



GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

An Introduction to Radon

Kristian James MPH CEnvH
Principal Environmental Public Health Specialist

**Specialist content provided by the
Radon Group - Programmes Team, PHE Centre for
Radiation, Chemicals and Environmental Hazards**

Radon gas

- Radon is a colourless, odourless radioactive gas.
- Formed by the radioactive decay of the small amounts of uranium that occur naturally in all rocks and soils.
- A noble gas, moves easily through the ground,
- Four day half-life, decays to particulates
- Particulates emit alpha (α) radiation which damages lung tissue
- Mixed in air (units of Becquerel per cubic metre of air, Bq m^{-3})

Why is radon harmful to us?

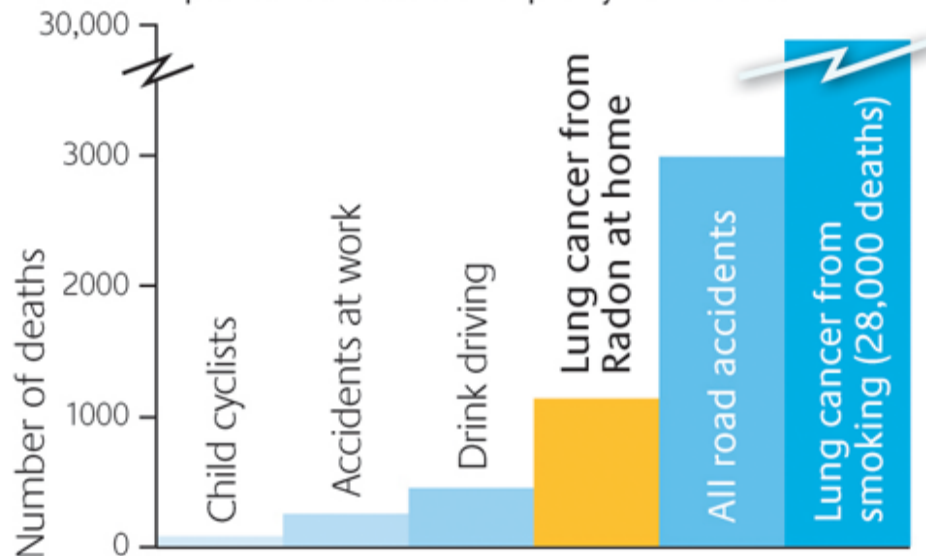
- Radon increases your risk of lung cancer
- The higher the radon, the longer the exposure, the greater the risk
- Radon causes over 1,100 deaths from lung cancer each year in the UK
- Half of these deaths occur among the quarter of the population who are current smokers

The risk...

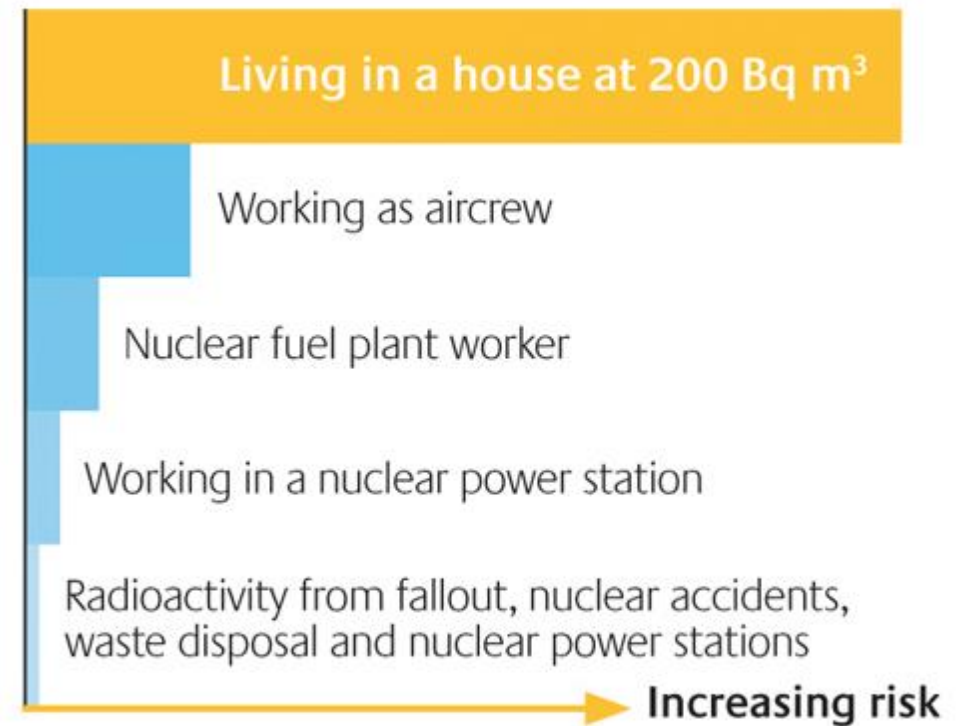
Any radiation exposure carries a risk:
the higher the exposure the higher the risk.

