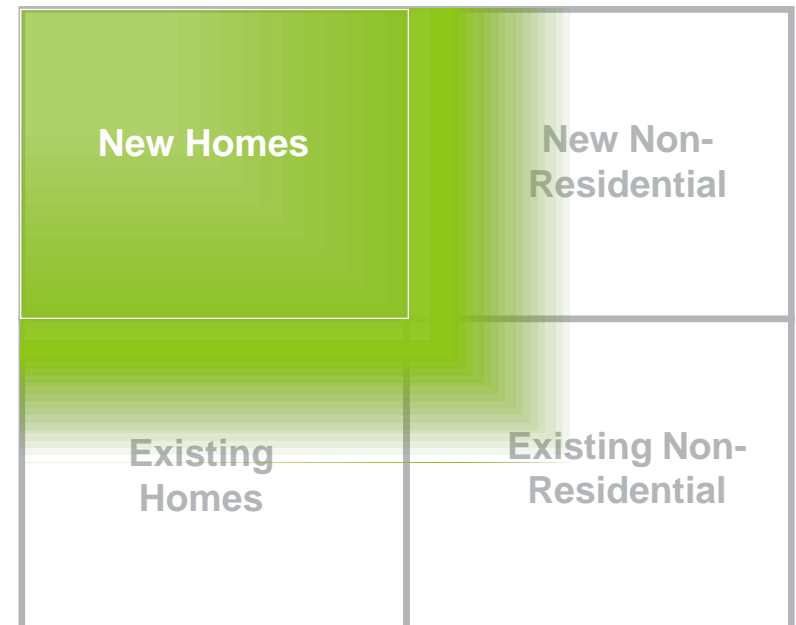


ROLE of the ZERO CARBON HUB in the UNITED KINGDOM

PURPOSE AND STRATEGIC OBJECTIVES

“Facilitate the mainstream delivery of low and zero carbon homes in the UK”

- Provide leadership and create confidence
- Reduce risk and clear obstacles
- Disseminate information

