

Sut y gall cynllunio a
dylunio gyfrannu at fynd
i'r afael â materion
iechyd a llesiant a achosir
gan newid yn yr
hinsawdd?

Yr Athro Carolyn Hayles
Dylunio Amgylcheddol a Chynaliadwy ar gyfer yr
Amgylchedd Adeiledig
Ysgol Gelf a Dylunio Caerdydd
Prifysgol Metropolitan Caerdydd

How can planning and
design contribute to
addressing health and
wellbeing issues caused
by Climate Change?

Professor Carolyn Hayles
Chair of Environmental and Sustainable Design
for the Built Environment
Cardiff School of Art and Design
Cardiff Metropolitan University



Cyd-destun

- ❖ Cymrodoriaeth ymchwil hinsawdd sefydledig gyda Llywodraeth Cymru (2021 - 2022)
- ❖ Cyfuniad o'r wyddoniaeth a'r ymchwil sy'n bodoli eisoes
- ❖ Dealltwriaeth sylfaenol o sut mae safonau gorfodol a gwirfoddol presennol y diwydiant adeiladu yn mynd i'r afael â risg Newid yn yr Hinsawdd
- ❖ Deall pa mor eang ac effeithiol yw'r addasiadau Newid yn yr Hinsawdd sy'n cael eu defnyddio ar hyn o bryd ledled y DU
- ❖ Gwerthuso sut y gellir dod â setiau data sy'n ymwneud â'r hinsawdd a a'r rhai nad ydynt yn ymwneud â'r hinsawdd ynghyd i helpu i fapio'r risgiau a'r rhyngweithiadau

ADRODDIAD LLAWN AR GAEL YN:

[Resilience of buildings to challenges associated with climate change: report | GOV.WALES](#)

Context

- ❖ Embedded climate research fellowship with Welsh Government (2021 - 2022)
- ❖ Synthesis of existing science and research
- ❖ Baseline understanding of how existing mandatory and voluntary building industry standards address Climate Change risk
- ❖ Understand how widespread and effective the Climate Change adaptations currently being employed across the UK are
- ❖ Evaluate how climate and non-climate related data sets can be brought together to assist with mapping of risks and interactions

• FULL REPORT AVAILABLE AT:

- [Resilience of buildings to challenges associated with climate change: report | GOV.WALES](#)

Bwlch Tystiolaeth

Nid yw newid yn yr hinsawdd na'r angen i gynllunio ar gyfer senarios hinsawdd yn y dyfodol wedi'u hintegreiddio na'u cyflawni'n effeithiol ac yn gyson eto drwy bolisi adeiladu a rheoleiddio.

Mae'r ymarfer presennol wedi amlygu'r canlynol:

- ❖ **Diffyg** dylanwad sydd gan **dystiolaeth newid yn yr hinsawdd** ar bolisi a rheoliadau adeiladu cyfredol.
- ❖ **Prinder cyngor** ac **offer** i fynd i'r afael ag effaith amodau hinsoddol y dyfodol ar yr amgylchedd adeiledig.
- ❖ **Mae angen negeseuon cyson** ar addasu i newid yn yr hinsawdd a'i reoleiddio, yn enwedig o ran anheddau presennol.
- Un o'r pryderon a rennir wrth baratoi ar gyfer ac addasu i hinsawdd sy'n newid yw'r **canlyniadau anfwriadol** o ganolbwyntio ar un sbardunwr, er enghraifft effeithlonrwydd ynni (i leihau allyriadau carbon), dros un arall, e.e. iechyd a llesiant meddianwyr adeiladau.
- Mae angen ymagwedd **polisi cyfannol** o ddylunio, adeiladu a chynllunio i ddechrau ceisio datrys cymhlethdodau mynd i'r afael â newid yn yr hinsawdd.

Evidence Gap

Climate change and the need to plan for future climate scenarios, are yet to be effectively and consistently integrated or delivered through building policy and regulation.

- The current exercise has highlighted the:
 - ❖ **Lack of influence climate change evidence** has on current building policy and regulations.
 - ❖ **Shortage of advice** and **tools** to tackle the impact of future climatic conditions on the built environment.
 - ❖ **Need for consistent messaging** on and the regulation of climate change adaptation, particularly when it comes to existing dwellings.
- One of the shared concerns when preparing for and adapting to a changing climate is that of the **unintended consequences** of focussing on one driver, for example energy efficiency (to reduce carbon emissions), over another, e.g. the health and wellbeing of building occupants.
- A **holistic policy approach** to the design, build and planning process is needed to start addressing the complexities of tackling climate change.

Modelu Bregusrwydd yr Hinsawdd

mewn cydweithrediad â **Resilient Analytics**.

Bregusrwydd:

- ❖ Ansawdd yr Amgylchedd Dan Do
 - ❖ Cysur Thermol
 - ❖ Lleithder
- Adeiladwaith yr Adeiladau

Setiau data:

- ❖ Rhagamcanion UKCP18 Lleol (2.2km).
- ❖ Senario Allyriadau: RCP8.5
- ❖ Cyfnodau Amser:
 - ❖ 1981-2000 (Llinell Sylfaen)
 - ❖ 2021-2040 (2030)
 - ❖ 2061-2080 (2070)
- ❖ 12 model HadGEM3-GC3.05
- ❖ Cyflwynwyd 6 lleoliad

Climate Vulnerability Modelling

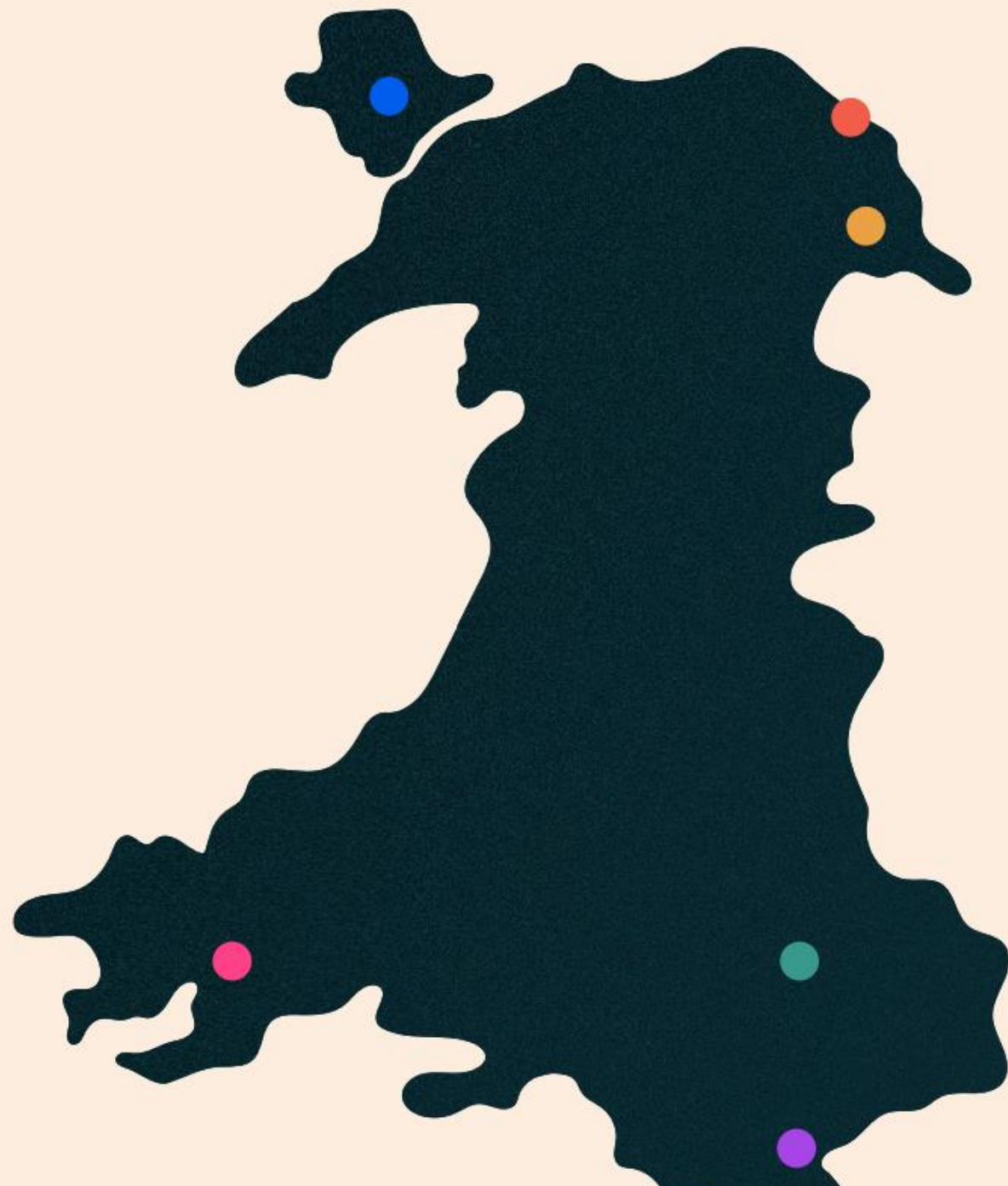
in collaboration with **Resilient Analytics**.

Vulnerabilities:

- ❖ Indoor Environmental Quality
 - ❖ Thermal Comfort
 - ❖ Moisture
- ❖ Building Fabric

Datasets:

- ❖ UKCP18 Local (2.2km) projections
- ❖ Emissions Scenario: RCP8.5
- ❖ Time Periods:
 - ❖ 1981-2000 (Baseline)
 - ❖ 2021-2040 (2030)
 - ❖ 2061-2080 (2070)
- ❖ 12 HadGEM3-GC3.05 models
- ❖ 6 locations presented



- Cardiff
- Narberth
- Wrexham
- Llangefni
- Brynmawr
- Shotton

Ansawdd yr Amgylchedd Dan Do

Cysur Thermol

Indoor Environmental Quality

Thermal Comfort

Methodoleg gyffredinol

Mewnbwn: Tymheredd cyfartalog dyddiol y tu allan

Allbwn: Tymheredd cyfartalog dyddiol dan do, tymheredd uchaf dyddiol dan do, a thymheredd dan do fesul awr

Perthynas yn deillio [addasiad °C] o astudiaeth fonitro yn y DU o 193 o anheddau [Beizaee et al. 2013]

Cyfnod o 6 wythnos [22 Gorffennaf-31 Awst]

Building classes		Adjustment (°C) Add to calculate internal temperature	
		Mean	Maximum
Age	Pre 1919	-1.0	-1.8
	1919-1990	0.1	0.2
	Post 1990	0.8	0.8
Building construction	Timber framed	0.0	-0.3
	Solid stone	-1.6	-2.1
	Solid and cavity brick	0.0	0.2
Dwelling type	End and mid terrace, semi detached	0.1	0.2
	Detached	-0.4	-0.4
	Flat	0.7	0.8
Insulation	Internal wall insulation	0.4	0.6
Window	Double glazing (pre 1919)	-0.4(-1.4)	-0.6(-2.4)

General methodology

Input: Daily average outdoor temperature

Output: Daily average indoor, daily maximum indoor, and hourly indoor temperatures

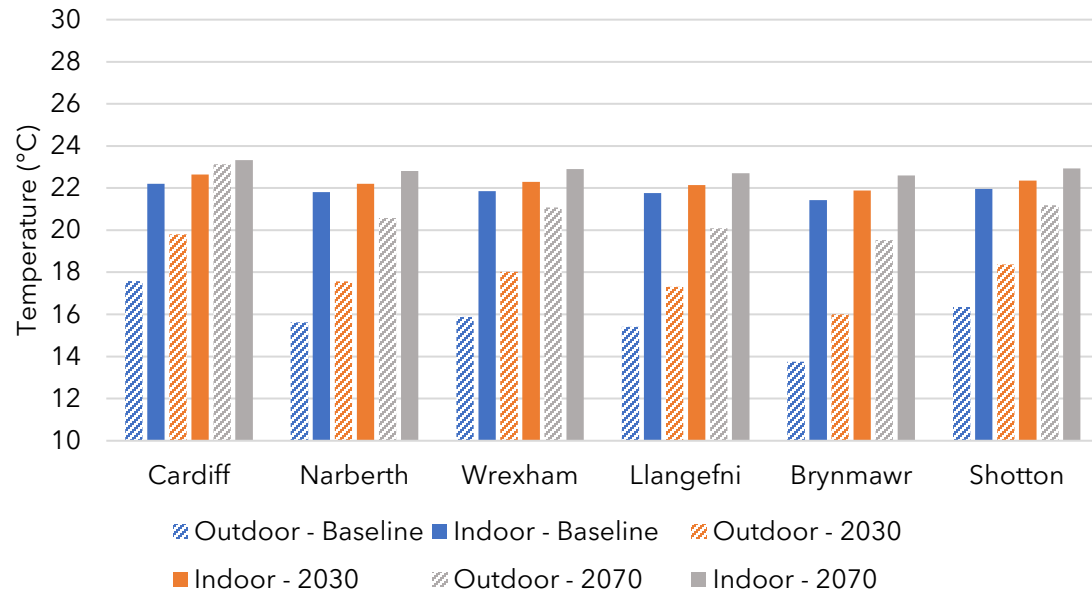
Relationship derived [°C adjustment] from a UK-based monitoring study of 193 dwellings [Beizaee et al. 2013]

6-week period [22 July-31 August]

