Housing energy efficiency and indoor air quality: radon exposure

HPRU in Environmental Change and Health

Policy Brief

Key Messages

- Radon is the second leading cause of lung cancer worldwide behind smoking.
- Radon is a radioactive gas that seeps into homes from the ground. Making buildings more airtight may increase concentrations inside the home.

Existing homes:

- Our research demonstrates that energy efficiency measures applied to existing homes, such as double glazing, may increase the radon exposure of occupants by reducing overall levels of ventilation.
- Radon concentrations might increase by around 50% but the increase will vary by dwelling characteristics and occupant behaviour.
- This potential adverse impact of home energy efficiency measures should be considered in planning and building regulation.
- Homeowners and renters need to be aware of potential radon risks and maintain good ventilation in the home (for example, through the use of trickle ventilators).
- Homeowners and renters living in areas of moderate and high radon risk should be encouraged to arrange for radon measurements to be carried out in their homes, especially after energy efficiency upgrades. Current guidance is that action to reduce indoor concentrations should be taken if the radon level in a home is more than 200 Bq m^{-3} and additionally considered at 100 Bq m^{-3} if a householder is a current or ex-smoker.

New builds in high radon areas:

- New homes should comply with building regulations and be built with modifications (such as a sump and protective membrane) to the specification of foundations that minimise radon ingress from the ground.
- Homeowners and renters of new builds in areas of moderate or high radon risk should be encouraged to arrange for radon measurements in their homes to assess whether further action may be required.

Context: Environmental Change and Health in the UK

The unsustainable use of resources is causing large-scale rapid changes to the environment which are likely to have significant impacts for human health and well-being. These include climate change, biodiversity loss and increasing pressure on life-sustaining resources (including water, food, air, energy and materials). The aim of this Health Protection Research Unit (HPRU) is to ensure that decision makers concerned with health protection and health promotion (in Public Health England, local government, and society) have the knowledge, foresight and tools to mitigate, adapt to and benefit from environmental change.

NIHR | Health Protection Research Unit in Environmental Change and Health at London School of Hygiene and Tropical Medicine

Context

Improvement of the energy efficiency of housing is a core objective of UK government policy to address climate change through the Zero Carbon strategy.

The UK will need to design and construct new houses to high energy efficiency specifications and also retrofit existing dwellings to improve fabric thermal insulation and reduce uncontrolled ventilation (draughts). The programme of energy efficiency improvements will affect most dwellings nationwide.

Making homes more airtight will alter indoor air quality, reducing the concentration of pollutants that enter the home from the outside air, but increasing the concentration of pollutants generated within the dwelling.

Radon is a colourless odourless radioactive gas that seeps into homes from the ground on which homes are built. Its concentration may also increase with greater air tightness of the dwelling as ventilation is important to its dispersal.

Its concentrations are high in many parts of the UK (see figure 1), especially in the South West, parts of the midlands, the North West, Wales, Scotland and Northern Ireland. Altering the ventilation characteristics of dwellings may therefore have adverse impacts on the concentration of radon in homes and the associated risk of lung cancer risk.

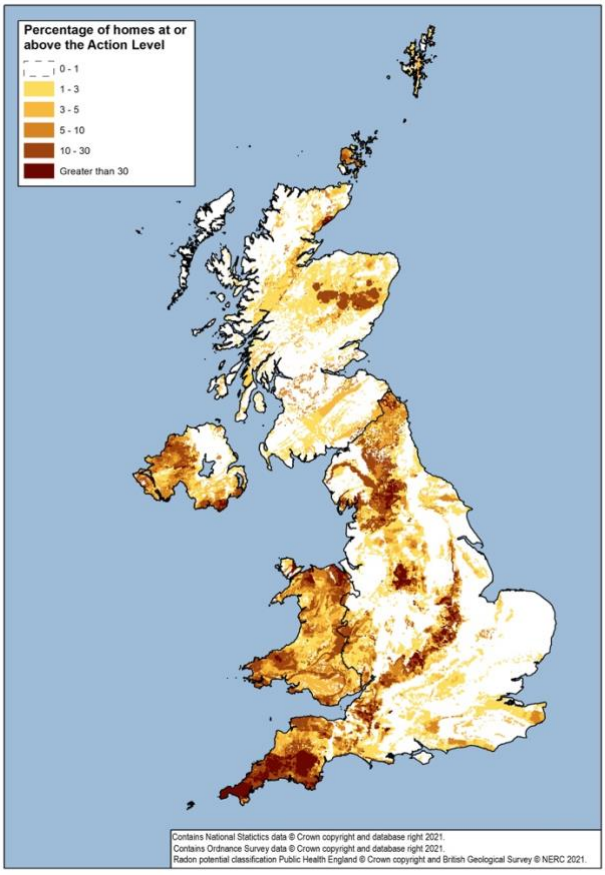

Figure 1: Radon map.

Our research

We investigated the link between home energy efficiency and radon levels through two strands of research:

(1) Modelling the indoor radon concentrations of UK dwellings using building physics models to predict the changes caused by energy efficiency measures that reduce uncontrolled ventilation;

(2) Using measurements of indoor radon concentrations held by Public Health England in half a million homes as part of UK monitoring programmes, we linked these measurements to data on the energy efficiency characteristics of homes.

What we found

- Modelling of indoor radon suggests that, without compensatory mechanisms to increase ventilation, energy efficiency retrofit measures are likely to increase average indoor radon concentrations.
- Radon concentrations might increase by around 50% but the level of change will vary by dwelling characteristics and occupant behaviour.
- Radon levels were higher in homes with certain energy efficiency characteristics. Most notably, homes with double glazing had radon concentrations around 67% higher than non-retrofitted homes. Homes with loft and wall insulation had concentrations 47% and 32% higher, respectively.
- Such energy efficiency improvements, if scaled up nationally, could substantially increase the burden of radon-related lung cancer.
- Although this risk is highest for homes in high radon areas, many of the additional lung cancer cases would occur in the very large number of homes with low or moderate levels of radon.

References and sources

[1] Milner J, Shrubsole C, Das P, et al. Home energy efficiency and radon related risk of lung cancer: modelling study. BMJ. 2014;348:7493.

[2] Symonds P, Rees D, Daraktchieva Z, et al. Home energy efficiency and radon: An observational study. *Indoor Air* 2019; 29: 854–864.

For more information on specific interventions to reduce radon in the home see: https://www.ukradon.org/information/

Acknowledgements

The research was funded by the National Institute for Health Research Health Protection Research Unit (NIHR HPRU) in Environmental Change and Health at the London School of Hygiene and Tropical Medicine in partnership with Public Health England (PHE), and in collaboration with the University of Exeter, University College London, and the Met Office. Jonathon Taylor and Phil Symonds were funded from the Wellcome Trust for the 'Complex Urban Systems for Sustainability and Health' (CUSSH) project [award codes 205207/Z/16/Z and 209387/Z/17/Z].