Radon deaths

compared with other causes of premature deaths per year in the UK



Any radiation exposure carries a risk:
the higher the exposure the higher the risk.



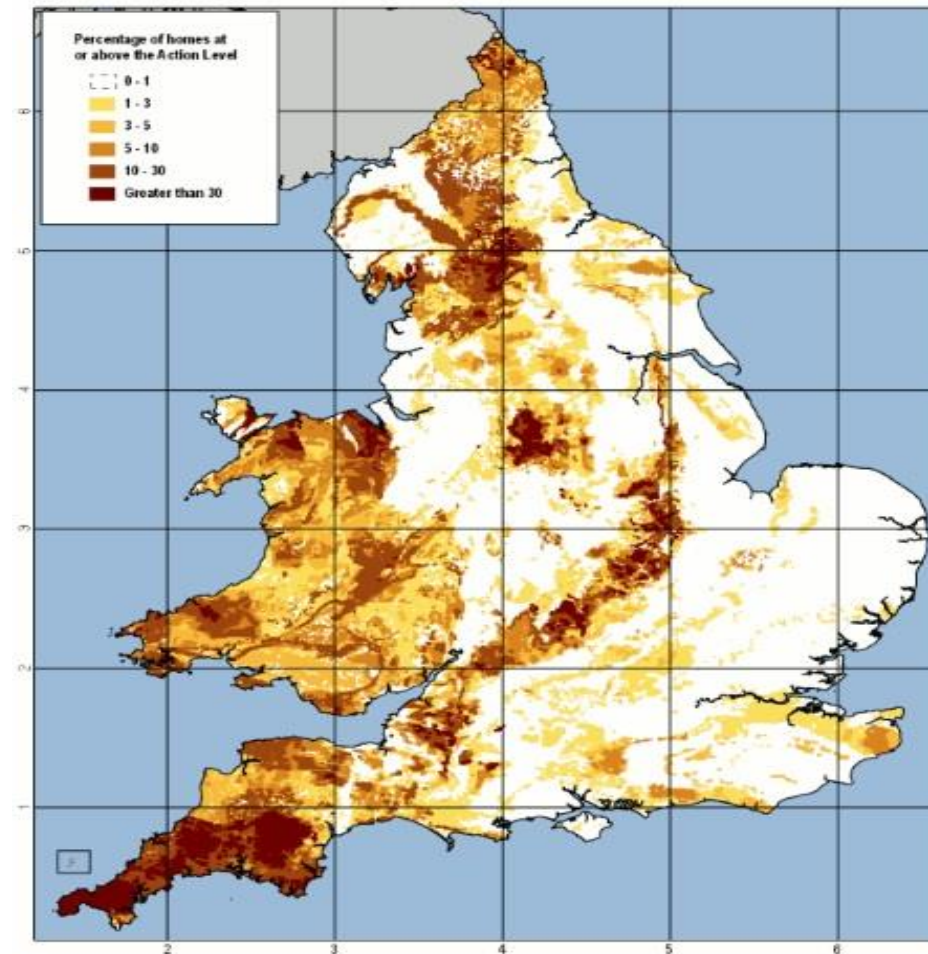
Source: UK Radon <http://www.ukradon.org/information/risks>