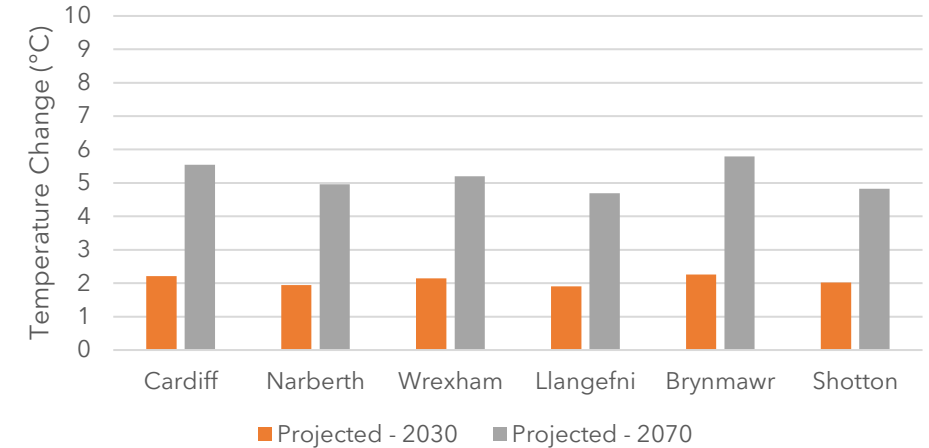
Tymheredd Cyfartalog

Average Temperature

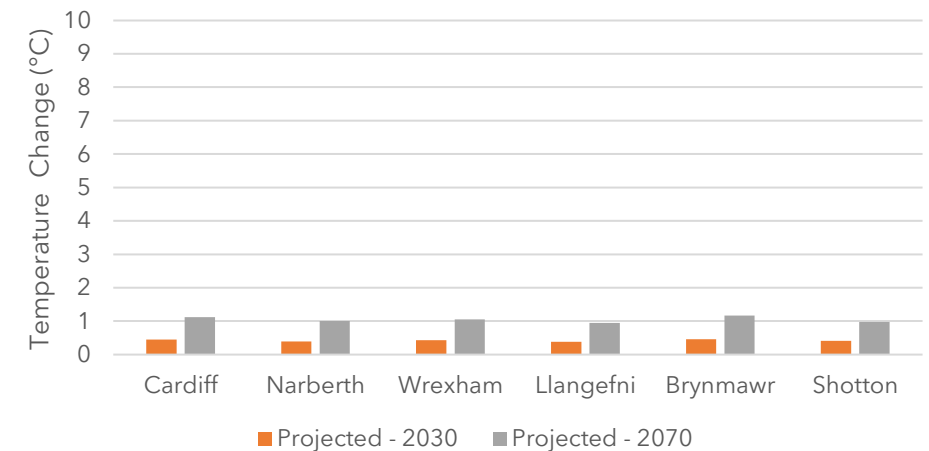
Average Temp
22-July thru 31-Aug



Average Outdoor Temp
Change from Baseline
22-July thru 31-Aug

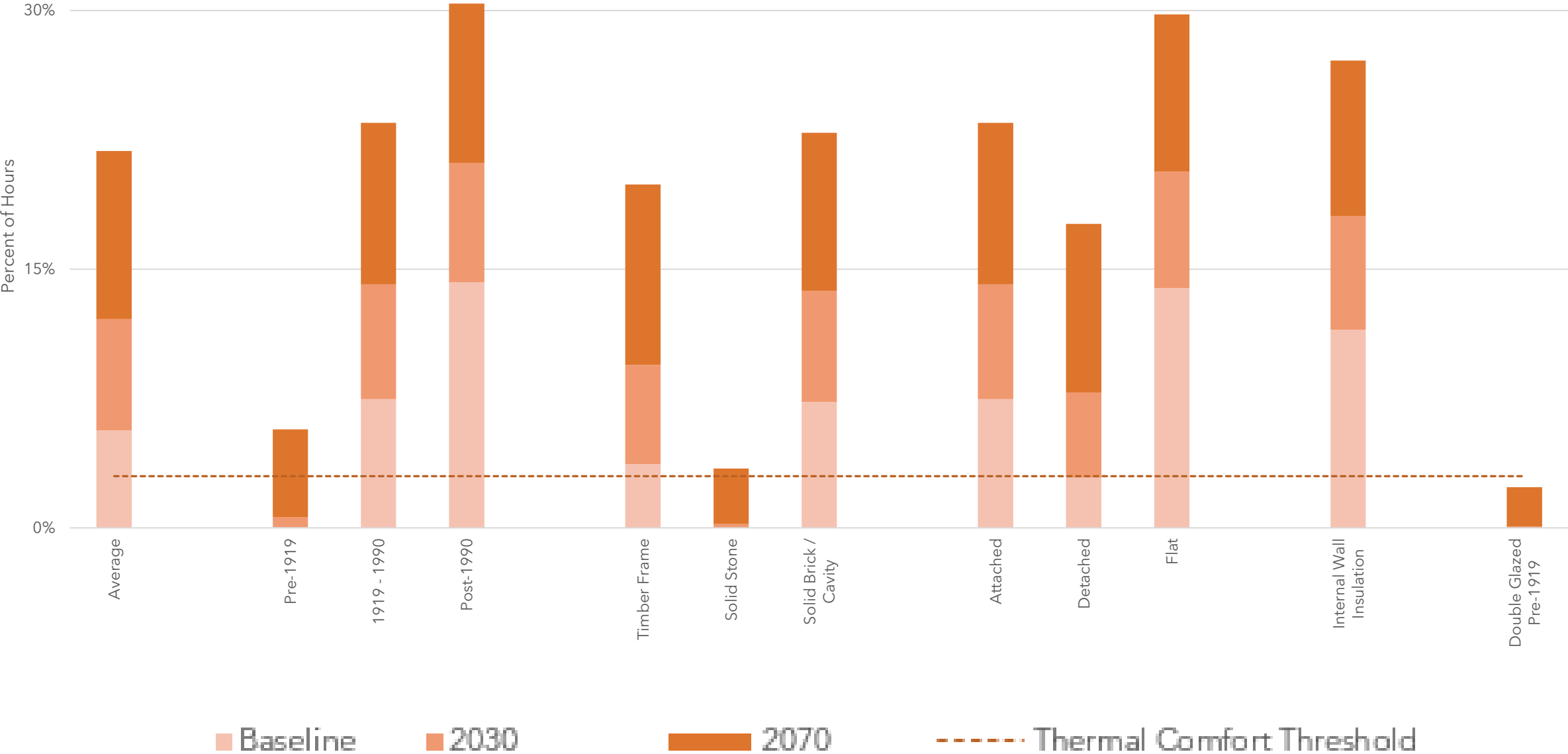


Average Indoor Temp
Change from Baseline
22-July thru 31-Aug



Canran yr Oriau dros 26°C
22 Gorffennaf - 31 Awst
Caerdydd

Percent of Hours over 26°C
July 22nd - August 31st
Cardiff



Canran yr Oriau dros 26°C
22 Gorffennaf - 31 Awst

Percent of Hours over 26°C
July 22nd - August 31st

Cardiff

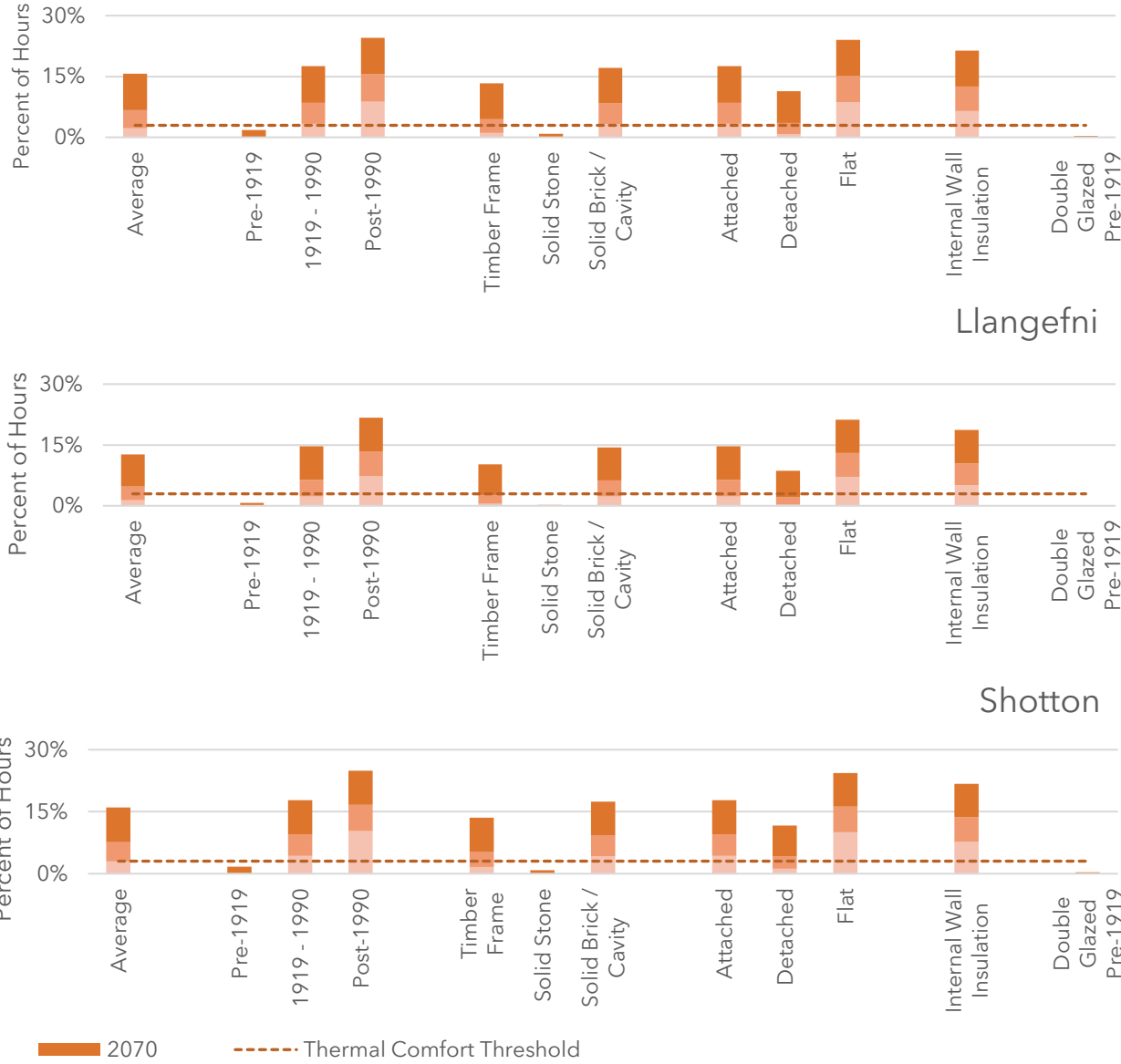
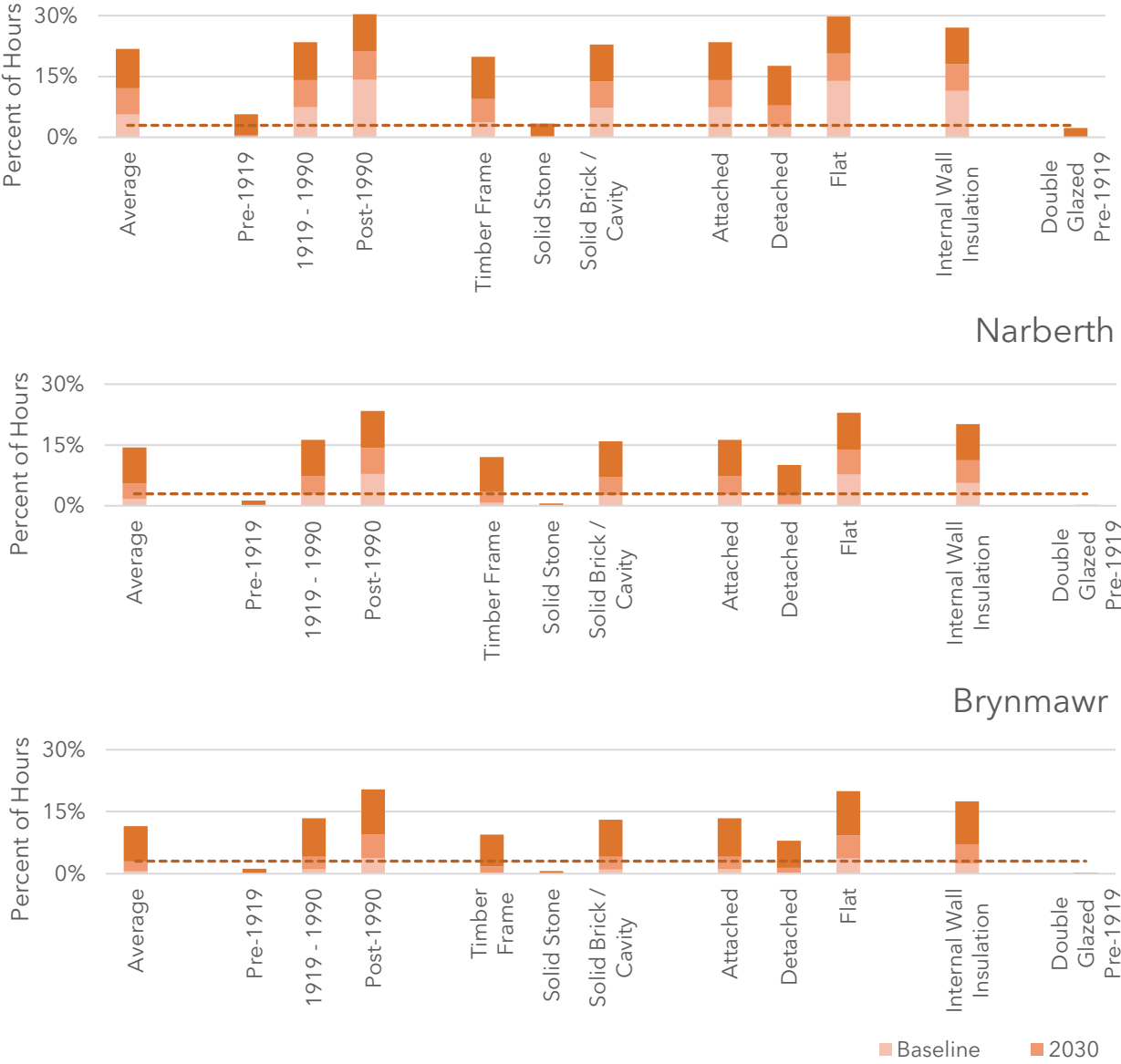
Wrexham

Narberth

Llangefni

Brynmawr

Shotton



Crynodeb o'r canlyniadau ar gyfer Cysur Thermol

Cynnydd yn y nifer o achosion o orboethi yn ystod yr haf yn y rhan fwyaf o anheddau

- ❖ Yr anheddau a berfformiodd orau oedd anheddau a adeiladwyd cyn 1919 ac anheddau sydd â waliau cerrig solet.
- ❖ Yr anheddau a berfformiodd waethaf oedd yr anheddau, y fflatiau a'r eiddo a adeiladwyd ar ôl 1990 ag iddynt waliau mewnol wedi'u hinswleiddio
- ❖ Bydd angen mwy a mwy o strategaethau oeri i leihau tymheredd yr aer dan do.