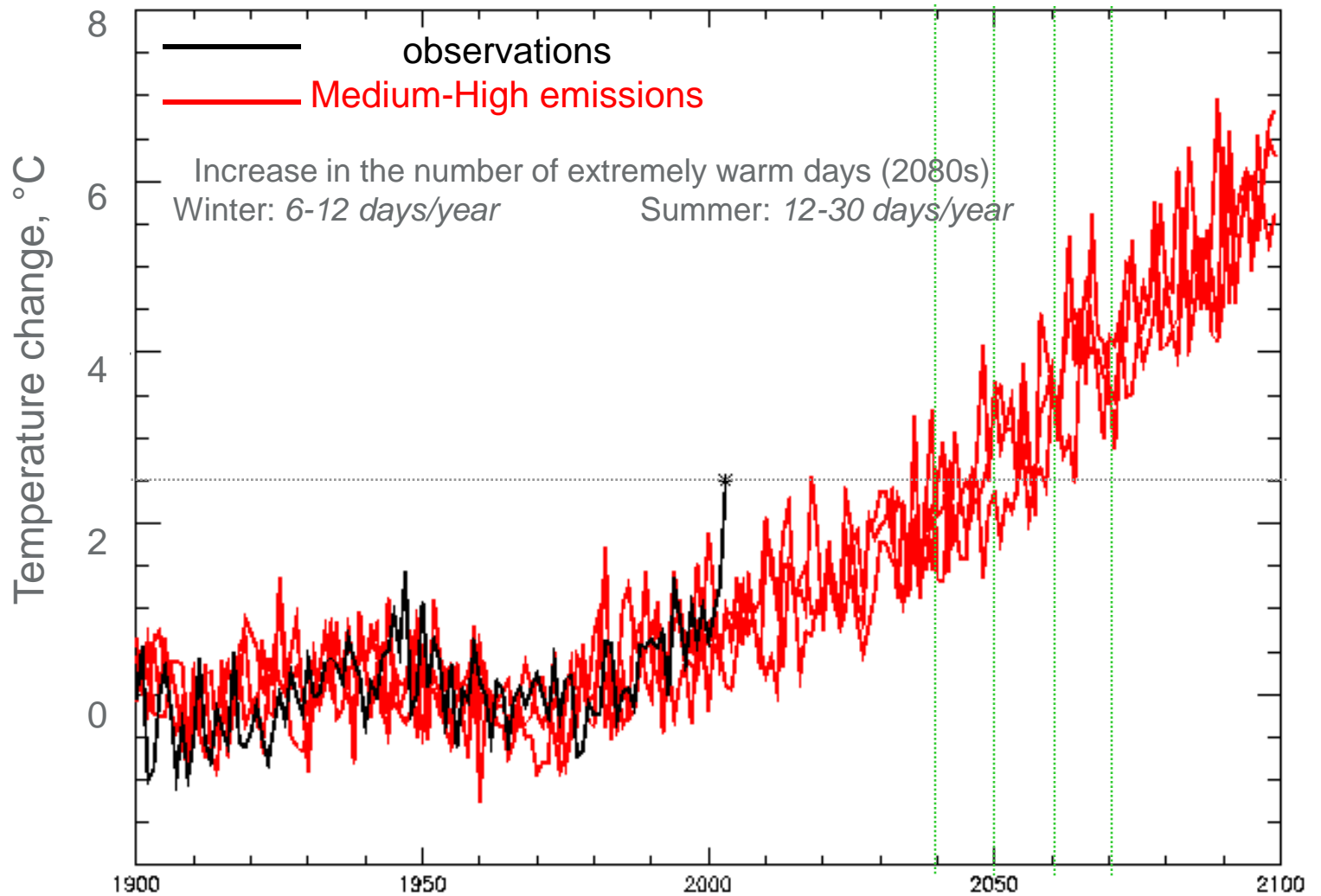


CLIMATE CHANGE

The Road to Zero Carbon



CLIMATE CHANGE – EXPECTED INCREASE IN TEMPERATURE





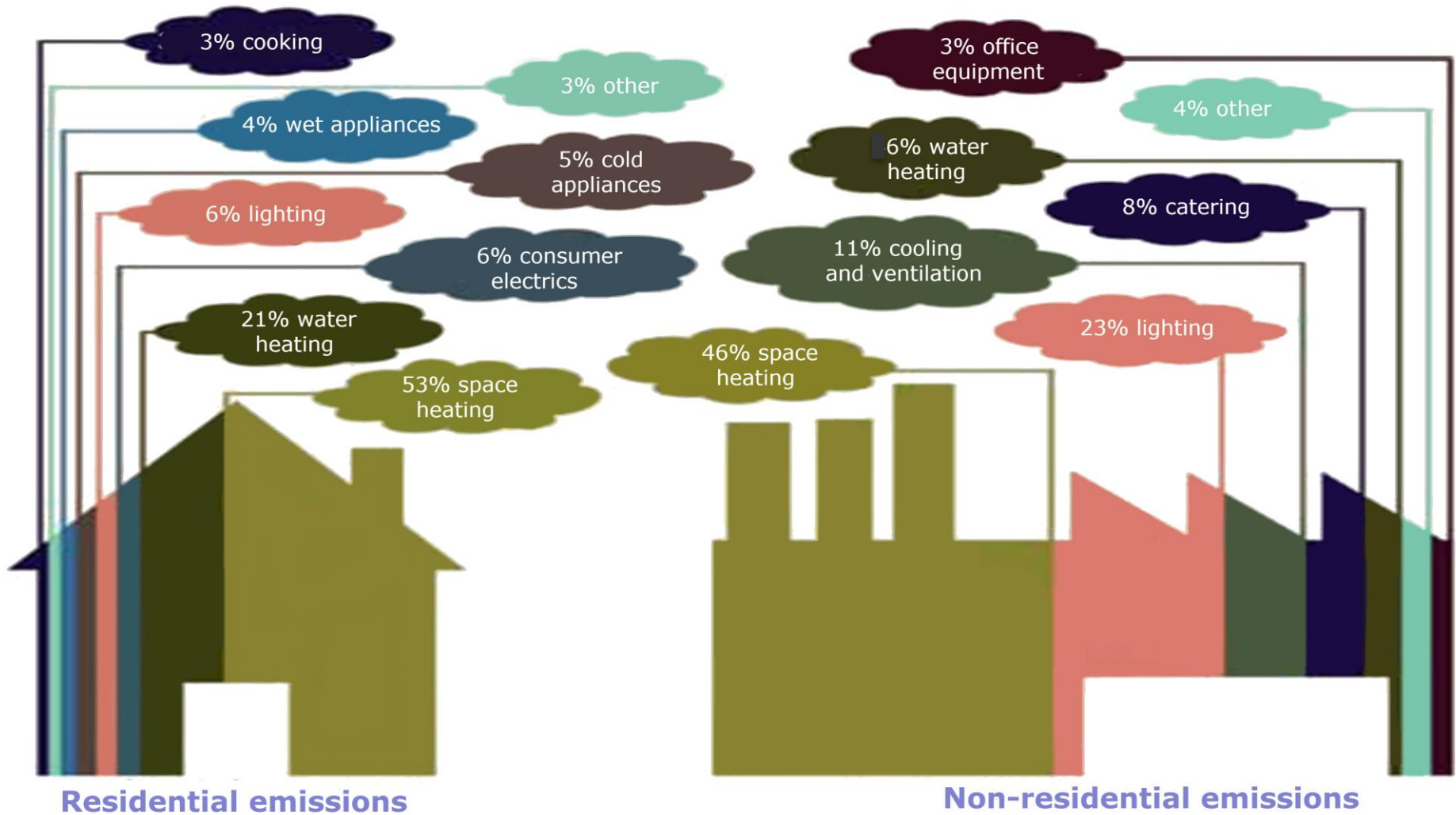
1998-2007 was the warmest decade on record)

2013/4 was the wettest winter on record)

2009 – 5th warmest globally and 14th warmest in the UK

2012 Hottest day ever in Scotland and wettest June in the UK

CARBON CULPRITS



UK IN FOCUS

The Road to Zero Carbon

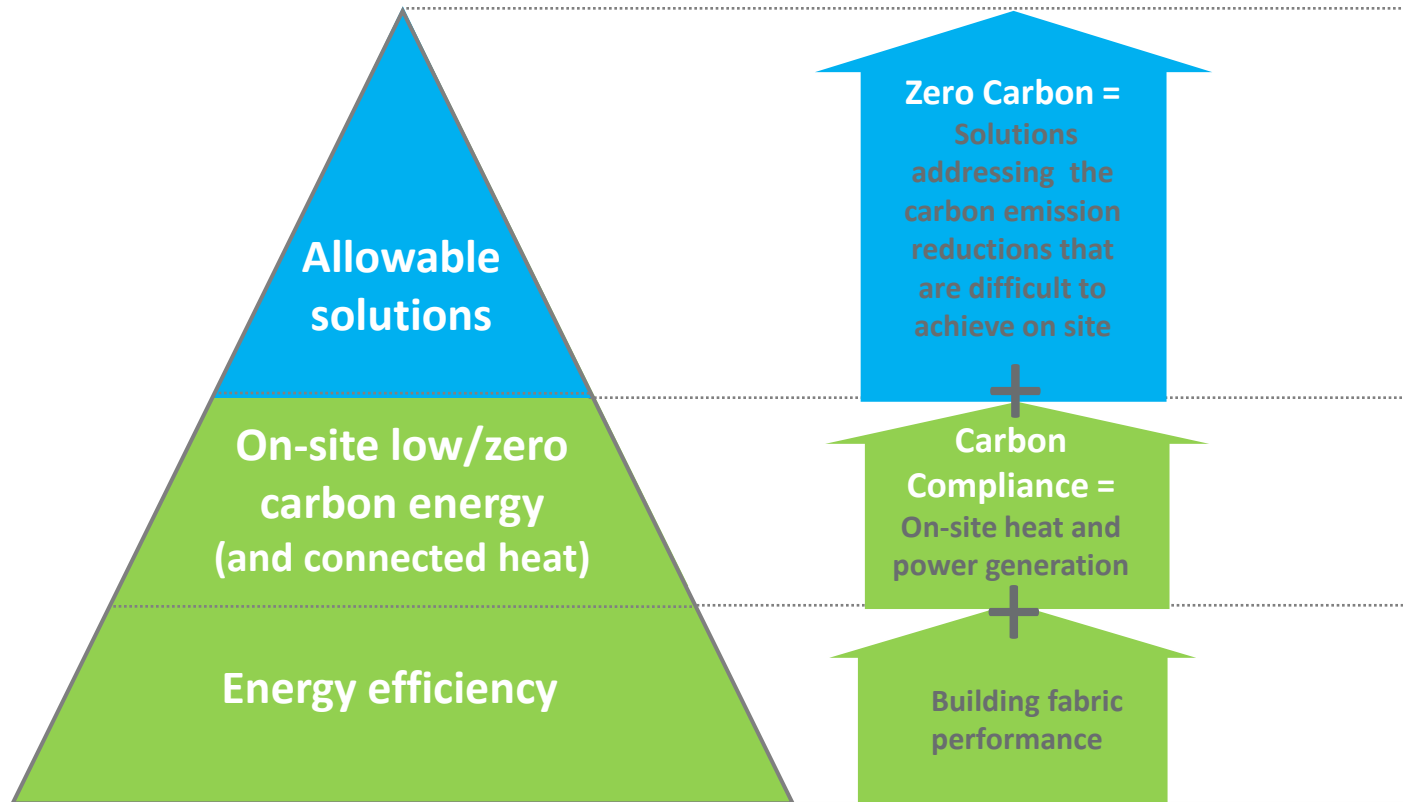


UK POLICY

- UK Government has made a Commitment to reduce carbon emissions by 80% by 2050 and by at least 26% by 2020 against a 1990 baseline.
- Homes contribute 27% of UK's CO2
- All new domestic buildings will be Zero Carbon from 2016
- All new commercial buildings will be Zero Carbon from 2019
- Existing Homes Carbon are addressed via a mechanism to allow the cost of improvements to be paid via energy bills
- There are no plans to address existing commercial buildings at this time



