UCL Institute for Environmental Design & Engineering

COMPLEX BUILT ENVIRONMENT SYSTEMS

Indoor Air Quality and Overheating: The Causes of Unintended Consequences

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Homes and Communities Agency ENEWorkshop – Overheating and indoor air quality in new homes

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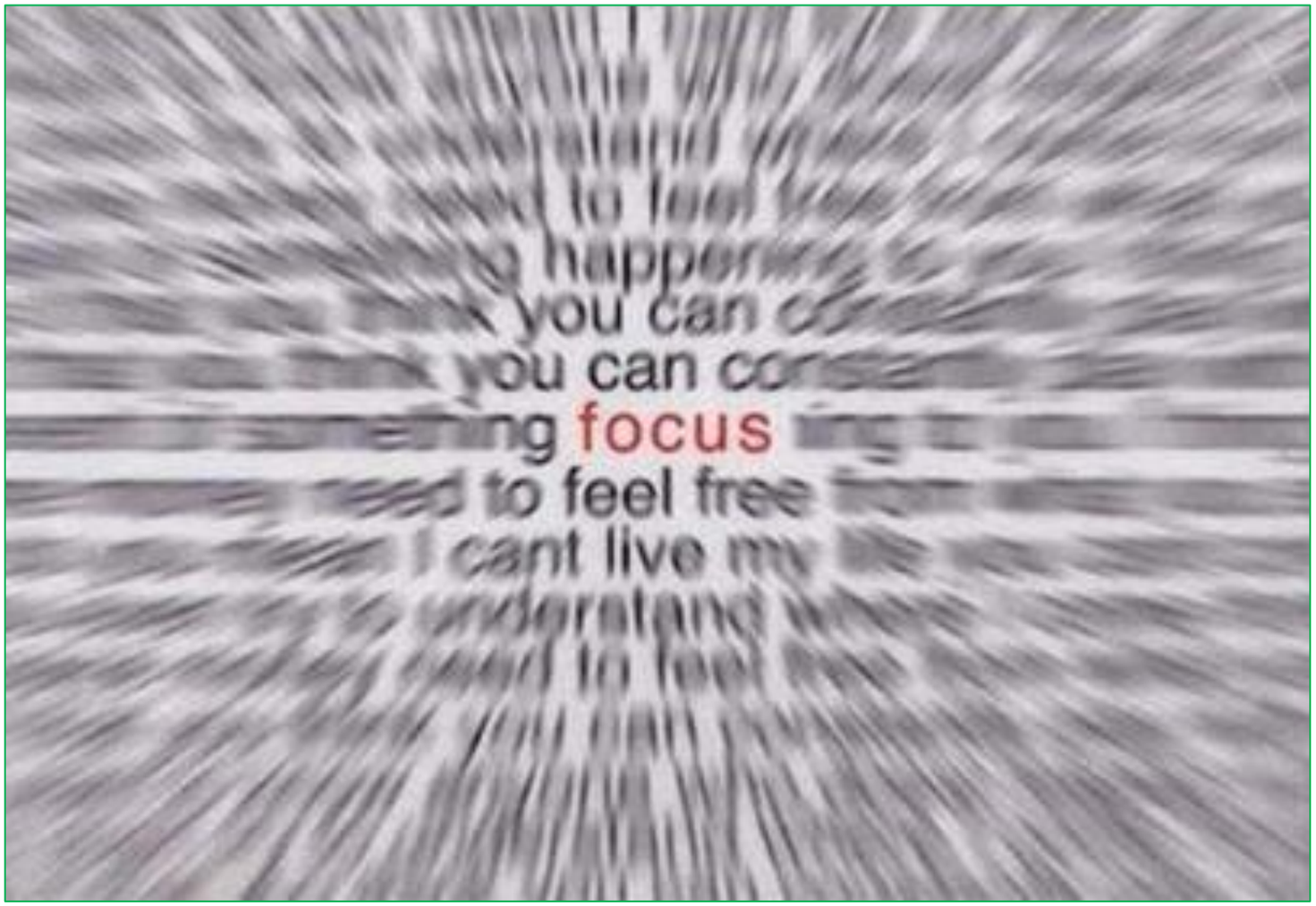
The UK Government's approach to CO_2 reduction involving the housing sector

Legislation

Carbon Budgets

Policies and Incentives


focus
to feel free
I cant live my

What do we mean by unintended consequences in the context of building energy efficiency policy ?

'Outcomes that arise unintentionally or indirectly as a result of policy development and/or implementation'.