Summary of results for Thermal Comfort

Increased incidences of summertime overheating in a majority of dwellings

- ❖ Best performing dwellings were pre 1919 dwellings and dwellings with solid stone walls.
- ❖ Poorest performing dwellings were post 1990 dwellings, flats and properties with internal wall insulation.
- ❖ Cooling strategies to reduce indoor air temperature will increasingly be required.

Ansawdd yr Amgylchedd Dan Do

Lleithder Cymharol

Cyfrifiadau Bregusrwydd

Defnyddir lleithder cymharol uchaf a chyfartalog fel dangosydd ar gyfer metrigau lluosog ar gyfer ansawdd aer dan do

Methodoleg gyffredinol

Mewnbyn: lleithder penodol y tu allan - cyfartaledd dyddiol

Allbyn: lleithder cymharol dan do - uchafswm dyddiol

Perthynas yn deillio o astudiaeth fonitro fyd-eang o 6 lleoliad

$$SH_i = SH_o * 0.752 + 2.186$$

Indoor Environmental Quality

Relative Humidity

Vulnerability Calculations

Maximum and **average** relative humidity used as an indicator for multiple indoor air quality metrics

General methodology

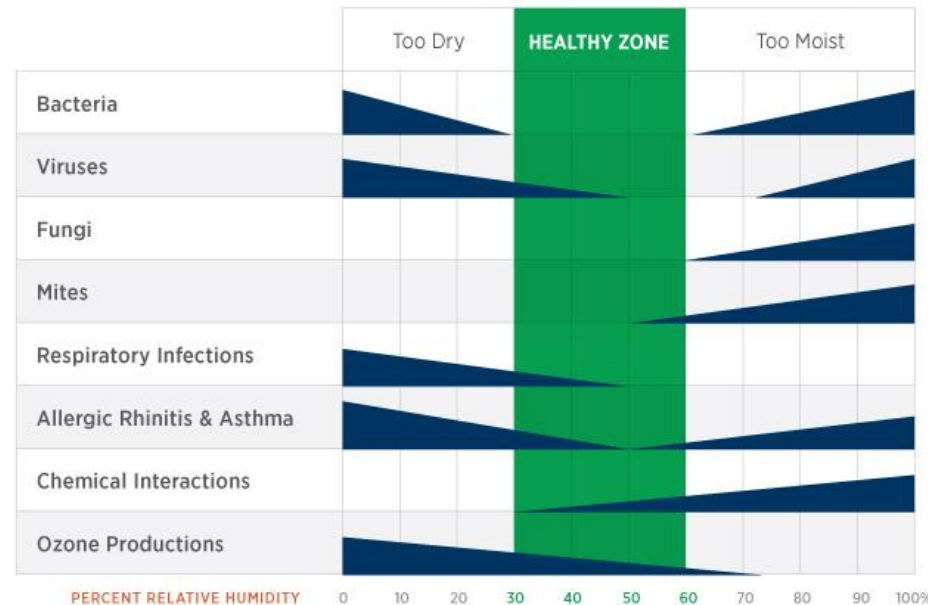
Input: daily average outdoor specific humidity

Output: daily maximum indoor relative humidity

Relationship derived from a global monitoring study of 6 locations

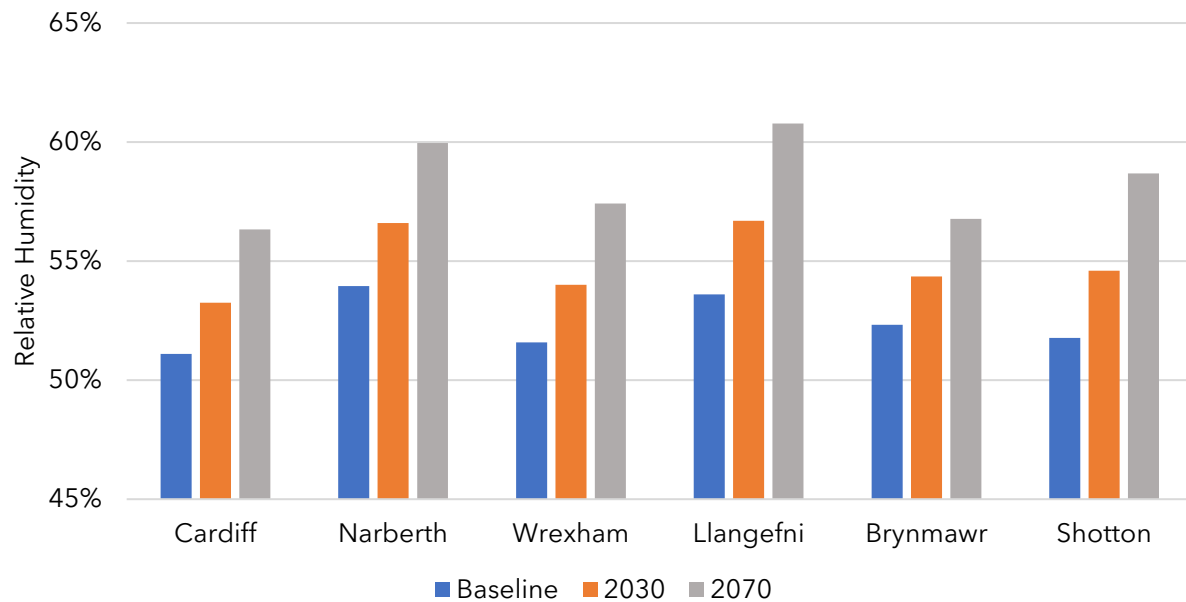
$$SH_i = SH_o * 0.752 + 2.186$$

Optimum relative humidity range for human comfort and health
(a decrease in bar height indicates a decrease in effect for each of the items)