ZERO CARBON DEFINITION IN THE UK FOR NEW HOMES



The Zero Carbon Hierarchy – stepped progress towards a workable definition.

investments in energy storage and demand-side management projects

investment in embodied carbon reduction initiatives

investment in retro-fitting of low-carbon technologies

investment in low carbon cooling

investment in low carbon electricity generation assets

investment in Energy-from-Waste plants

Investment in district heating pipework

OFF-SITE OPTIONS

investment in local low carbon street lighting

investment in local sustainable energy infrastructure

retrofitting of local communal buildings

low carbon heat export infrastructure

investment in local electric vehicle infrastructure

communal waste management solutions

local micro-hydro schemes

local energy storage solutions

NEAR-SITE OPTIONS

UK ZERO CARBON HIERARCHY

UNREGULATED EMISSIONS
(cooking, electrical appliances)

REGULATED EMISSIONS
(heating, ventilation, lighting)

Allowable Solutions

On site low/zero carbon heat and power

Fabric Energy Efficiency

CARBON COMPLIANCE

home electricity storage

LED street lighting

ON-SITE OPTIONS

demand side management

site-based heat storage

home electric vehicle charging

vacuum waste collection systems

smart appliances

Green Gas Certificates

CHP biomass boilers

thermal bridging high efficiency boilers solar hot water

ground source heat pumps air source heat pumps photovoltaic panels

external heat gains

thermal mass

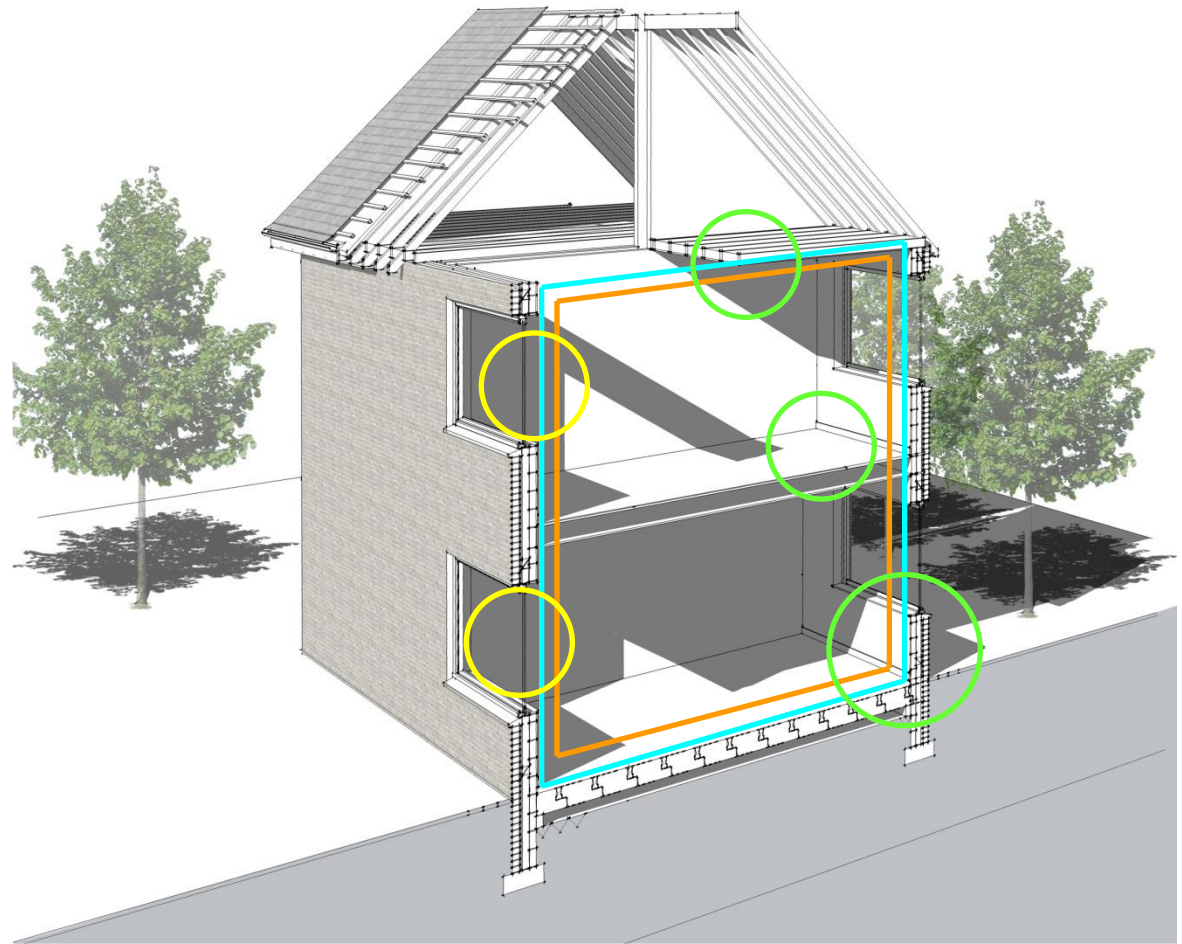
internal heat gains

air permeability

building fabric U-values

THE ENERGY EFFICIENCY STANDARD

-  Building Fabric:
U-values
Thermal mass
-  Thermal Bridging
-  Air-permeability
-  Orientation, solar gains,
Glazing proportion



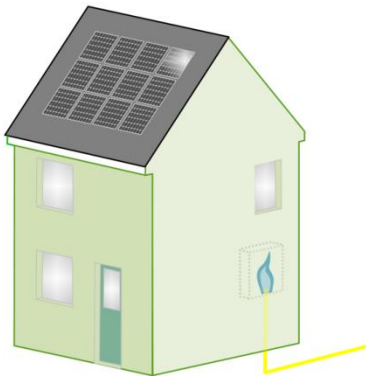
CARBON COMPLIANCE

Target Carbon Compliance of **10** kg CO₂/m²/year for detached homes

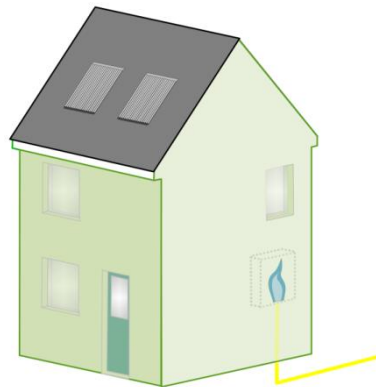
11 kg CO₂/m²/year for attached homes

14 kg CO₂/m²/year for apartments

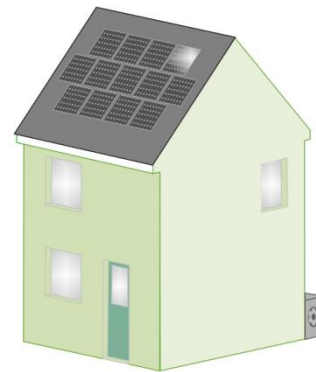
Approach provides solutions for a range of practical situations:



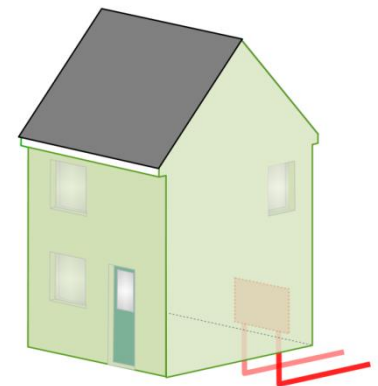
On gas grid
'PV'



On gas grid
'Fabric'



Off gas grid
Heat Pump

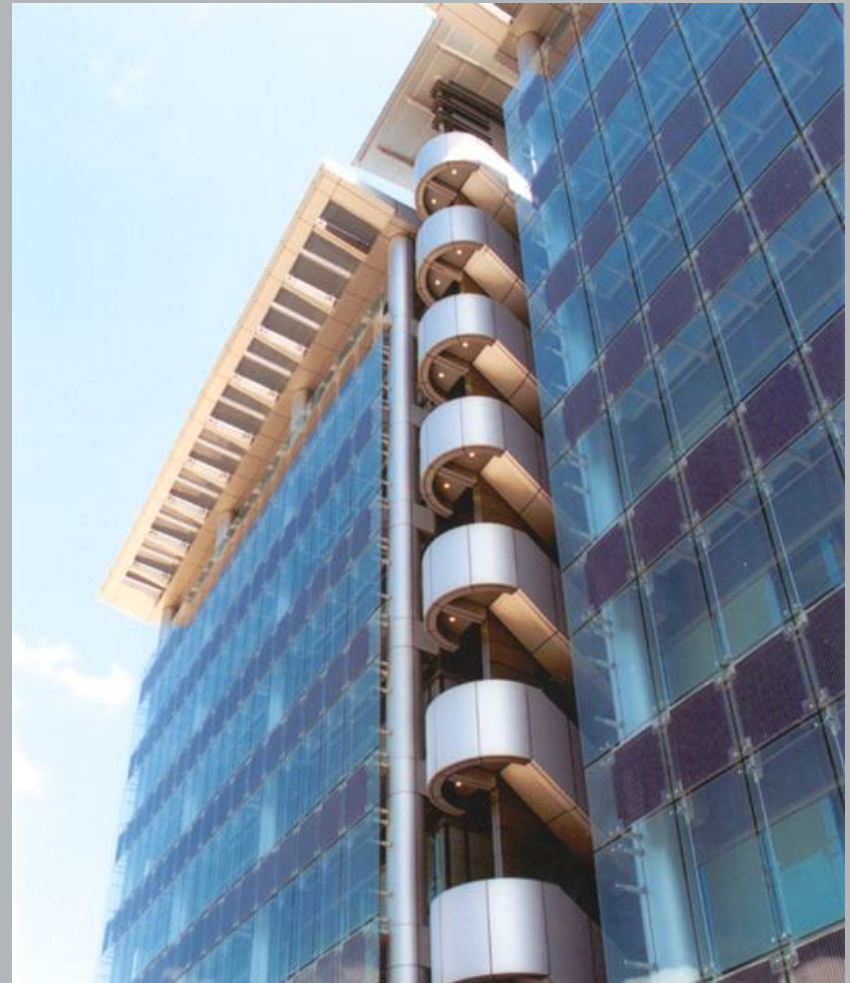


Community Heat
Network

KEEPING ASSUMPTIONS UNDER REVIEW



Roof space availability
for PV/solar
technologies considered
a limitation on high rise





ALLOWABLE SOLUTIONS

Smart appliances

District heating

Energy from waste

Home electrical vehicle
charging

Retrofit lzc technologies
to local community
buildings

LC Energy generation
larger scale

Electricity storage for
home

Local micro hydro
schemes

Investment in carbon
cooling

LED streetlights for a
development

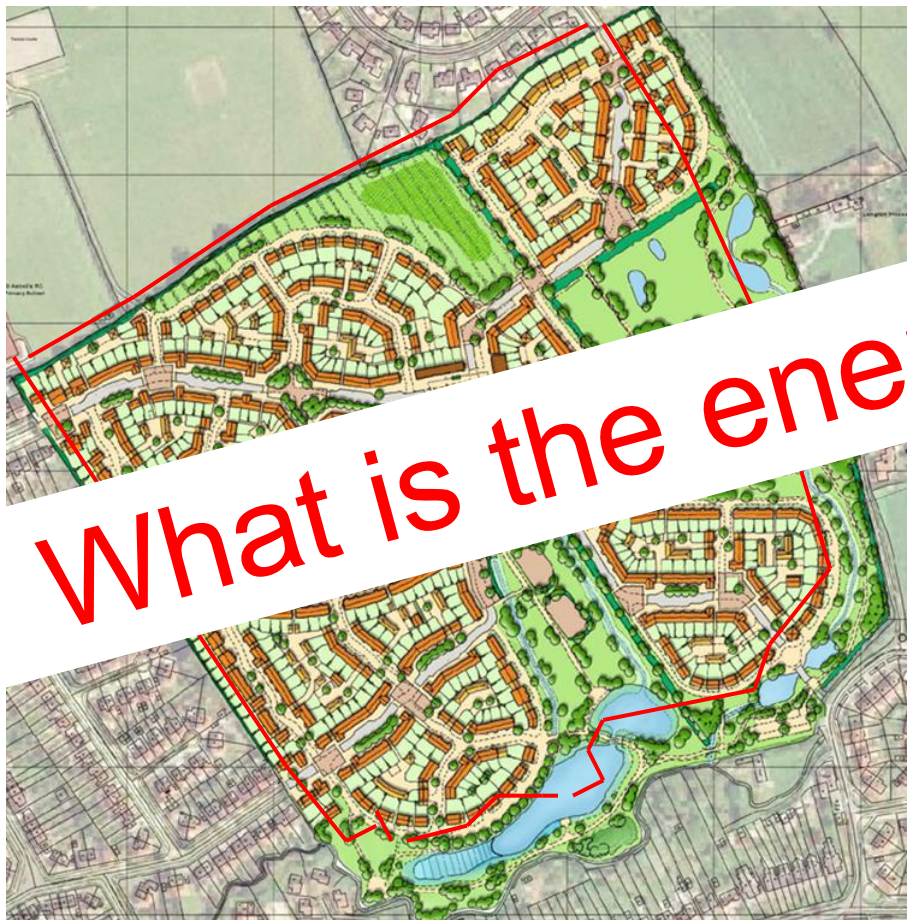
Local energy storage
schemes

Investment in embodied
carbon reduction

The Future of retrofit projects: THE GREEN DEAL

- Desire for market led solution
- Millions of homes without double glazing
- Half of homes do not have sufficient insulation
- UK committed to reduce its GHG emission by at least 80% by 2050 from 1990 levels.