Three steps to manage radon in buildings

- Check
- Measure
- Act

CHECK

Indicative map of radon



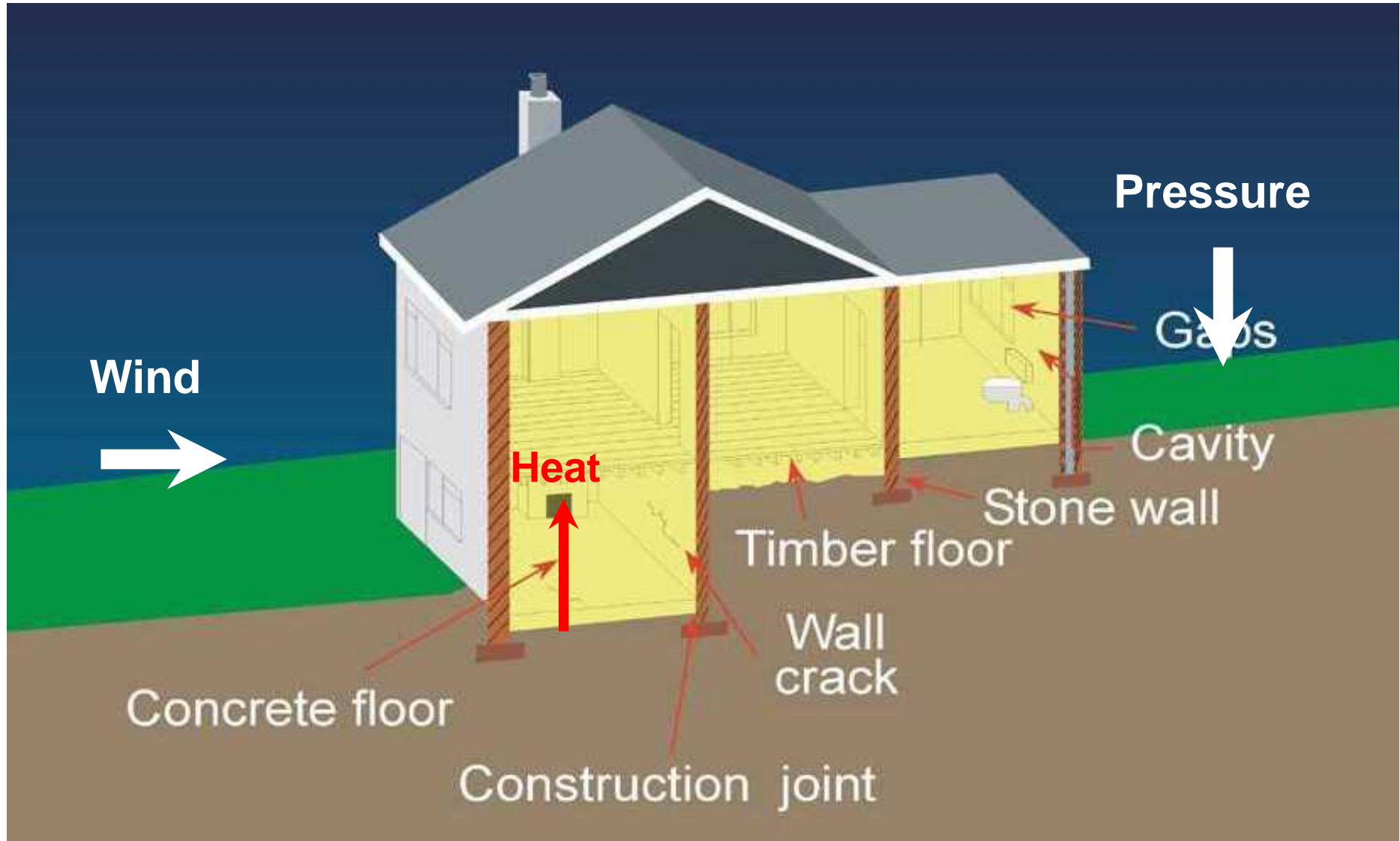
Overall map of radon Affected Areas in England and Wales (axis numbers are the 100-km coordinates of the national grid)
© Crown copyright. All rights reserved [Health Protection Agency][10010509][2007]
Radon potential classification © Health Protection Agency and British Geological Survey copyright [2007]

- Radon Affected Areas show where >1% homes exceed 200 Bq m⁻³ Action Level
- The darker the colour the greater the chance of a higher level.
- Affected Areas are based on radon measurements in existing homes, and geological units

Indicative map of radon affected areas in England and Wales produced by Public Health England and British Geological Survey.

<http://www.ukradon.org/information/ukmaps/englandwales>

Radon movement into buildings



GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

'Overall' radon control strategy

	Domestic	Occupational
Responsibility	Householder	Employer
Control	Voluntary*	Statutory
Government	Encouragement	Enforcement
Action Level	200 Bq m⁻³	400 Bq m⁻³

*** HHSRS puts duties on landlords**



GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

Workplace Regulations

The Management of Health and Safety at Work Regulations 1999

3 (1) Every employer shall make a suitable and sufficient assessment of:-

(a) the risks to the health and safety of his employees to which they are exposed whilst they are at work...

The Ionising Radiations Regulations 1999

3 (1) ...these Regulations shall apply to:-

(b) any work... carried out in an atmosphere containing radon 222 gas at a concentration in air, averaged over any 24 hour period, exceeding 400 Bq m⁻³...