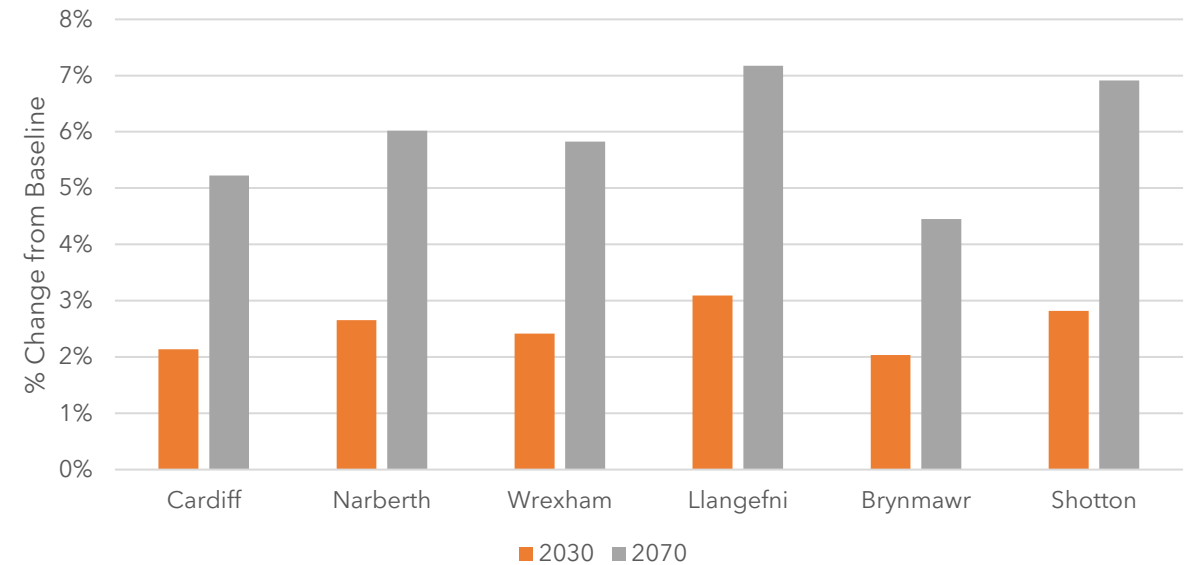
Lleithder Cymharol Cyfartalog Dan Do

Average Daily Relative Humidity
July 22nd - August 31st



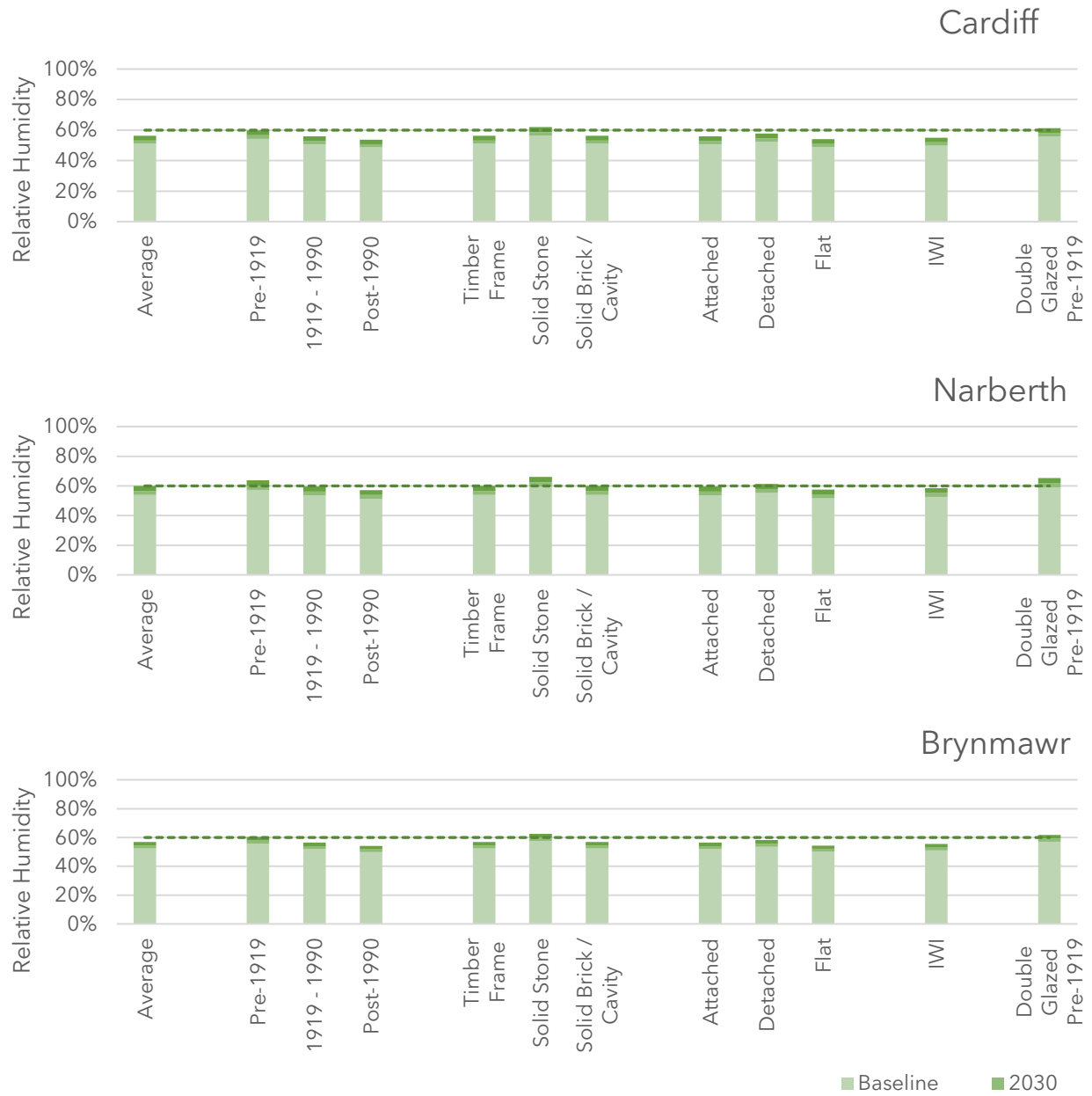
Average Indoor Relative Humidity

Average Daily Relative Humidity
Change from Baseline
July 22nd - August 31st



Lleithder Cymharol Dyddiol **Cyfartalog**

Y cyfartaledd ar gyfer 22 Gorffennaf - 31 Awst

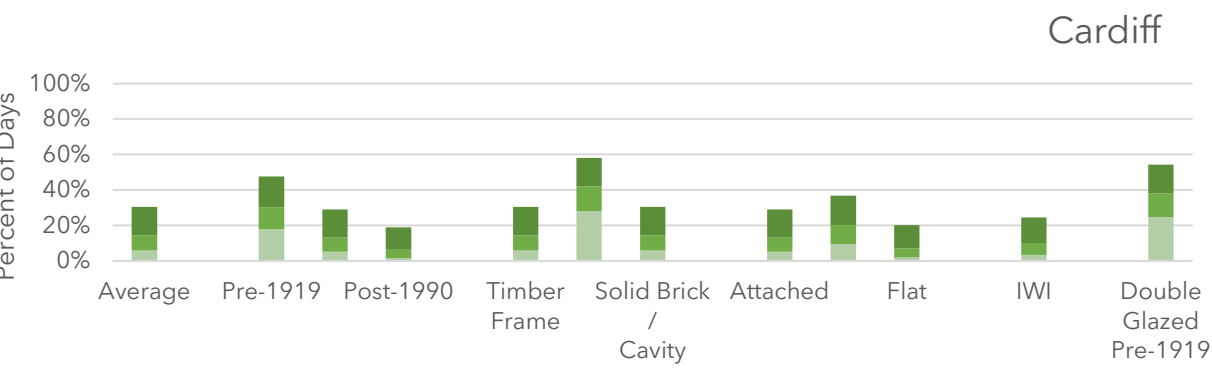


Daily **Average** Relative Humidity

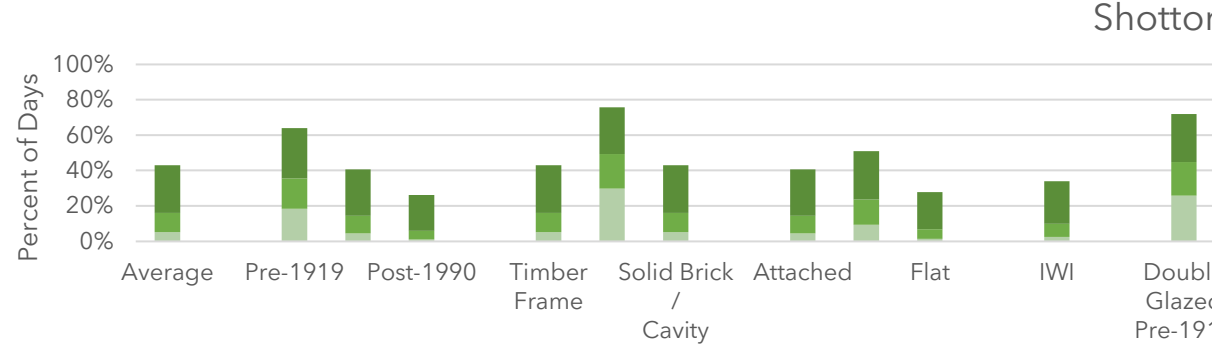
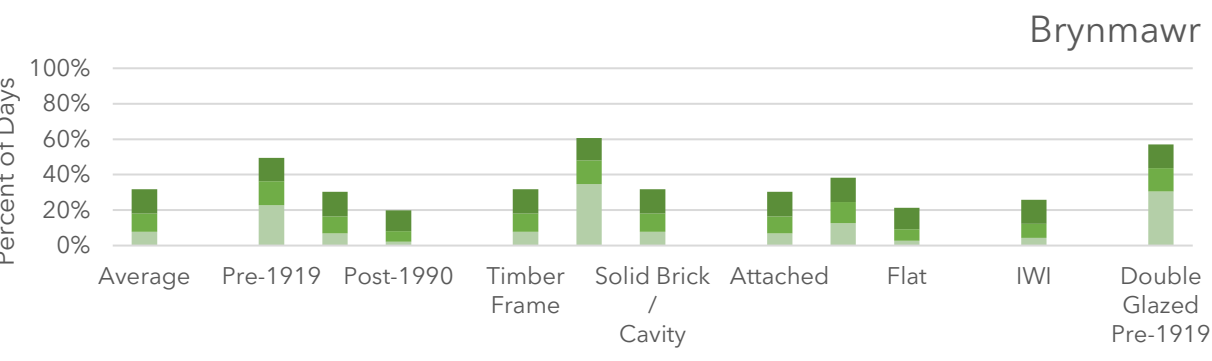
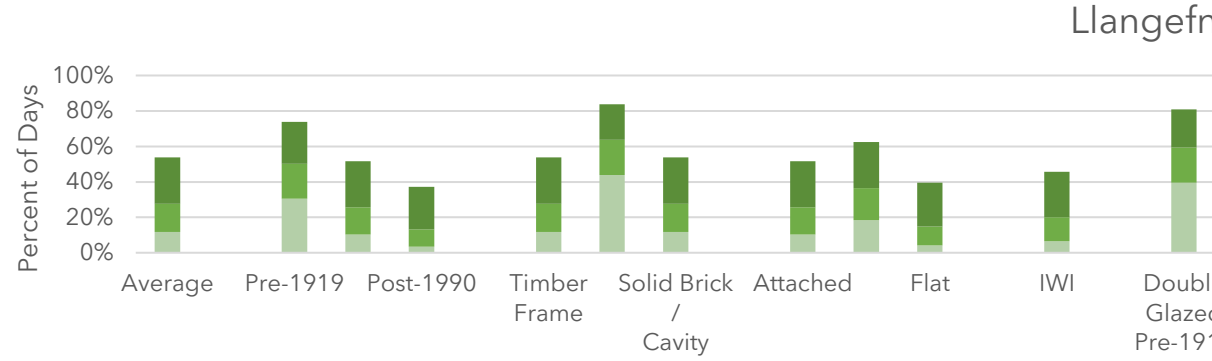
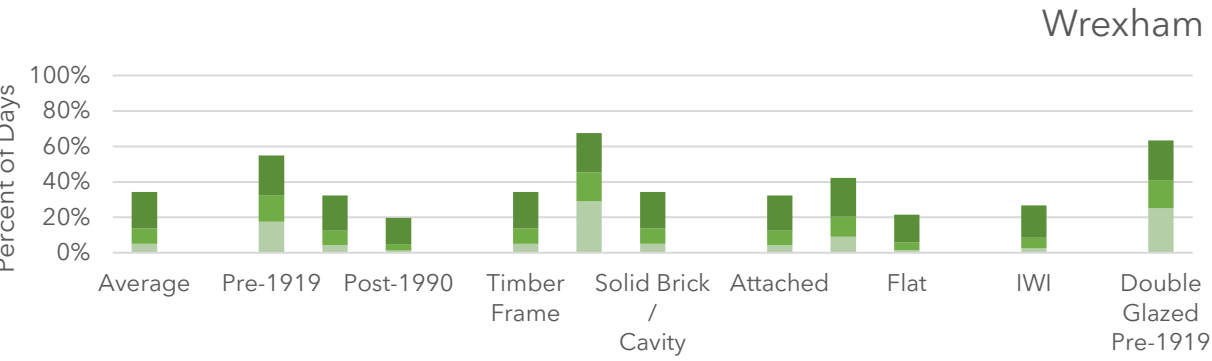
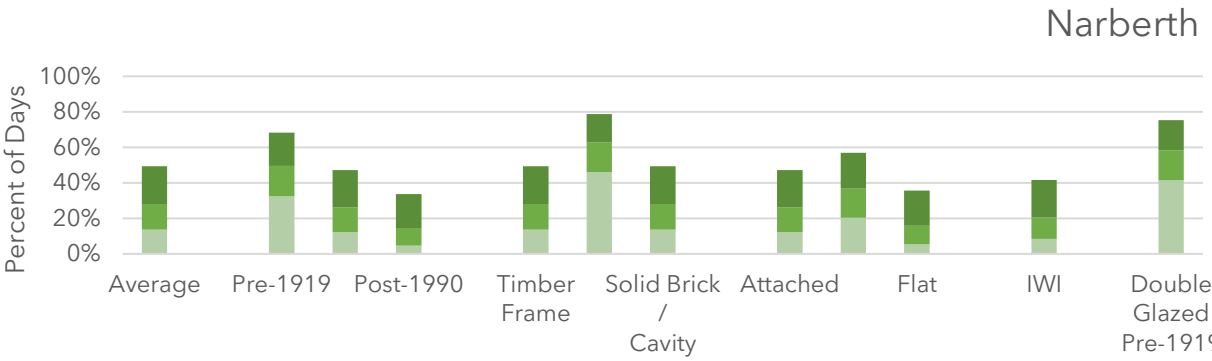
Average for July 22nd - August 31st



% y Dyddiau pan oedd Lleithder Cymharol **Cyfartalog**
Mwy na 60%
Y cyfartaledd ar gyfer 22 Gorffennaf - 31 Awst



% of Days with **Average** Relative Humidity
Greater than 60%
Average for July 22nd - August 31st



Baseline 2030 2070

% y Dyddiau pan oedd Lleithder Cymharol

Cyfartalog

Mwy na 60%

Y cyfartaledd ar gyfer 22 Gorffennaf - 31 Awst

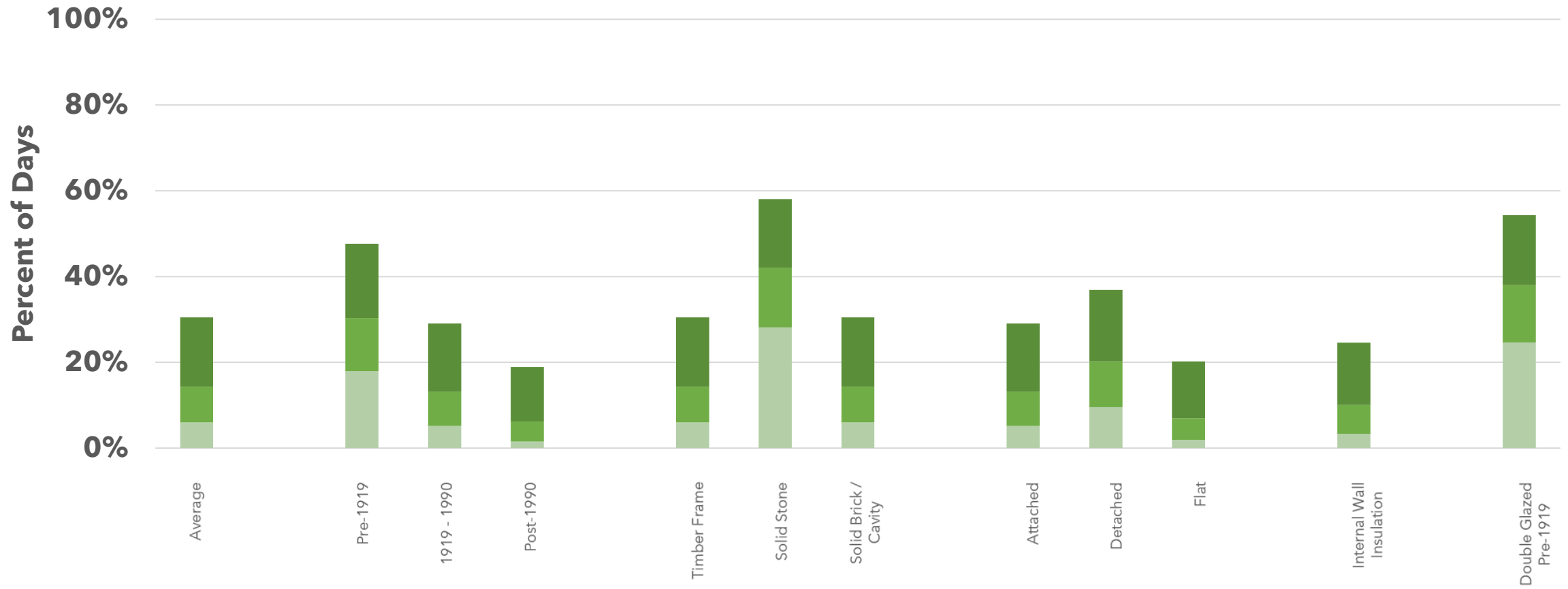
% of Days with **Average** Relative

Humidity

Greater than 60%

Average for July 22nd - August 31st

Cardiff/Caerdydd



Crynodeb o'r canlyniadau ar gyfer ansawdd yr amgylchedd dan do

Summary of results for Indoor environmental quality

Potensial ar gyfer ansawdd gwaeth yn yr amgylchedd dan do [yn yr haf] oherwydd cynnydd mewn lleithder cymharol.

- ❖ Bydd pob annedd yn gweld cynnydd mewn lleithder cymharol ni waeth beth fo'r math o annedd.
- ❖ Bydd y lleithder cymharol ar ei uchaf mewn anheddau a adeiladwyd cyn 1919 ac anheddau sydd â waliau cerrig solet ni waeth beth fo'u lleoliad.
- ❖ Mae angen strategaethau awyru i wella tynnu aer llawn lleithder [a llygryddion a gynhyrchir dan do] er mwyn i'r anheddau hyn osgoi mwy o achosion o anwedd, lleithder a thyfiant llwydni, ac effeithiau andwyol alergenau, gronynnau a llygryddion eraill.

Potential for poorer indoor environmental quality [in the summer] due to an increase relative humidity.

- ❖ All dwellings will experience increases in relative humidity regardless of dwelling typology.
- ❖ Relative humidity will be highest in pre 1919 dwellings and dwellings with solid stone walls regardless of location.
- ❖ Ventilation strategies to improve the extraction of moisture-laden air [and indoor-generated pollutants] are required if these dwellings are to avoid increased incidences of condensation, damp, and mould growth, and adverse impacts from other allergens, particles and pollutants.

Optimum relative humidity range for human comfort and health
(a decrease in bar height indicates a decrease in effect for each of the items)



Adeiladwaith yr Adeiladau

Cyfrifwyd bregusrwydd adeiladwaith yr adeiladau gan ddefnyddio data oes gwasanaeth.

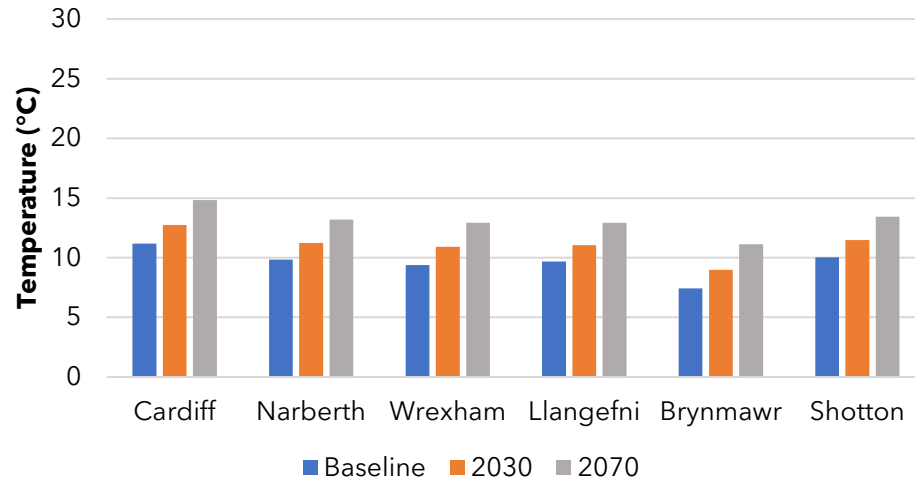
Cyflwynir oes gwasanaeth wedi'i addasu [a chostau cysylltiedig] ar gyfer newidynnau hinsawdd unigol fel allbwn mesuradwy a chyfrifadwy.