Site Conditions:

- Access
- Location (regional weather)
- Ground conditions
- Flood risk
- Existing

... network

Planning:

- Dwelling type mix/ density
- Built form considerations - roof pitch, building height etc
- PV and solar panels
- Local Renewable targets

Site Layout:

- Dwelling types
- Design for solar technologies:
 - Orientation for solar technology
 - Roof pitch
 - Over-shading

Other:

- Localism



DEVELOPMENT LAYOUTS

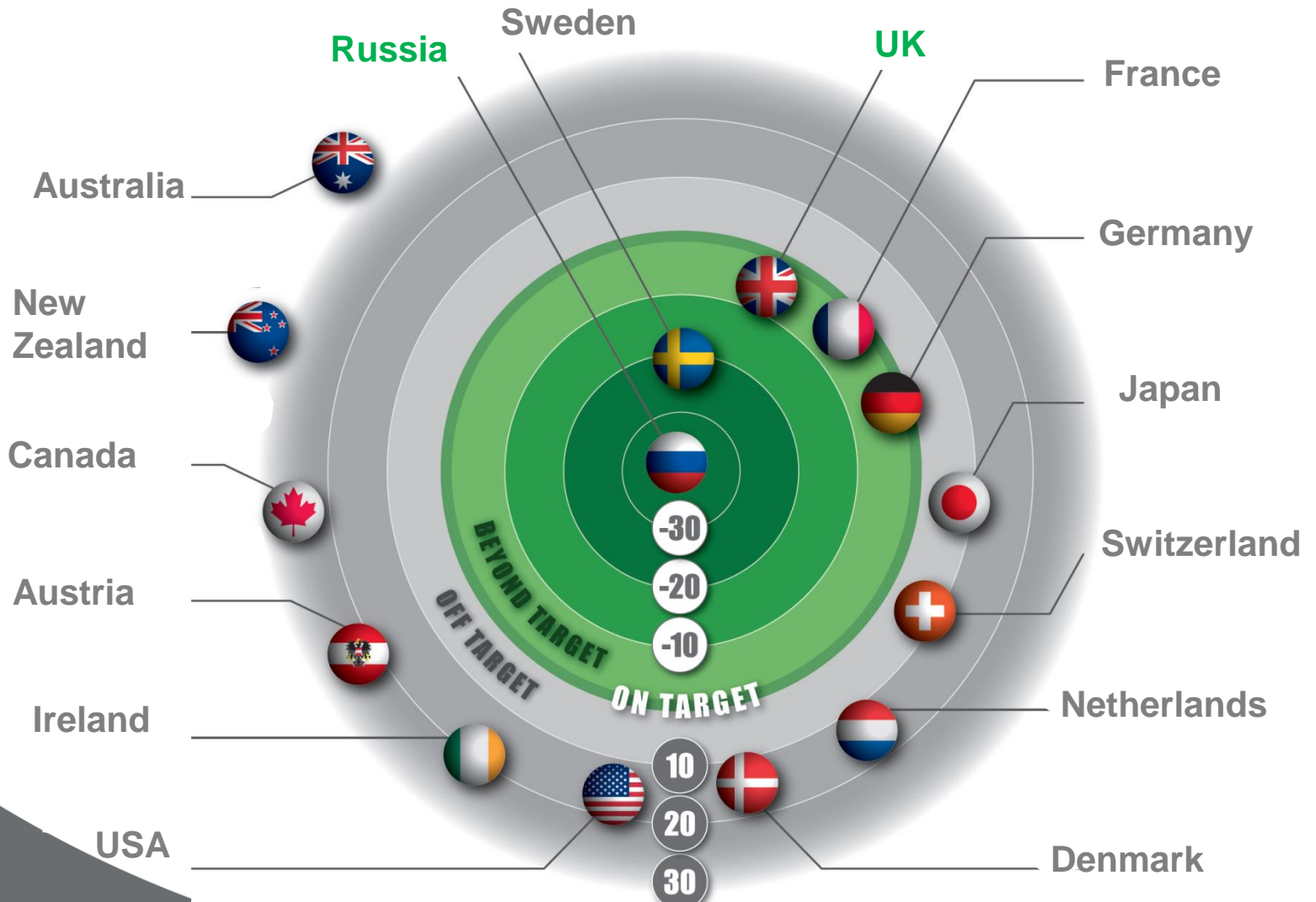
AN INTERNATIONAL CONTEXT

The Road to Zero Carbon



KYOTO – WHO'S ON TARGET

China?



UNITED KINGDOM

CAPITAL LONDON

THE WORLD'S FIRST INDUSTRIALISED NATION¹¹

THE WETTEST WINTER IN ENGLAND AND WALES IN ALMOST 250 YEARS

2014

LEADING TO EXTENSIVE FLOODING AND DAMAGE¹²

51%

EUROPE'S WIND TURBINES ARE OFFSHORE IN THE UK¹³

67% OIL DEMAND + 53% GAS DEMAND MET FROM RESERVES IN THE NORTH SEA¹⁴

£1 BILLION HAS BEEN PLEDGED

THE COMMERCIALISATION OF CARBON CAPTURE AND STORAGE

READY TO BE SUCCESSFUL INSTALLED IN THE 2020'S¹⁵

THE ONLY COUNTRY TO SET LEGALLY BINDING TARGETS TO REDUCE GREENHOUSE GAS EMISSIONS¹⁶

80% BY 2050



London, UK

As the world's first industrialised nation, fossil fuels have played a key part in the United Kingdom's rapid growth since the 19th century.

However, recent years have seen strong political support for the decarbonisation of the UK's energy system, placing it ahead of most countries in the recognition of the importance of this shift. Climate change mitigation and adaptation have been made a priority domestically, while the UK is a global leader in promoting energy efficiency worldwide. Although oil is still an important part of the UK's energy balance, contributing 37% to the country's total energy consumption in 2013, the total generation from renewable energy reached 15% during the same year, with overall renewable energy use tripling between 2000 and 2012.⁷

The UK is one of the world's most energy efficient countries, in part due to successful efficiency improvement across the economy. An area which still offers significant savings is the built environment, with policy seeking to improve the performance of both new and existing buildings. Part L of the Building Regulations requires that all new homes be zero carbon by 2016 (and all non-domestic buildings to be zero carbon by 2019), while the ambitious Green Deal scheme allows consumers to receive energy efficiency improvements with no up-front costs (which are ultimately recovered by the installer through charges on the consumer's now-reduced energy bill). This year saw the beginning of a large scale rollout of smart meters across the country, where 53 million units will be installed by 2019.⁸

KEY FACTS

Country Population
63.7 million

Area
243,610 km²

Density
263 people/km²

% of population in cities
79.6%



24.5 million
Number of houses


26%
Population in megacities
(over 1 million residents)


516
Motor vehicles
per 1000 people


5,472 kWh
Electric power
consumption per capita


7.9 mtCO₂
CO₂ emissions
per capita


31%
of total energy used
by residential sector


16.1%
Electricity generated
from renewables


-27°C to 38°C
Average temperature

CHINA

CAPITAL **BEIJING**

19% OF THE GLOBAL POPULATION^[1]

GLOBALLY



LARGEST PRODUCER & CONSUMER
2ND LARGEST CONSUMER^[2]

49%

OF FORECASTED EMISSIONS BETWEEN 2010 AND 2040 ARE EXPECTED TO BE EMITTED BY CHINA ALONE^[4]

THE WORLD'S **LARGEST WIND ENERGY PRODUCER**^[5]

THE SECOND LARGEST EXPORTER OF **LOW CARBON TECHNOLOGIES AND ENVIRONMENTAL SERVICES** WORLDWIDE^[5]

2012

CO₂

TO TACKLE SMOG IN FIRST HALF 2014 BEIJING CUT COAL CONSUMPTION^[6]

7%



Tianjin, China

China continues to top numerous global rankings, as the world's most populated country, the biggest energy consumer and producer, the largest emitter of global carbon emissions and the world leader in renewable energy production.