Radon in the workplace

- The amount of radon in a building depends on location, structure & use.
- In workplaces such as offices, where hazards are normally low, radon can be the largest occupational health risk.
- All workplaces in radon Affected Areas (RAA) should be tested, unless a detailed assessment shows good reason to expect the radon level to be low.
- Search services are available to find out if premises are in RAA
- Underground areas are more likely to have high radon levels. Frequently occupied basements should also be tested, regardless of whether or not within an RAA.
- Individual risk depends on the radon level in the different areas where staff spend most of their time. It is important to measure the radon levels in areas that represent the different working environments in the building.

Landlord responsibilities

- Landlord is responsible to ensure no hazards present (Radon identified as a hazard – causes lung cancer in HHSRS)
- The Housing Health & Safety Rating System (HHSRS) used by Local Authorities (LAs) to evaluate risk and hazards including radon.
- To comply with HHSRS, landlords in Affected Areas should carry out a radon test (Guidance available).
- If radon levels in excess of domestic Action Level of 200 Bq/m³, landlord should arrange for remedial works.
- Level of risk determines level of any enforcement e.g. If LA inspector discovers a Category 1 hazard in a home, they have a duty to ensure that this hazard is rectified without delay.
- If a landlord fails to comply, LA can issue Improvement Notice / or prohibit use of part / all of the property for tenancy until the hazard is removed.

Also to consider...

- Tenant suspects they are in RAA.
- Private water supplies may contain radon.

MEASURE

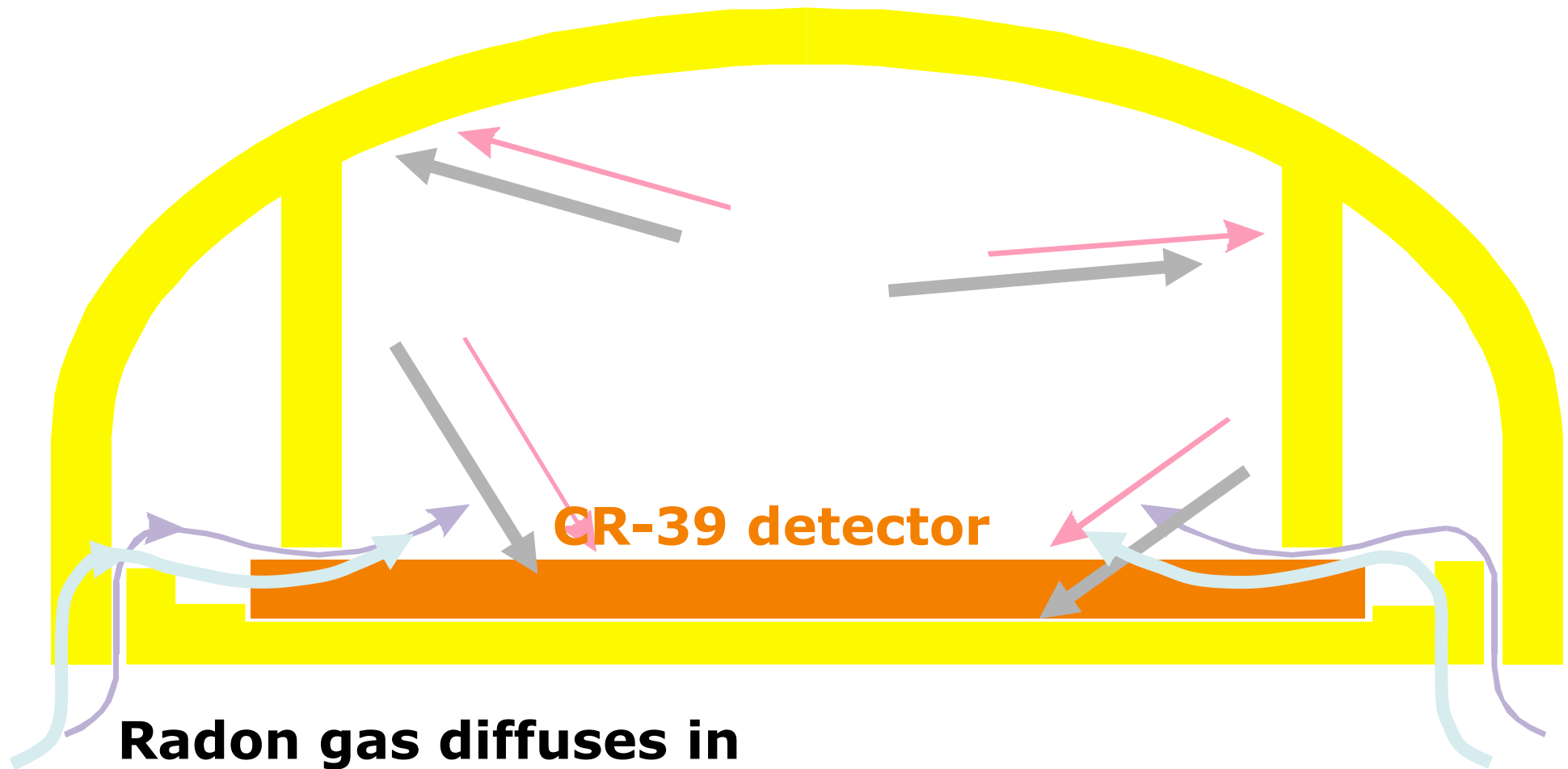


Radon gas passive monitors



Radon gas passive monitor – how it works.