Building Fabric

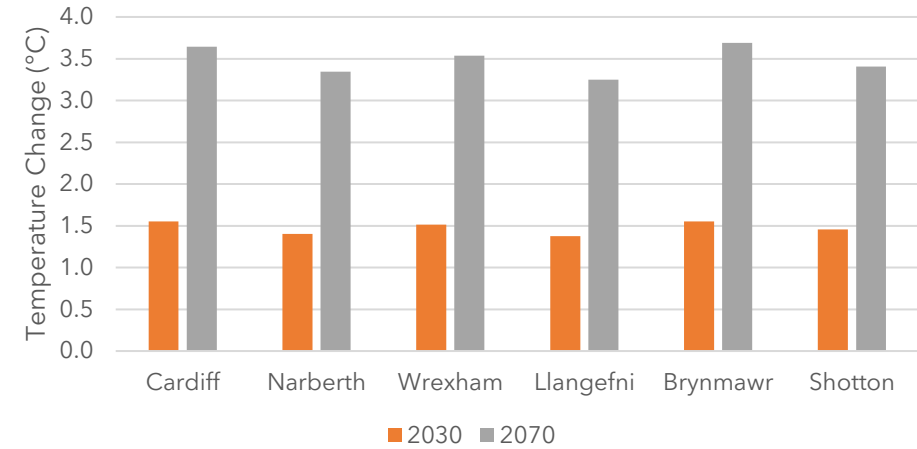
Building fabric vulnerabilities were calculated using **service life data**

adjusted service lives [and associated costs] are presented for individual climate variables as a measurable and quantifiable output.

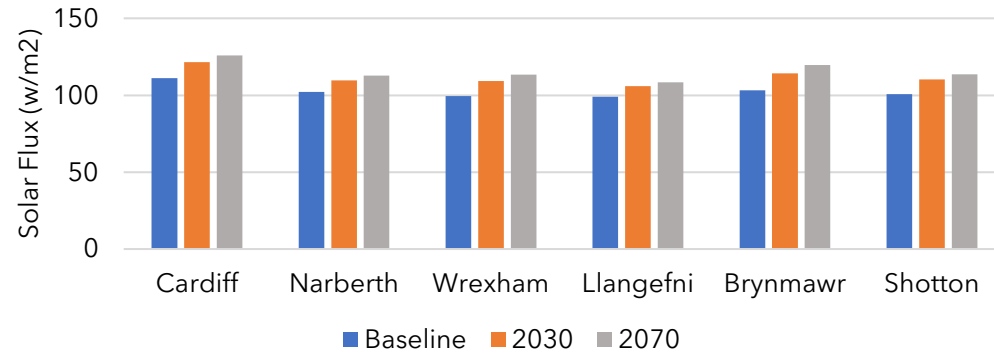
Average Daily Outdoor Temperature
1-Jan thru 31-Dec



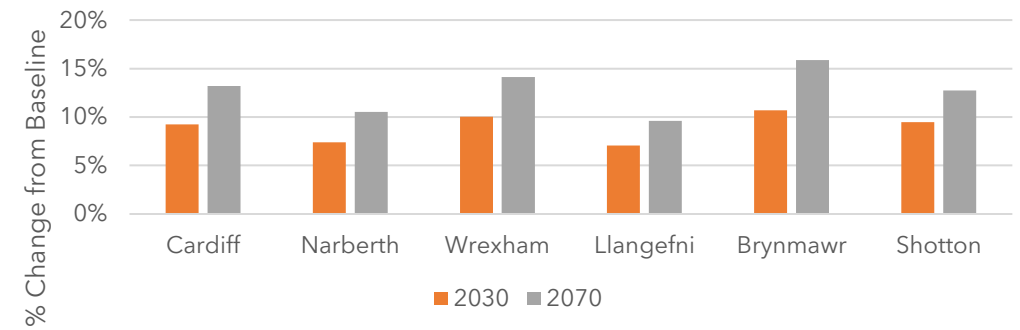
Average Outdoor Temp
Change from Baseline
January 1st - December 31st



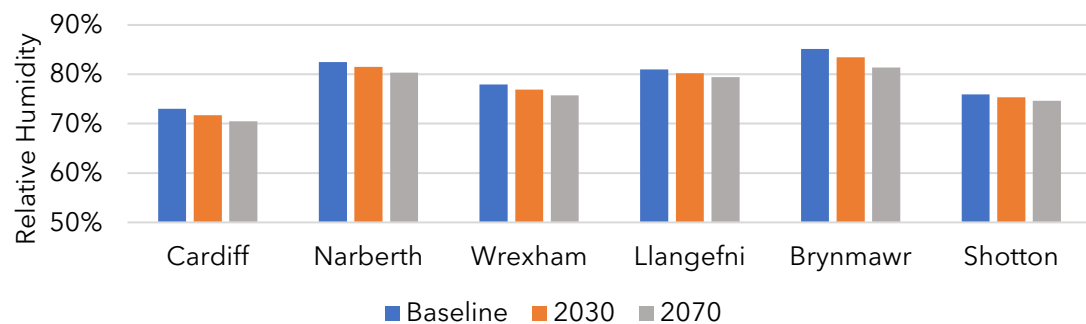
Average Daily Solar Flux
January 1st - December 31st



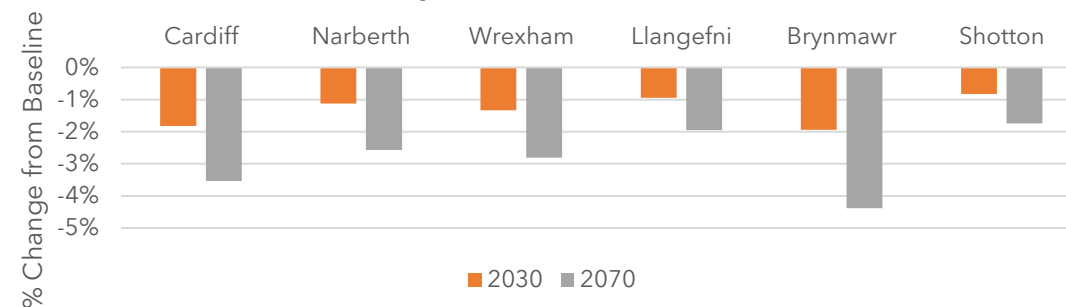
Average Daily Solar Flux
Change from Baseline
January 1st - December 31st



Average Daily Relative Humidity
January 1st - December 31st

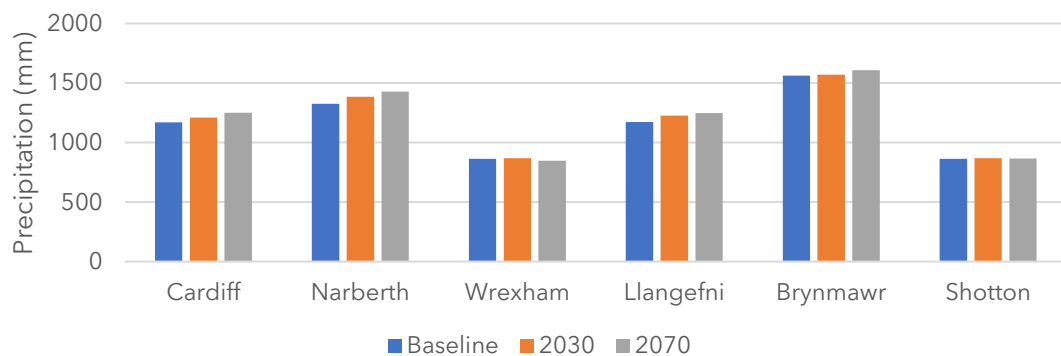


Average Daily Relative Humidity
Change from Baseline
January 1st - December 31st

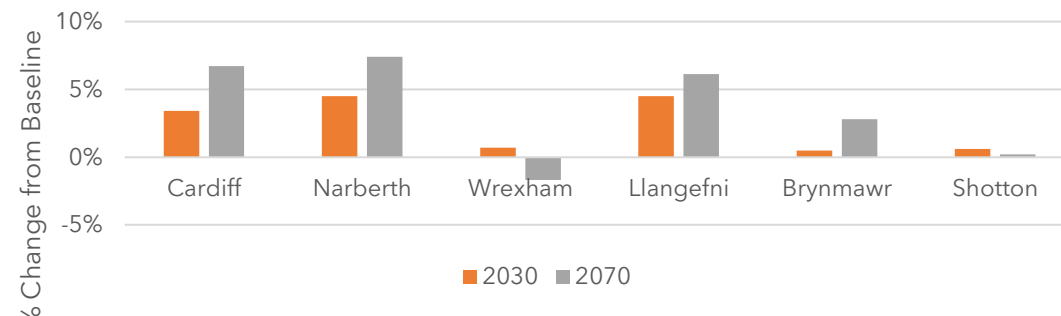


Because warm air can carry more moisture than cold air, the **relative humidity** level will be higher in cold air and **lower** in **warm** air at the same absolute **humidity** level.

Average Annual Precipitation
January 1st - December 31st



Average Annual Precipitation
Change from Baseline
January 1st - December 31st



Y Fethodoleg

- Cyfrifwyd **ffactorau oes gwasanaeth wedi'u haddasu** yn seiliedig ar amlygiad i bob newidyn hinsawdd, wedi'i fesur fel y newid o'r llinell sylfaen, ar gyfer pob cydran o adeiladwaith yr adeiladau [Fel yr amlinellwyd yng ngweithdrefn Dull Ffactor ISO 15686].
- Cymhwyswyd ffactorau i werthoedd oes gwasanaeth llinell sylfaen i ddod o hyd i'r oes gwasanaeth wedi'i addasu o dan amodau hinsawdd rhagamcanol [fel y cyhoeddwyd yn Safon Brydeinig 7543].
- Cyfrifwyd tri oes gwasanaeth wedi'u haddasu ar wahân, un ar gyfer pob newidyn hinsawdd, a ddefnyddiwyd wedyn i gyfrifo'r **newid canrannol mewn costau cynnal a chadw a/neu adnewyddu** ar gyfer pob cydran adeiladu.
- Mae'r dadansoddiad o adeiladwaith yr adeiladau wedi'i rannu'n dri gwerthusiad ar wahân o'r bregusrwydd o amlygiad solar, o leithder cymharol a dyddodiad.
- Ni ellid cyfuno ffactorau hinsawdd gan fod data dirywiad ar gael ar gyfer pob newidyn hinsawdd yn gweithredu'n annibynnol yn unig.

Methodology

- **Adjusted service life factors** were calculated based on exposure to each climate variable, quantified as the change from baseline, for each building fabric component [As outlined in the ISO 15686 Factor Method procedure].
- Factors were applied to baseline service life values to find the adjusted service life under projected climate conditions [as published in the British Standard 7543].
- Three separate adjusted service lives were calculated, one for each climate variable, which were then used to calculate the **percent change in maintenance and/or replacement costs** for each building component.
- The building fabric analysis is broken into **three separate evaluations of vulnerability** from solar exposure, from relative humidity and from precipitation.
- Climate factors could not be combined since degradation data was only available for each climate variable acting independently.

Caerdydd

Cardiff

Building Fabric Degradation Results for: Cardiff													
Material / Component	Solar Flux	Relative Humidity	Precipitation	Forecast Level of Deterioration	Baseline Service Life	Adjusted Service Life				Change from Baseline Cost			
						Solar Flux	Relative Humidity	Precipitation	Average	Solar Flux	Relative Humidity	Precipitation	Average
2030													
Roof Tiles (clay/slate/concrete)	High	Low	High	Moderate	30	28.1	31.1	29.7	29.6	6.7%	-3.6%	1.1%	1.4%
Walls (brick/stone)		Low	High	Moderate	70		72.6	69.3	70.9		-3.6%	1.1%	-1.2%
Render & Mortar (lime/cement)	High	Low	High	Moderate	50	46.9	51.8	49.5	49.4	6.7%	-3.6%	1.1%	1.4%
Masonry Paint	High	Low	High	Moderate	20	18.8	20.7	19.8	19.8	6.7%	-3.6%	1.1%	1.4%
Window & Door Frames	High		High	Severe	20	18.8		19.8	19.3	6.7%		1.1%	3.9%
2070													
Roof Tiles (clay/slate/concrete)	High	Low	High	Moderate	30	28.1	31.3	29.4	29.6	6.7%	-4.3%	2.1%	1.5%
Walls (brick/stone)		Low	High	Moderate	70		73.1	68.5	70.8		-4.3%	2.1%	-1.1%
Render & Mortar (lime/cement)	High	Low	High	Moderate	50	46.9	52.2	49.0	49.4	6.7%	-4.3%	2.1%	1.5%
Masonry Paint	High	Low	High	Moderate	20	18.8	20.9	19.6	19.7	6.7%	-4.3%	2.1%	1.5%
Window & Door Frames	High		High	Severe	20	18.8		19.6	19.2	6.7%		2.1%	4.4%

Crynodeb o'r canlyniadau ar gyfer adeiladwaith yr adeiladau

- ❖ Nid yw pob newidyn hinsawdd yn effeithio ar bob deunydd/cydran adeiladu.
- ❖ Gall newidynnau hinsawdd eraill gael effeithiau andwyol, gan gynnwys gwyntoedd eithafol, cawodydd dwys o law a digwyddiadau cysylltiedig megis llifogydd.
- ❖ Gellir defnyddio'r canlyniadau hynBydd cyfeiriadaeth yr adeiladau yn effeithio ar oes gwasanaeth wedi'i addasu, pa mor aml fydd angen gwneud gwaith atgyweirio a chynnal a chadw, ac fe fydd hyn yn newid y gost sylfaenol.
- ❖ ar y cyd â'n gwybodaeth a'n dealltwriaeth o berfformiad adeiladwaith yr adeiladau [a mecanweithiau dirywiad] i lywio pa mor aml fydd angen gwneud gwaith atgyweirio a chynnal a chadw yn well i leihau difrod pellach

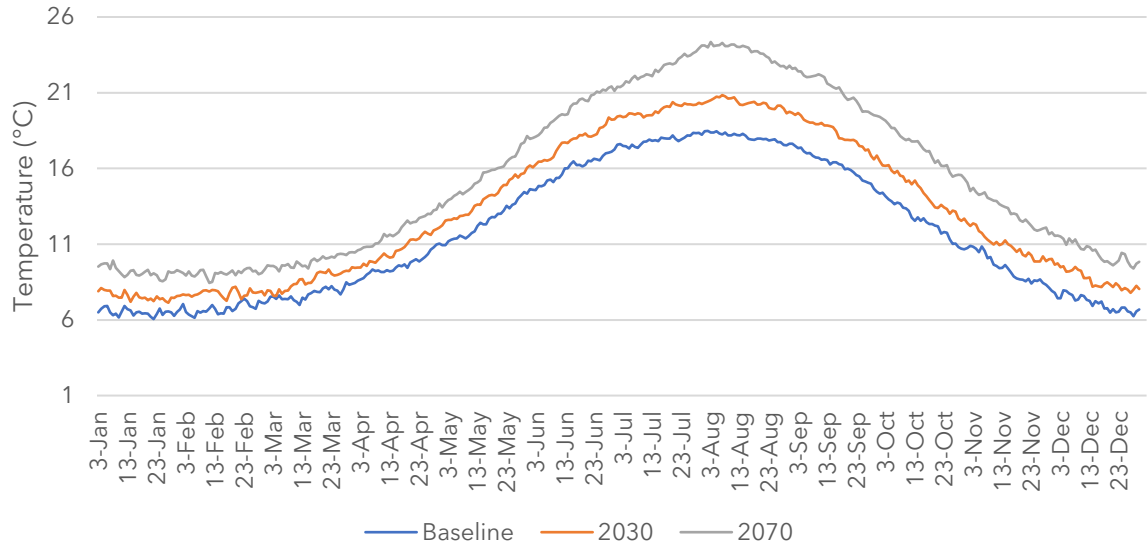
Summary of results for building fabric

- ❖ Not every building material/component is impacted by every climate variable.
- ❖ Other climate variables may have detrimental affects, including extreme winds, concentrated downpours and associated events such as flooding.
- ❖ Building orientation will impact on adjusted service life, frequency of repair and maintenance, and thus change from baseline cost.
- ❖ These results can be used in combination with our knowledge and understanding of building fabric performance [and deterioration mechanisms] to better inform frequency of repair and maintenance to mitigate further damage.