Despite its extensive natural resources, the Chinese government has placed a significant priority on expanding the number of renewable and natural-gas fired plants in the country as part of its 12th Five-Year Plan. The plan includes a priority to reduce the high carbon and energy intensity of China's economy by 17% and 16% between 2010 and 2015, respectively. The Government is also seeking to encourage greater private investment in the nation's energy market by streamlining the project approval process and loosening

control of energy prices. The Five-Year Plan also includes details regarding the mass deployment of renewable energy, with targets including 100GW of wind, 35GW of solar and 13GW of biomass.⁷

Beyond energy, there is a growing focus on green building in China, with the first LEED building in the country certified in 2005. By 2020, it is expected that green construction will account for 30% of all new construction. This is a significant number, as China surpassed the United States in 2010 as the world's largest construction market. Overall, a lack of understanding of the potential costs savings associated with green building means the demand for energy efficient homes remains low, but rising air pollution in urban centres has helped improve awareness.⁸

KEY FACTS

Country Population
1.355 billion

Area
9.6 million km²

Density
145 people/km²

% of population in cities
50.6%



435 million
Number of houses



22%
Population in megacities
(over 1 million residents)



69
Motor vehicles
per 1000 people



3,298 kWh
Electric power
consumption per capita



6.2 mtCO₂
CO₂ emissions
per capita



22%
of total energy used
by residential sector



20.7%
Electricity generated
from renewables



-52°C to 50°C
Average temperature

HONG KONG

CAPITAL HONG KONG

THE RICH BIODIVERSITY INCLUDES^[1]



3RD

BUSIEST **CONTAINER PORT** IN THE WORLD
MAKING IT A KEY CENTRE FOR GLOBAL TRADE^[2]

RELIES **SOLELY ON FOSSIL FUELS** IN POWER GENERATION^[3]

25%
OF ELECTRICITY IS IMPORTED^[4]

AIR POLLUTION IN HONG KONG HAS
WORSENEO SIGNIFICANTLY SINCE 2007

DUE TO **FACTORY PRODUCTION** IN CHINA'S PEARL RIVER DELTA^[5]

89% ELECTRICITY CONSUMPTION
IS FROM **THE BUILDINGS**^[6]



Hong Kong City, Hong Kong

Though a leading financial centre both in Asia and worldwide, minimal natural resources and a reliance on imported goods in Hong Kong, including energy, has put a focus on energy security and the long-term sustainability of the island nation.

As a Special Administrative Region of China, the country relies heavily on energy supply from the mainland, with 25% of its electricity imported.⁷ Low levels of domestic energy production means Hong Kong solely relies on fossil fuels for power, contributing to its large ecological footprint, one of the highest in the Asia-Pacific region. In fact, residents use 150 times the level of resources than the territory can provide, second only to Singapore.⁸ High levels of air and water pollution are the result of coal-

fired power stations and traffic, as well as the numerous factories that dot the neighbouring Pearl River Delta. As a result, a Clean Air Plan for Hong Kong was released in 2013, which outlined concrete policies, measures and plans to address these challenges.

Though leading globally in high-rise accommodation, there is still room for improvement, with building's consuming nearly 90% of the city's electricity, the majority of which is used for air conditioning. To tackle this, Hong Kong's Green Building Council launched HK3030 in 2012 with the target of encouraging the reduction of electricity consumption of buildings by 30% from 2005 by 2030⁹, while the nation's first Green Building Week took place in September 2013.

KEY FACTS

Country Population
7.1 million

Area
1,104 km²

Density
6866 people/km²

% of population in cities
100%



435 million
Number of houses



22%
Population in megacities
(over 1 million residents)



69
Motor vehicles
per 1000 people



3,298 kWh
Electric power
consumption per capita



6.2 mtCO₂
CO₂ emissions
per capita



15%
of total energy used
by residential sector

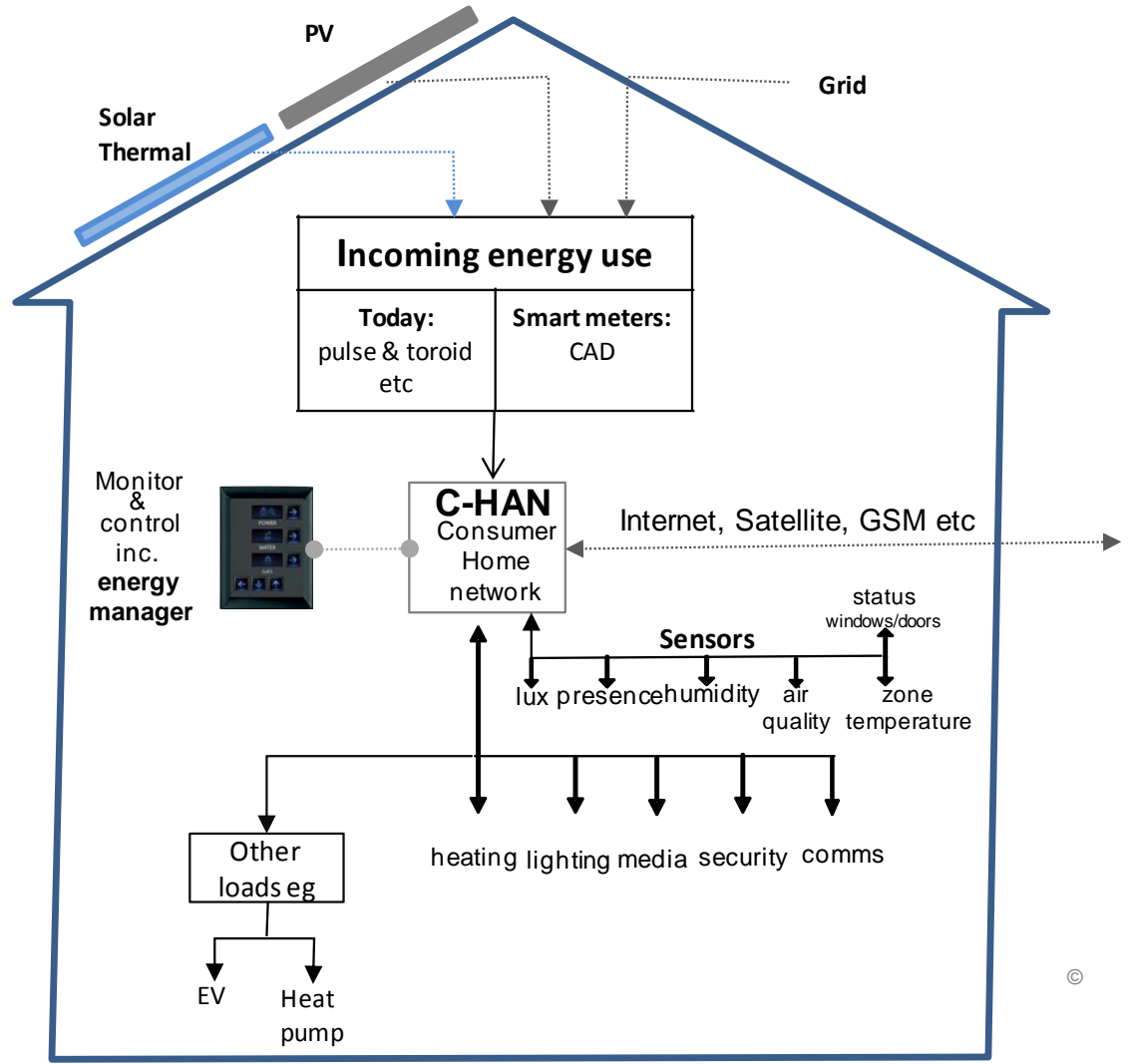
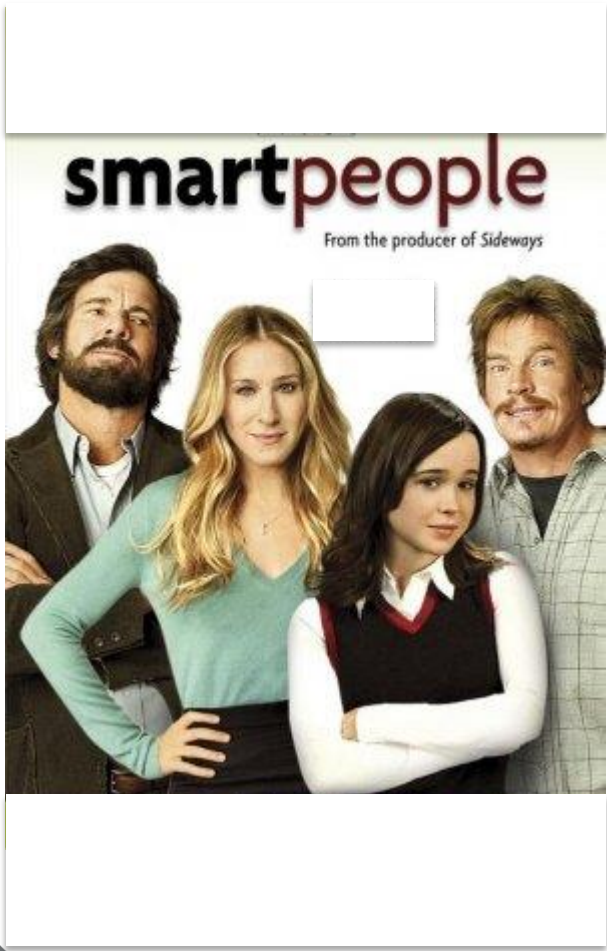