They can be broadly grouped into two categories:

1. An unexpected benefit or negative effect (or a combination of both), which may occur in addition to the desired effect of the policy or action
2. An effect contrary to the original intention that undermines the intention and even makes the problem worse

Multiple direct and indirect consequences can occur as can complex and dynamic links between individual consequences

Changes in IAQ and overheating are two notable unintended consequences

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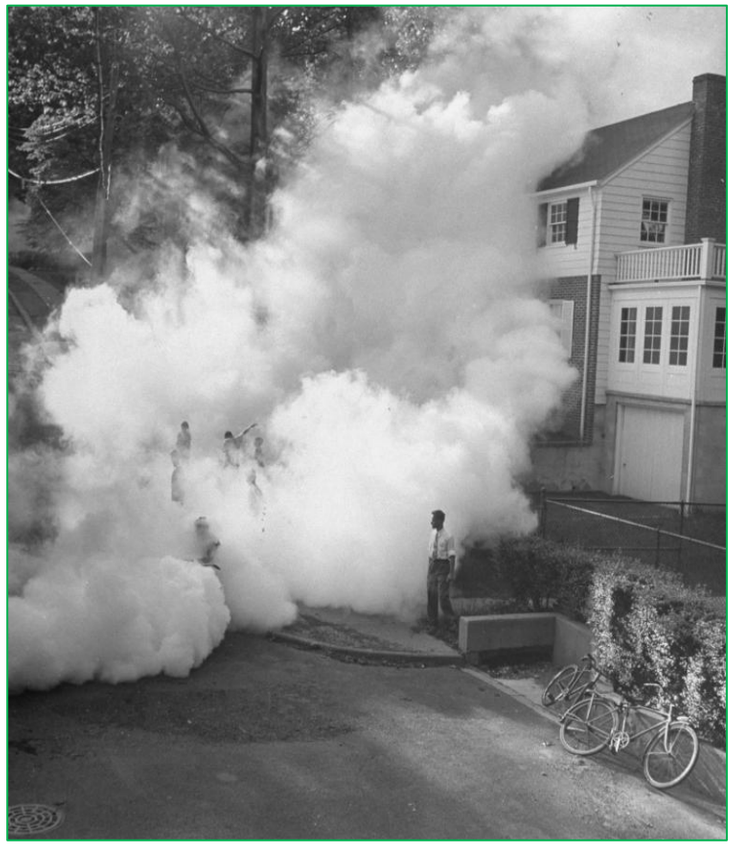
Single focus policies: Lessons from history:

1920 USA National Prohibition



1945-1955 USA Indiscriminate use of DDT

'Outcomes that arise unintentionally as a result of policy development and/or implementation'.

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What can we learn from such examples?

Single Focus Policies = Unintended Consequences

+ve Positive Co-Benefits

+/-ve Uncertain Outcomes

-ve Negative Trade offs

Impacts of Airtightness: Without Purpose Provided Ventilation (PPV)

No	Policy Impact on Buildings →		Impacts on People/ Nature: Unintended Consequence	Domain	Direction of Impact
1	Airtightness	Quieter Environment	Peace/Wellbeing / Security	Mental Health Psychological Well Being	+
2	Airtightness	Quieter Environment	Isolation/ Disconnection	Mental Health Psychological Well Being	–
3	Airtightness	Quieter Environment	Reduction in Noise	Mental Health	+
4	Airtightness	Quieter Environment	Absence of sound	Mental Health	–
5	Airtightness	Quieter Environment	Improvements in physical health; social, emotional, and behavioural outcomes	Child Development	+
6	Airtightness	Lower air change rate	Increased Relative Humidity Timber decay	Increase in mould, severity of asthma and allergies.	Physical Health	–
7	Airtightness	Lower air change rate	Changes in indoor air quality (IQA)	Increased exposure to indoor sourced pollutants. Decrease in external sourced pollutants (e.g. $PM_{2.5}$).	Physical Health	+/-
8	Airtightness	Additionally More water tight	Prevention of impacts from excess rainfall	Mitigation benefits, less water damage, mould risk	Physical Health	+

Building characteristics that can result in higher levels of indoor air pollution:

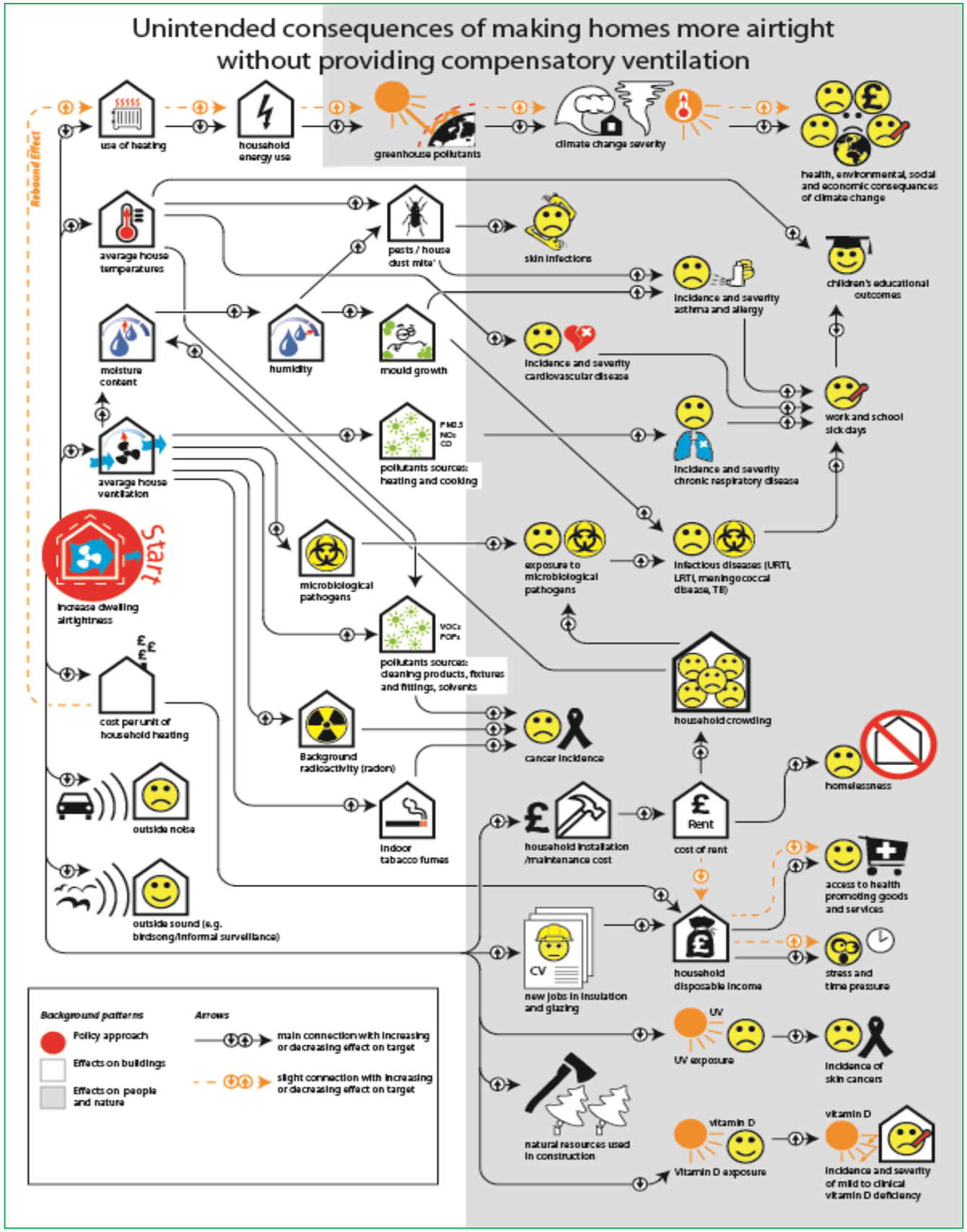
- Small rooms
- Non-working/unused kitchen extract and MVHR fans/changing of filters
- Lack of a purpose provided ventilation (PPV) strategy when applying energy efficiency interventions
- Location of home – ventilating a home by opening windows and doors in areas of high levels of outdoor pollution
- Overcrowding/occupancy patterns

Research shows that all of these factors are more prevalent in households below the Low Income Threshold (LIT) and that they experience greater overall concentrations of particulate matter (PM)* than those above the LIT. This suggests possible social inequalities driven by housing, leading to consequences for health.

* The smaller fractions ($PM_{2.5}$) are more toxic estimated to cause about 16% of lung cancer deaths, 11% of Chronic Obstructive Pulmonary Disease (COPD) deaths, and more than 20% of ischaemic heart disease and stroke (WHO, 2015)

Impacts of Insulation

No	Policy Impact on Buildings		Impacts on People/ Nature		
		→	Unintended Consequence	Domain	Direction of Impact
29	Insulation	Warmer Environment	Take back for comfort: "Jevons" effect. Increased fuel use and GHG emissions despite improvements	Physical Health Environment	+/-
30	Insulation	Warmer Environment	Increased time spent indoors Sedentary behaviour Weight gain /obesity	Physical Health	–
31	Insulation	Warmer Environment	Increased time spent indoors. Reduction in social cohesion	Mental Health Psychological Well Being	–
32	Insulation	Warmer Environment	Reduction in winter mortality.	Physical Health	+
33	Insulation	Poor design, increase in thermal mass → Higher average indoor temperatures	Summer overheating. Considered uninhabitable Breach of duty, Defective Premises Act 1972.	Physical Health Legal	–
34	Insulation	Poor design, increase in thermal mass → Higher average indoor temperatures	Additional cooling equipment used in summer increased energy use/ GHG emissions	Physical Health Environment	–
35	Insulation	Warmer Environment	increase in severity of skin infections, bed bugs, reactions to allergens	Physical Health	–



The complex links arising from the building envelope airtightening (without purpose provided ventilation) in the domestic stock and the impact on buildings, people and the wider environment

Policy construction incorporating input from multi- and inter-disciplinary teams with the diverse range of skill sets needed

The HEW Project (UCL)

- Integrated decision-making about Housing, Energy and Well-being

What to do to help avoid unintended consequences?

- ❑ Agile, Flexible and Evidence Based Policymaking.
- ❑ Systematic Learning
- Sharing and dissemination of knowledge – both research based and experience based. With due recognition that there is a 'lag period' in obtaining and analysing data
- Learn and share as you go approach- A 'willingness to share' ensuring that the best and most current knowledge is available for all.
- Circular rather than linear knowledge –outcomes from Building Performance Evaluation (BPE) and Post Occupancy Evaluation (POE)must be fed back into the policy making process.

Useful References:

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