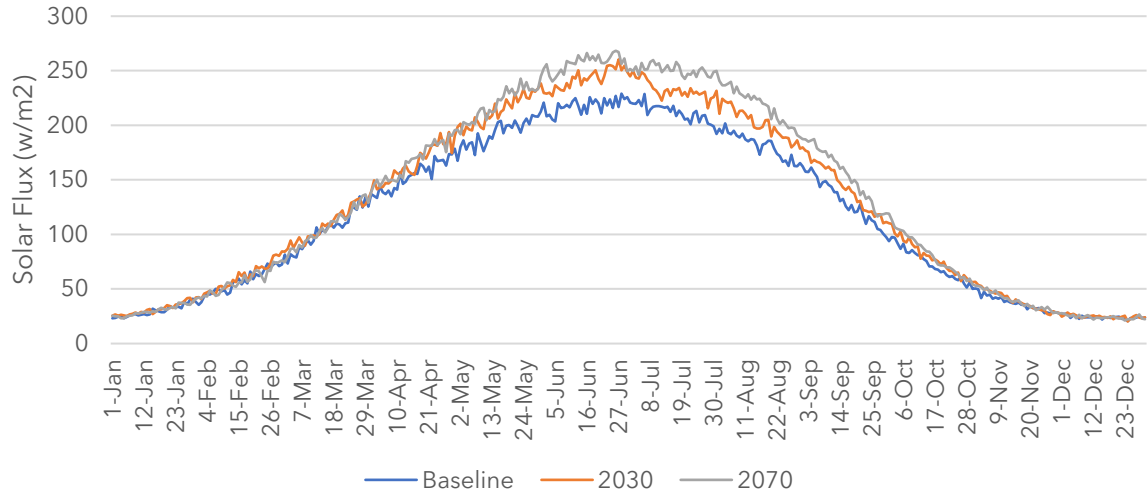
Cymhwyso - sut rydyn ni'n cymhwyso'r wybodaeth hon i'r hyn rydyn ni'n ei wybod eisoes?

Tueddiadau hinsawdd Caerdydd, bregusrwydd a ragwelir a mecanweithiau dirywiad hysbys

Daily Average Temperature



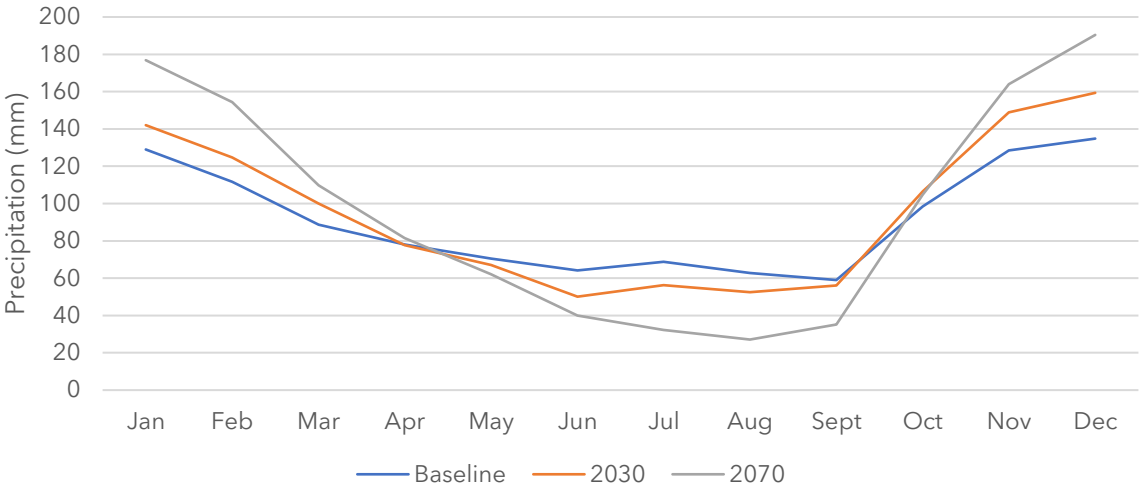
Daily Average Solar Flux



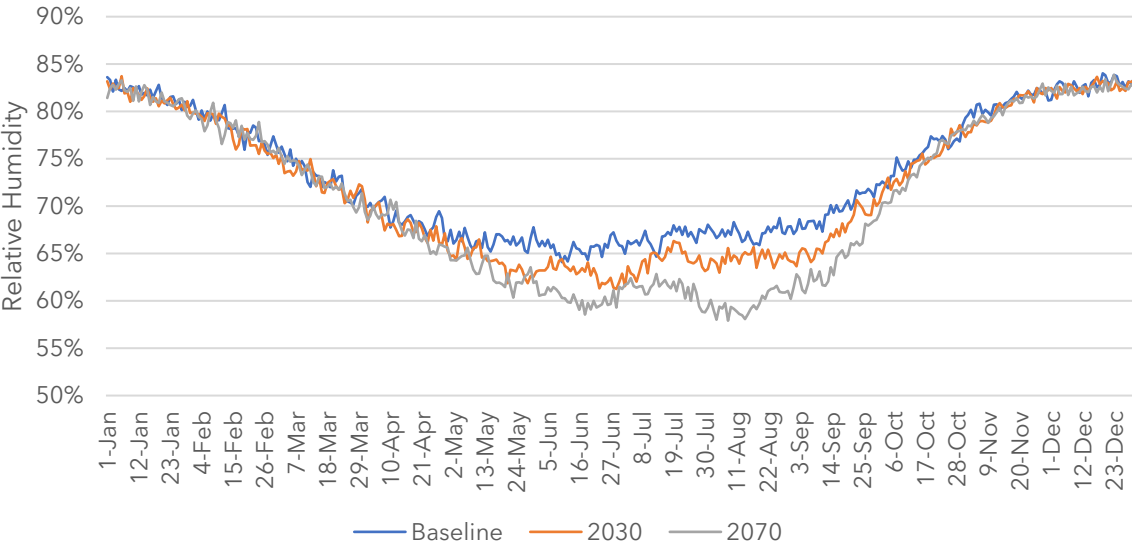
Application- how we apply this information to what we already know?

Cardiff Climate trends, predicted vulnerabilities and known deterioration mechanisms

Monthly Precipitation



Daily Average Relative Humidity



Cymhwyso canlyniadau bregusrwydd adeiladwaith yr adeiladau

Cyfuno mecanweithiau dirywiad hysbys â ffactorau straenachoswyr / bregusrwydd a ragwelir yn yr hinsawdd i ysgogi blaenoriaethau ymaddasu

Applying the building fabric vulnerabilities results

Combining known deterioration mechanisms with predicted climate stressors / vulnerabilities to drive adaptation priorities

Material/component	Deterioration mechanisms	Severe event safety measures
Solid stone or brick	<ul style="list-style-type: none">❖ Masonry deterioration is associated with excessive moisture content.❖ Water ingress, wet-dry cycles, freeze-thaw cycles, rain splatter at base of walls.❖ Discoloration (staining) micro-cracking, biological/organic growth.❖ Relative humidity < 75% can escalate crystallisation–hydration cycles, so drier, hotter summers could be a potential threat, especially for carbonate and sandstone but no estimate is yet available related to their correlation .	<ul style="list-style-type: none">❖ WDR and heavier downpours will require more regular maintenance of stone/brickwork❖ Address micro-cracking to reduce moisture ingress❖ Increased impact likely on northerly elevations.
Painted render	<ul style="list-style-type: none">❖ Water ingress, wet-dry cycles, freeze-thaw cycles, rain splatter at base of walls.❖ Discoloration (staining), cracking, biological/organic growth. Loss of strength may also occur.❖ A reflective/pale coating can prevent walls exposed to sunlight reaching a critically high temperature.	<ul style="list-style-type: none">❖ Address cracking to reduce moisture ingress.❖ Increased impact likely on northerly elevations.
Painted/treated timber (window frames and doors)	<ul style="list-style-type: none">❖ Solar radiation and moisture lead to erosion or stains and blistering of varnish/paint, that allow timber saturation❖ With high Solar flux, increased blistering will occur on painted timber on south facing elevations increased frequency of repair.❖ If level of moisture is raised > 20% , rot can damage frames	<ul style="list-style-type: none">❖ Frequency of repaint/retreating will increase on southern elevations.

Adaptation requirements



Cynllunio addasu

Cyd-greu mynegeion blaenoriaethu ar gyfer **Ansawdd yr Amgylchedd Dan Do ac Adeiladwaith yr Adeiladau** gan gynnwys ystyried gorboethi, ansawdd aer dan do, llwydni, lleithder, glaw, llifogydd a fflwcs solar.

- ❖ **Addasiadau ymddygiad** [gwneud newidiadau bach i'r ffordd yr ydym yn byw yn y cartref]
- ❖ **Newidiadau i'r adeiladwaith mewnol** [canolbwyntio ar y perchennog/meddiannydd]
- ❖ **Addasiadau i adeiladwaith yr adeilad** [perchennog/meddiannydd yn ogystal â lle bo angen contractwr/crefftwr]

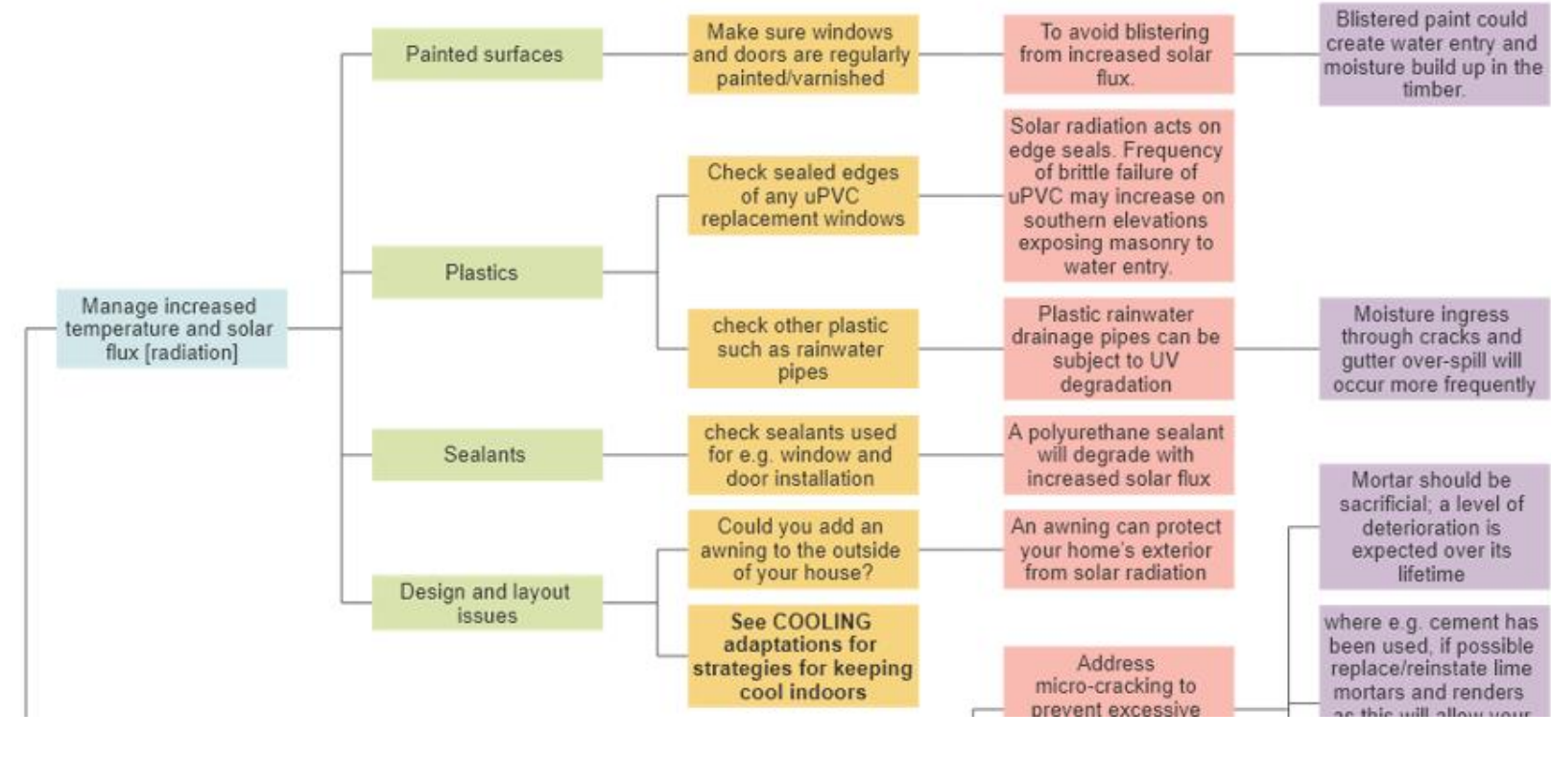
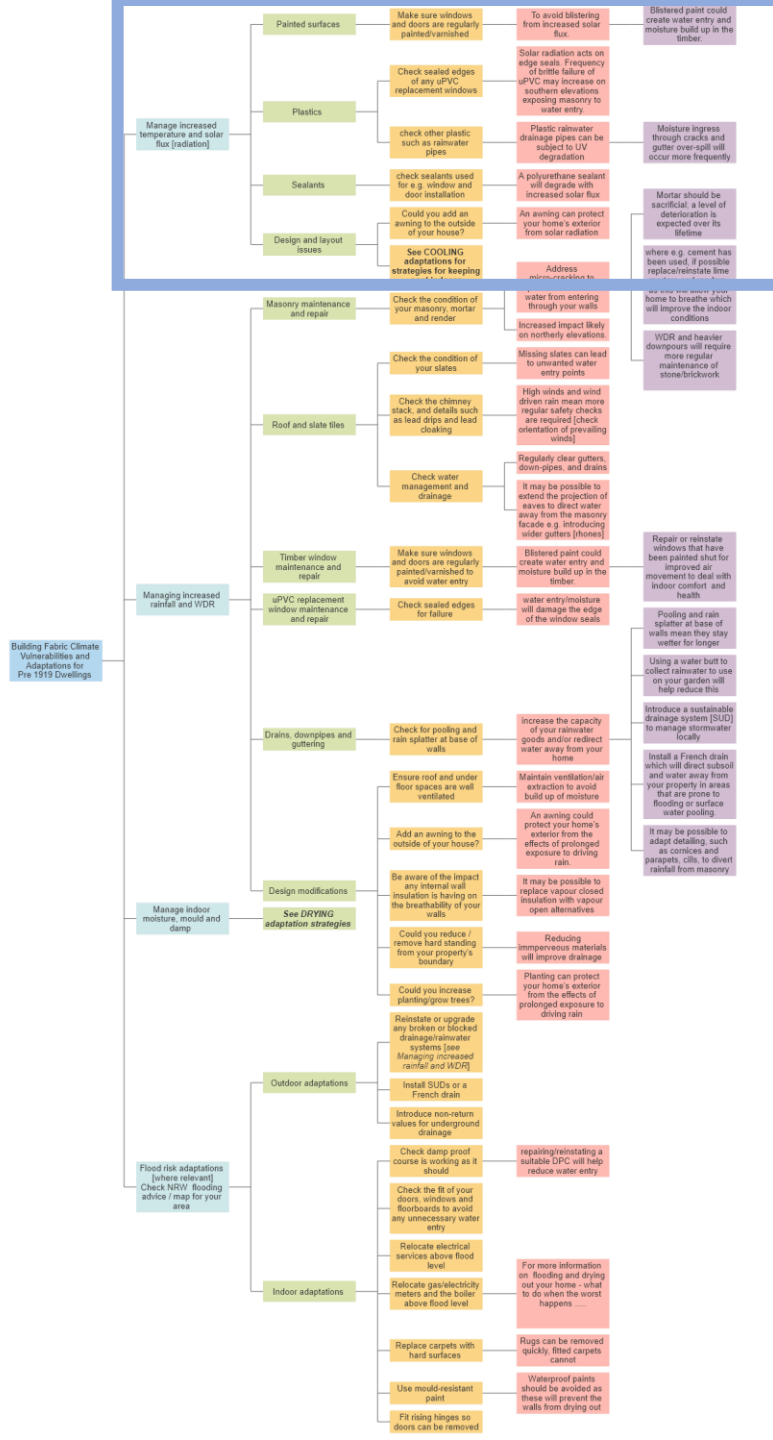
Adaptation planning