20.7%
Electricity generated
from renewables



-5°C to 38°C
Average temperature

SMART HOUSES



RESEARCH PROJECTS

The Road to Zero Carbon



Monitoring and Measurement

- Coheating
- Thermography
- Blower door / airtightness
- In situ u-values
- Energy supply measurement
- Photographic survey
- MVHR commissioning



THE LATEST HUB RESEARCH PROJECTS INCLUDE:

- The Performance Gap
- Overheating
- Ventilation
- Consumer Research



THE PERFORMANCE GAP

The Road to Zero Carbon

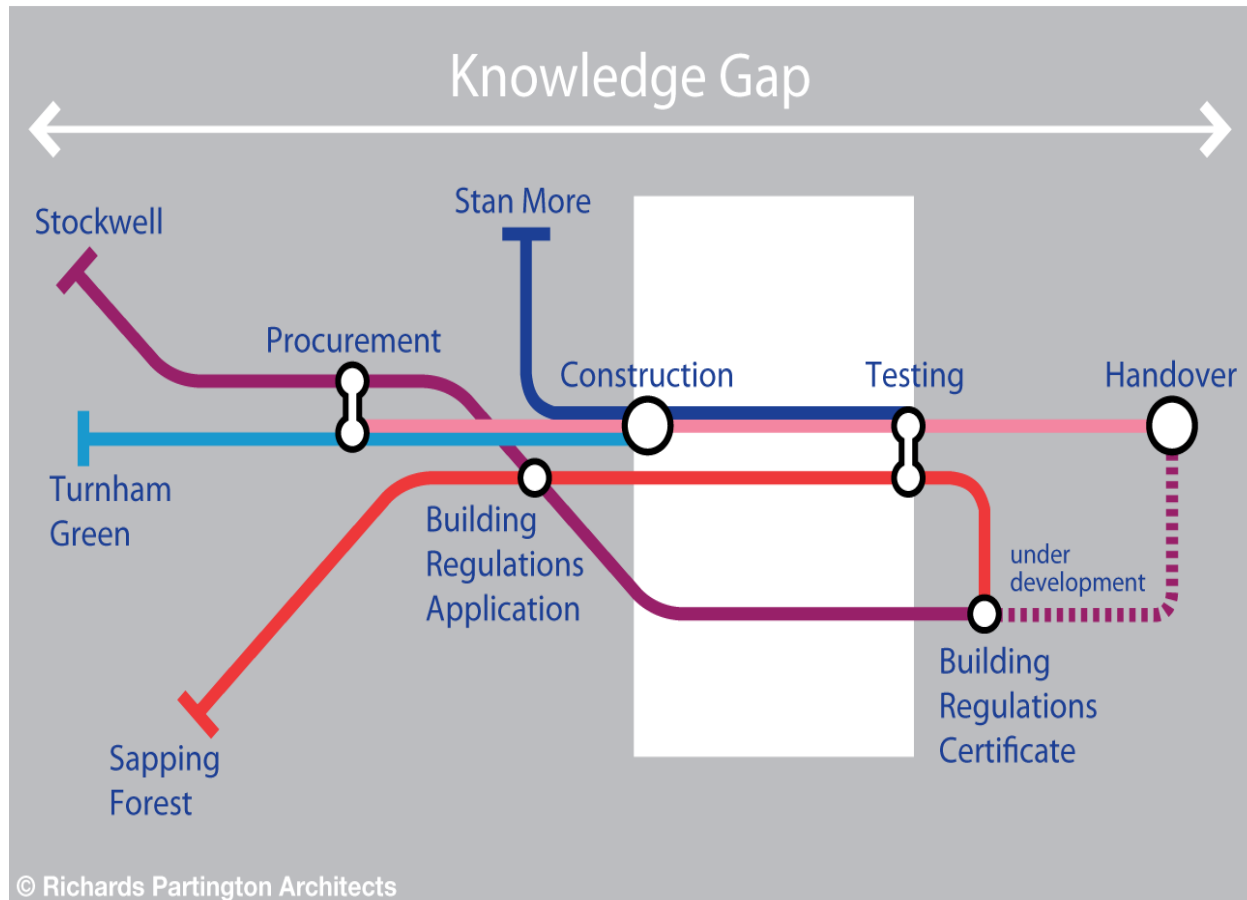


Ambition

Closing the performance gap – the 2020 ambition:

From 2020, be able to demonstrate
that at least 90% of all new homes
meet or perform better than the
designed energy/ carbon
performance

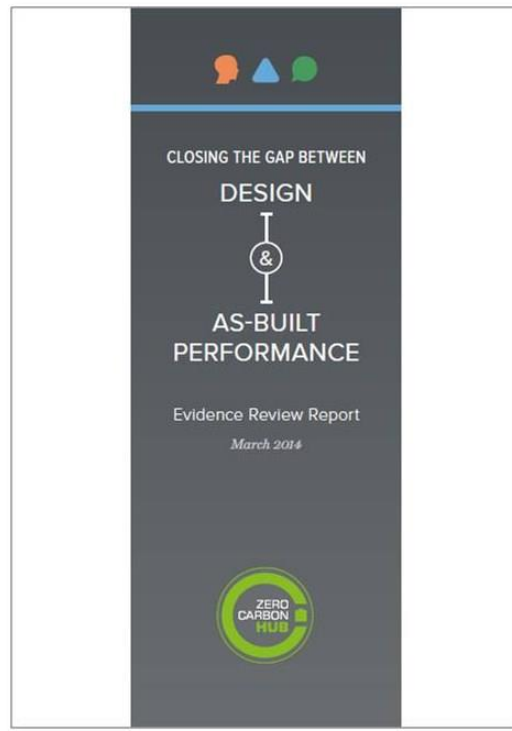
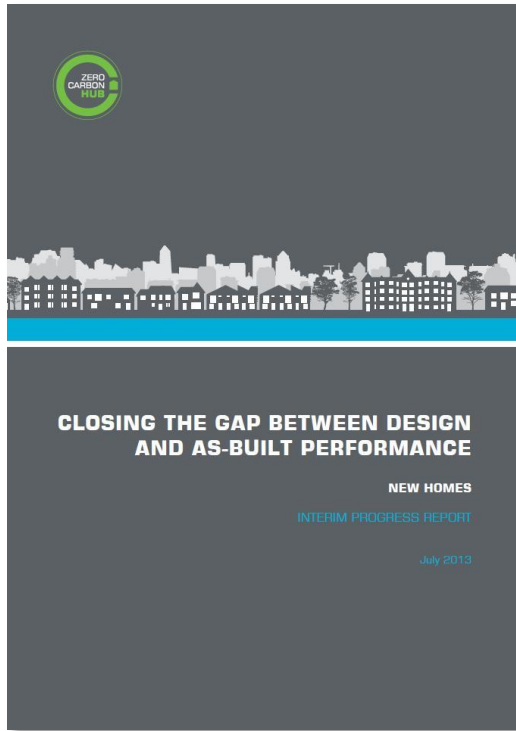
BUILDING PROCESS AND THE GAP



Key to lines

Designers
SAP Assessor
Manufacturer's Information
Sub Contractor Design
House Builder

The Journey so far



Prioritisation of issues



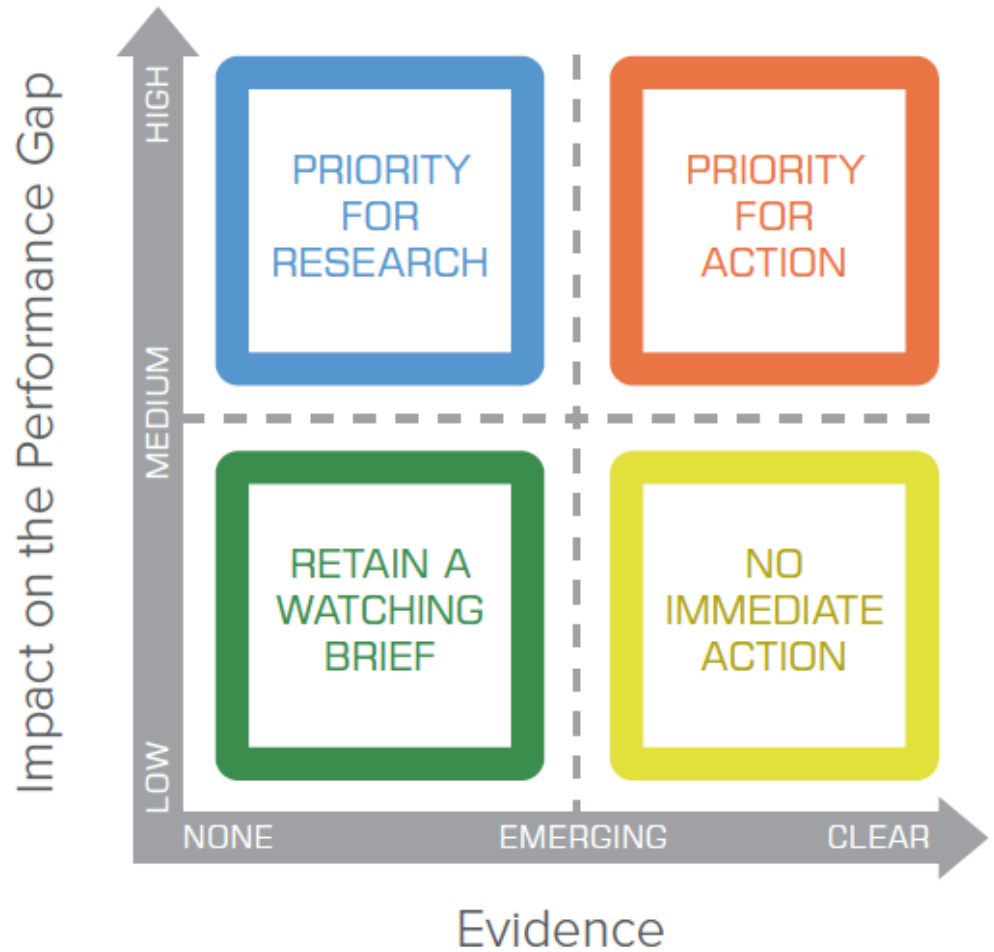
KNOWLEDGE & SKILLS



RESPONSIBILITY



COMMUNICATION



'End of Term' Report Recommendations

Industry

- Performance Assessment R&D
- Skills and Knowledge Development
- Construction Details Scheme
- Continued Evidence Gathering

Government

- Signal Clear Direction
- Stimulate Industry Investment
- Strengthen Compliance Regime
- Support Skills & Knowledge Development



OVERHEATING



The Road to Zero Carbon



Heat waves in context

○ Over **5000** people died in the UK of heat-related causes in the extreme heat wave of 2003

○ **31,100** excess winter deaths occurred in England and Wales in 2012/13 (ONS)

○ **Key point** - Summers as hot as 2003 could happen **every other year** by the year 2050 (Met Office)

Evidence gathering



Review
literature and
gather expert
opinion

Detailed
reviews and
create
definitions

New
monitoring
and testing
data


VENTILATION



The Road to Zero Carbon



INDOOR AIR QUALITY



Volatile Organic
Compounds
CO₂
High Humidity

CONSUMER RESEARCH

The Road to Zero Carbon



Helping the Consumer = Understanding them

Do our customers like
their Low Energy Homes?

Are they comfortable?

Are the controls easy
to use?



Thank you / 谢谢 / 謝謝

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