Co-creating prioritisation indices for **Indoor Environmental Quality** and **Building Fabric** including consideration of overheating, indoor air quality, mould, damp, rain, flooding and solar flux.

- ❖ **Behavioural adjustments** [making small changes to the way we live in the home]
- ❖ **Internal fit-out alterations** [owner/occupier focused]
- ❖ **Building fabric modifications** [owner/occupier as well as where contractor/trades required]

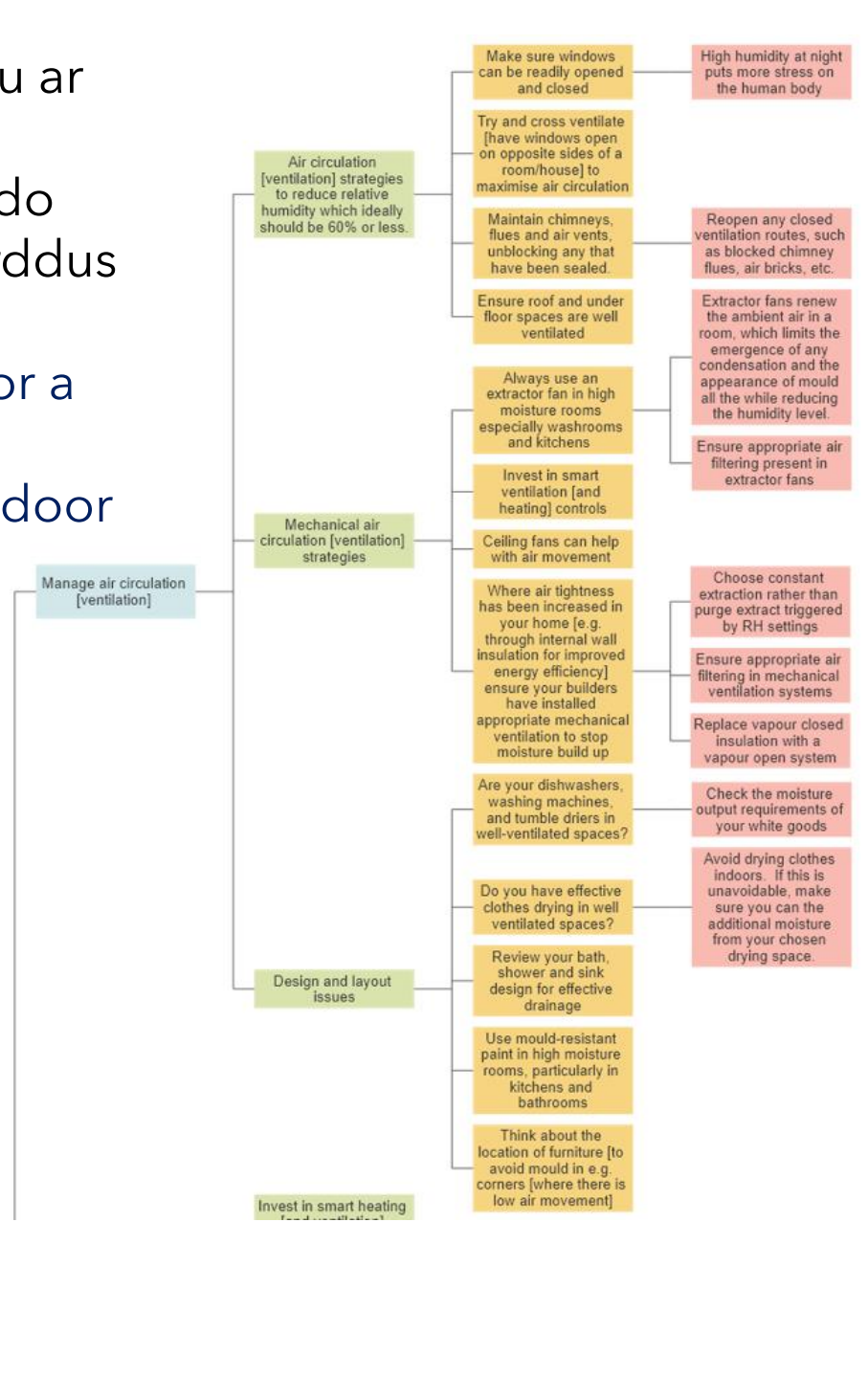
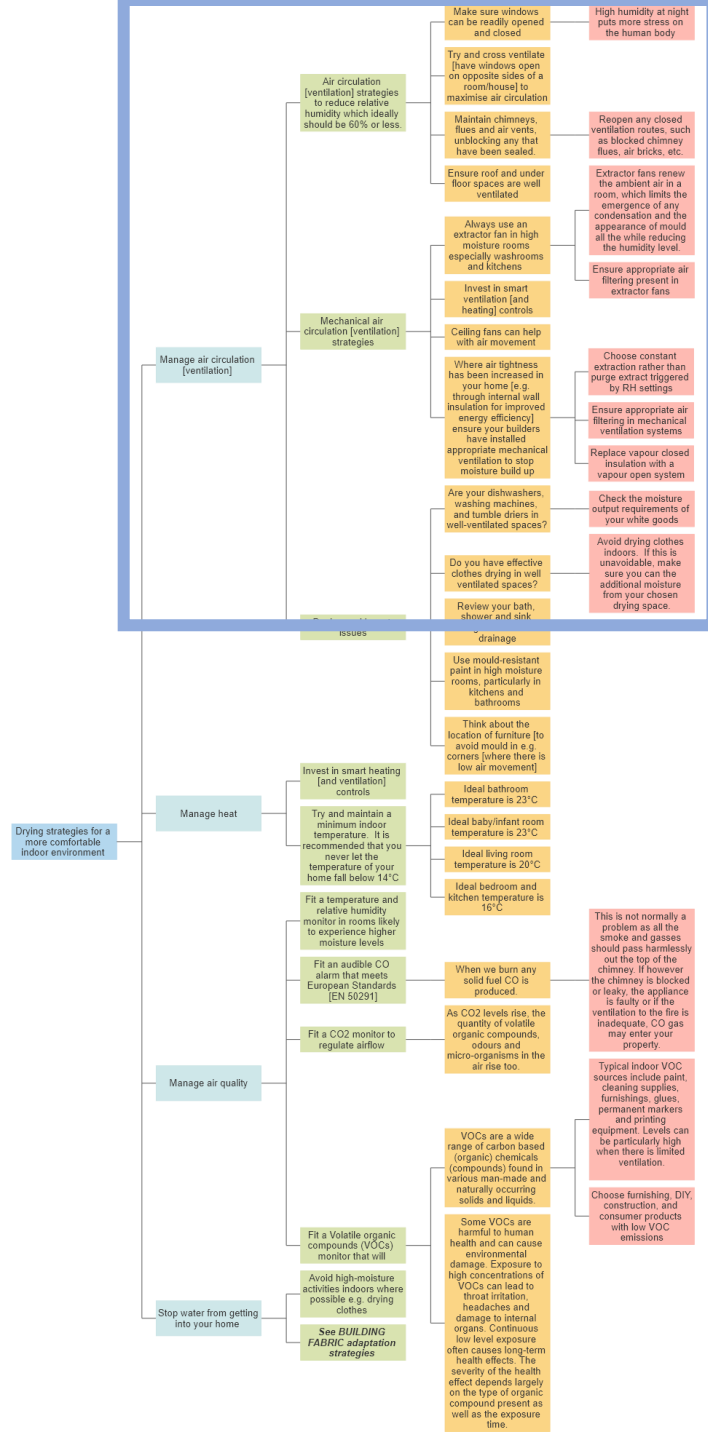
Bregusrwydd Hinsawdd Adeiladwaith yr Adeiladau e.e. Anheddau a adeiladwyd cyn 1919

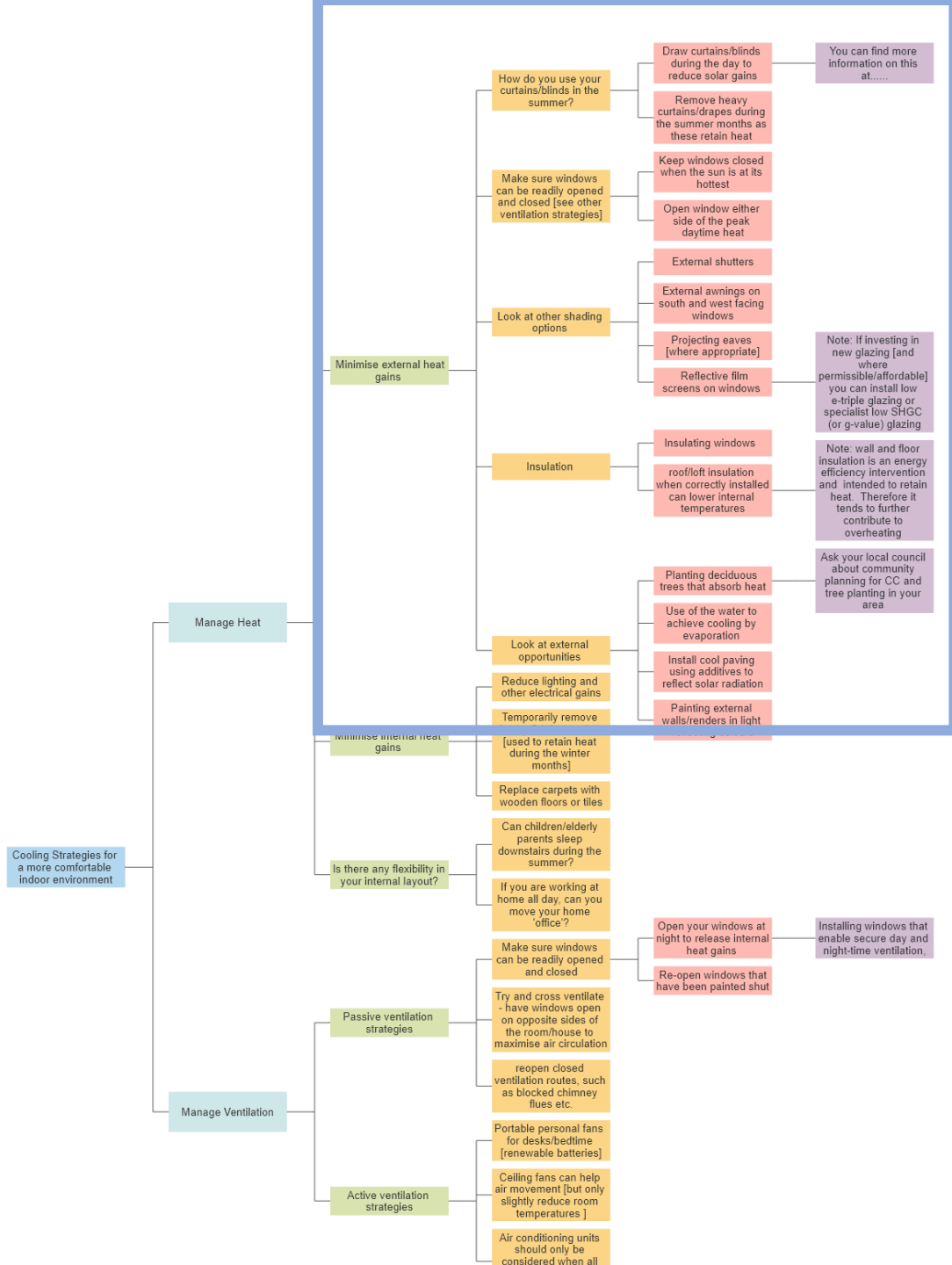
Building fabric Climate Vulnerabilities e.g. Pre-1919 Dwellings



Strategaethau sychu ar gyfer amgylchedd dan do iachach a mwy cyfforddus

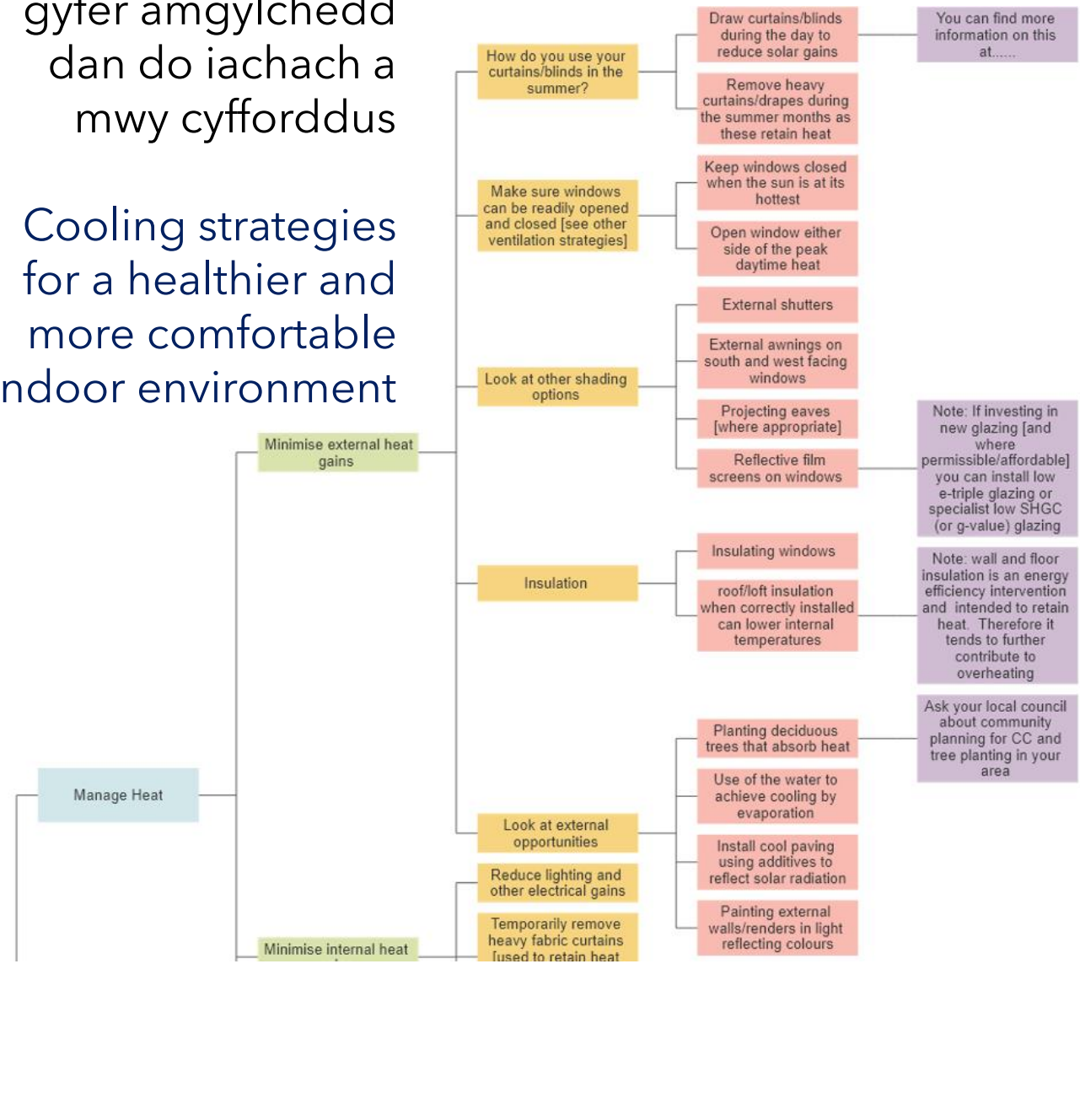
Drying strategies for a healthier and more comfortable indoor environment





Strategaethau oeri ar gyfer amgylchedd dan do iachach a mwly cyfforddus

Cooling strategies for a healthier and more comfortable indoor environment



Sut y gall cynllunio a
dylunio gyfrannu at fynd
i'r afael â materion
iechyd a llesiant a achosir
gan newid yn yr
hinsawdd?

How can planning and
design contribute to
addressing health and
wellbeing issues caused
by Climate Change?

Taflenni ffeithiau dwyieithog ar gyfer rheolwyr asedau a chydlynwyr ôl-osod

1. Ystyried **gorboethi yn ystod yr haf** mewn adeiladau **mwya newydd** [gan gynnwys adeiladau hŷn a drowyd yn fflatiau]
2. Ystyried **gorboethi yn ystod yr haf** mewn cartrefi sydd wedi'u **hinswleiddio'n dda iawn**
3. Ystyried **lleithder cymharol yn ystod yr haf** mewn **eiddo hŷn**
4. Addasu newid yn yr hinsawdd - blaenoriaethau **cynnal a chadw ac atgyweirio** ar gyfer eiddo hŷn

Bi-lingual factsheets for asset managers and retrofit coordinators

1. Considering **summertime overheating** in **newer build** properties [including older buildings converted into flats]
2. Considering **summertime overheating** in **highly insulated** homes
3. Considering **summertime relative humidity** in **older properties**
4. Climate change adaptation - **maintenance and repair** priorities for **older properties**

Heat Wave

Max Avg.

Heat Wave

CDD

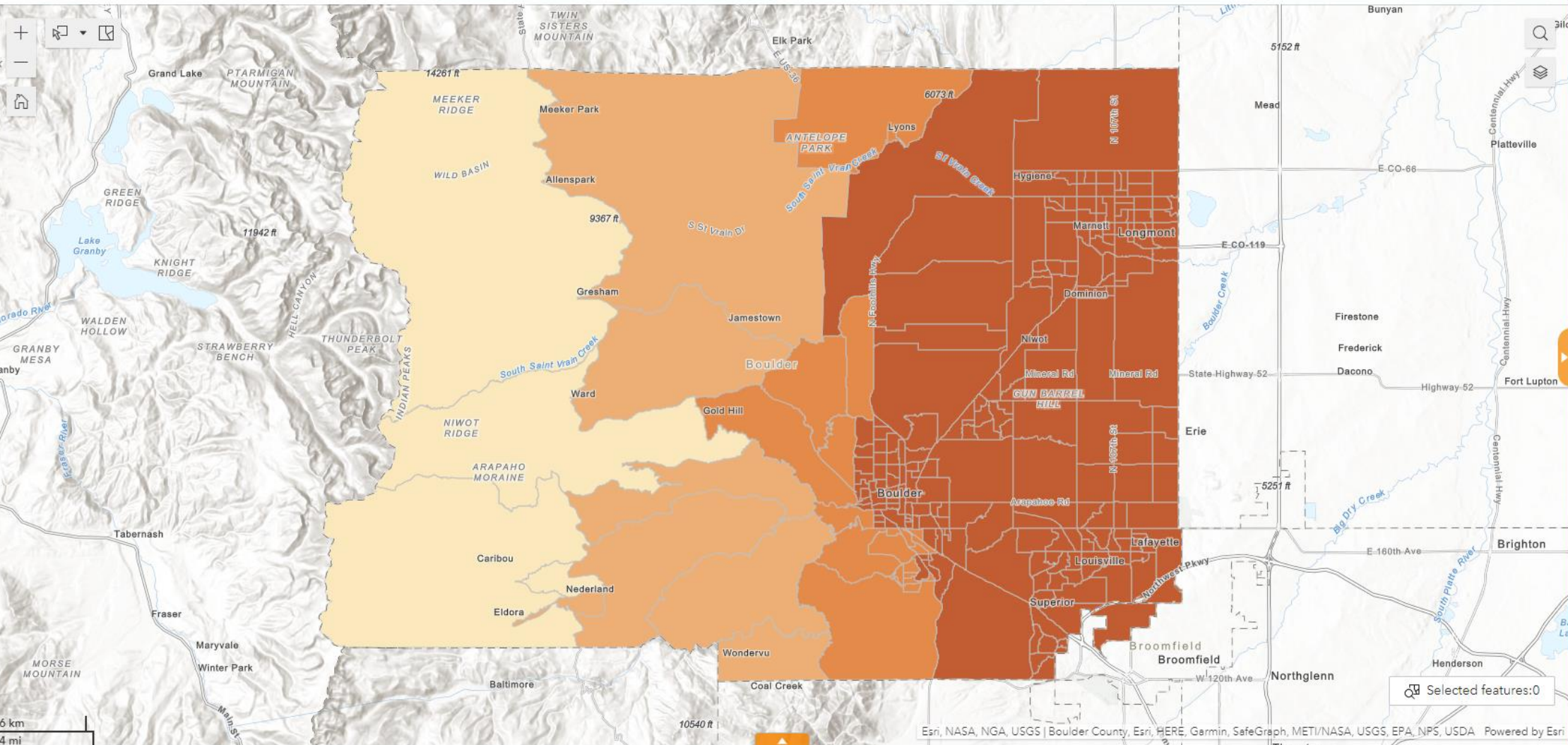
HFD

Extreme Precip

Drought

Tree Canopy

Details



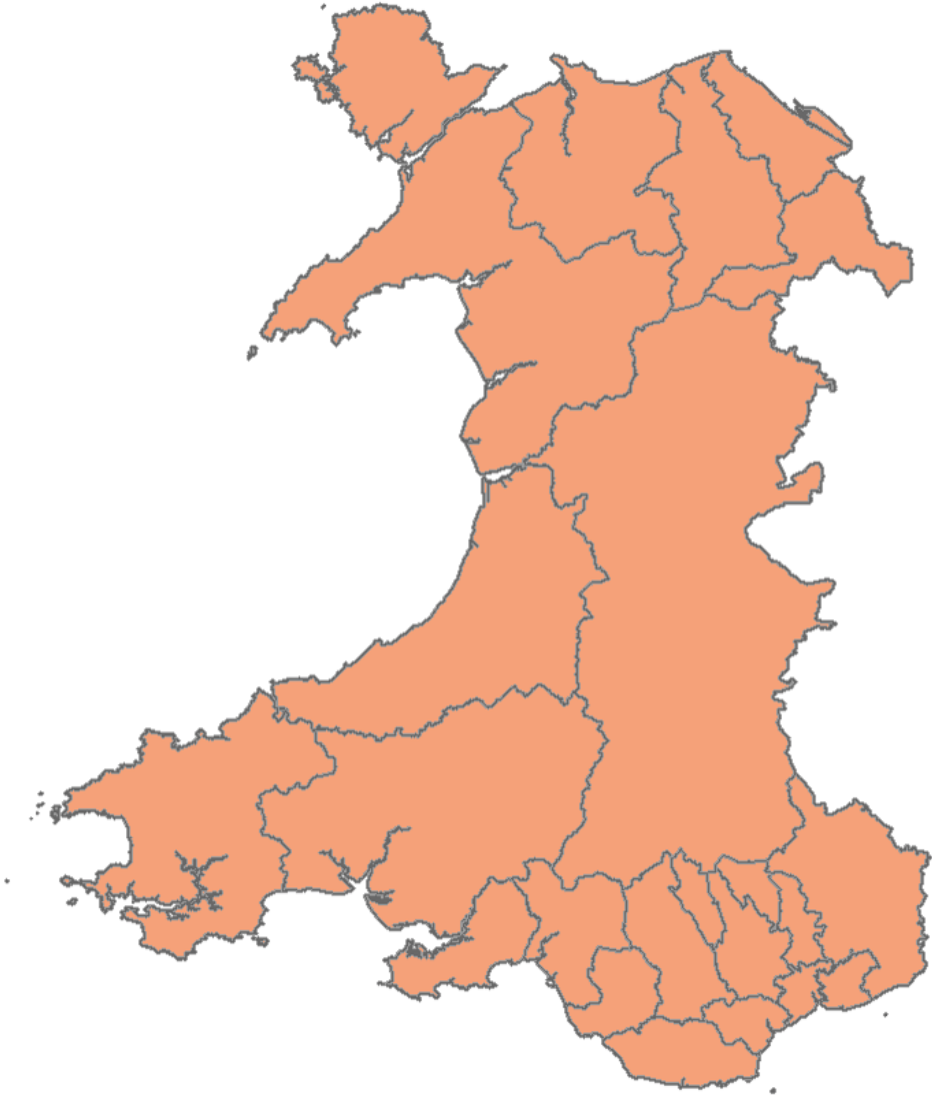
- Baseline ...
- 2030 ...
- 2050 ...
- Social ...
- Physical ...

Baseline

Baseline °F

- > 101 - 107
- > 95 - 101
- > 89 - 95
- > 83 - 89
- 77 - 83

Selected features:0



Individual pop-up maps will be created for:

Aberystwyth

Cardiff

Swansea

Wrexham

Diolch yn fawr iawn

Yr Athro Carolyn Hayles
Dylunio Amgylcheddol a Chynaliadwy
ar gyfer yr Amgylchedd Adeiledig
Ysgol Gelf a Dylunio Caerdydd
Prifysgol Metropolitan Caerdydd

Thank you

Professor Carolyn Hayles
Chair of Environmental and Sustainable
Design for the Built Environment
Cardiff School of Art and Design
Cardiff Metropolitan University

[Email: cshayles@cardiffmet.ac.uk](mailto:cshayles@cardiffmet.ac.uk)