Some alpha particles emitted by radon and daughters strike detector



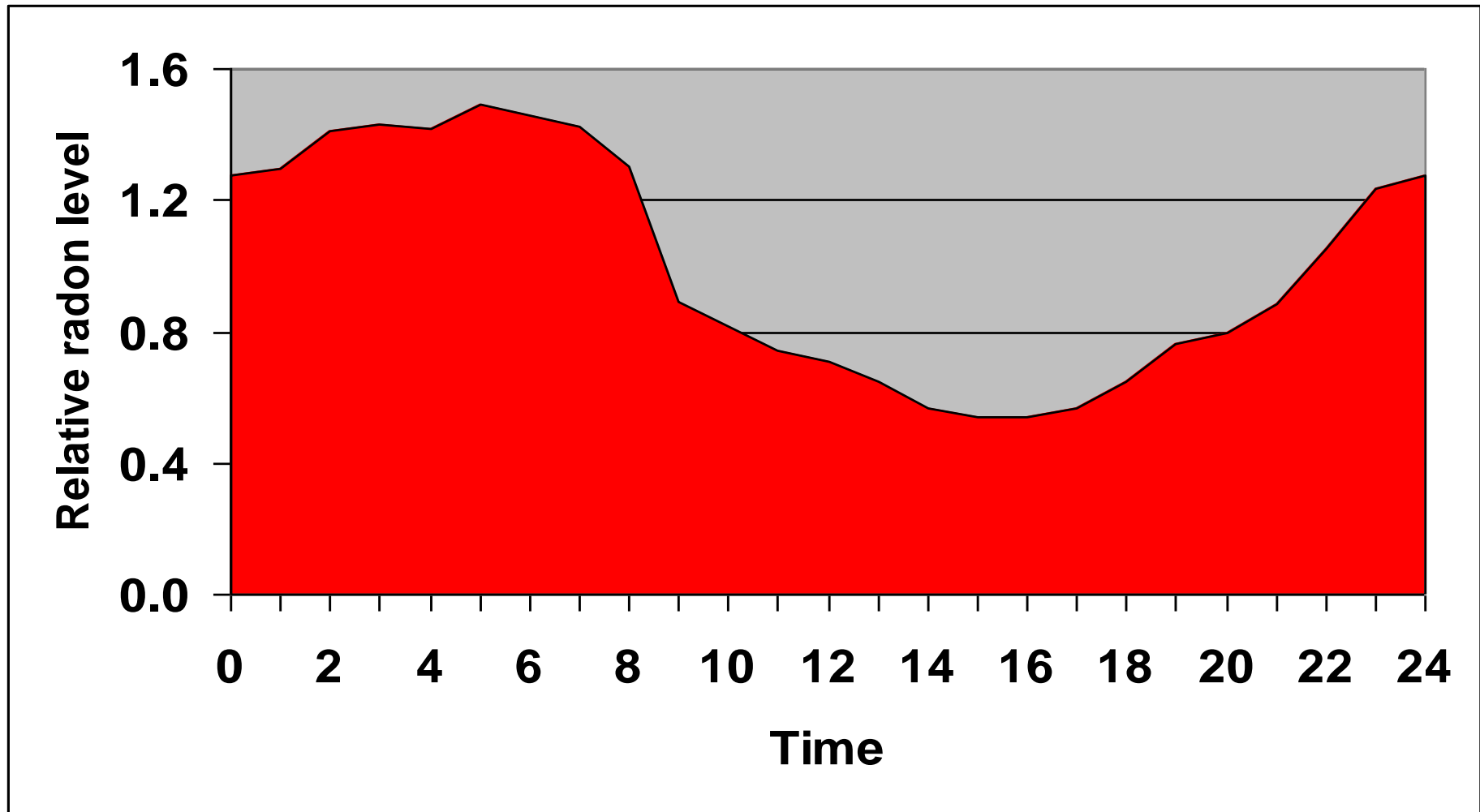
Radon gas diffuses in



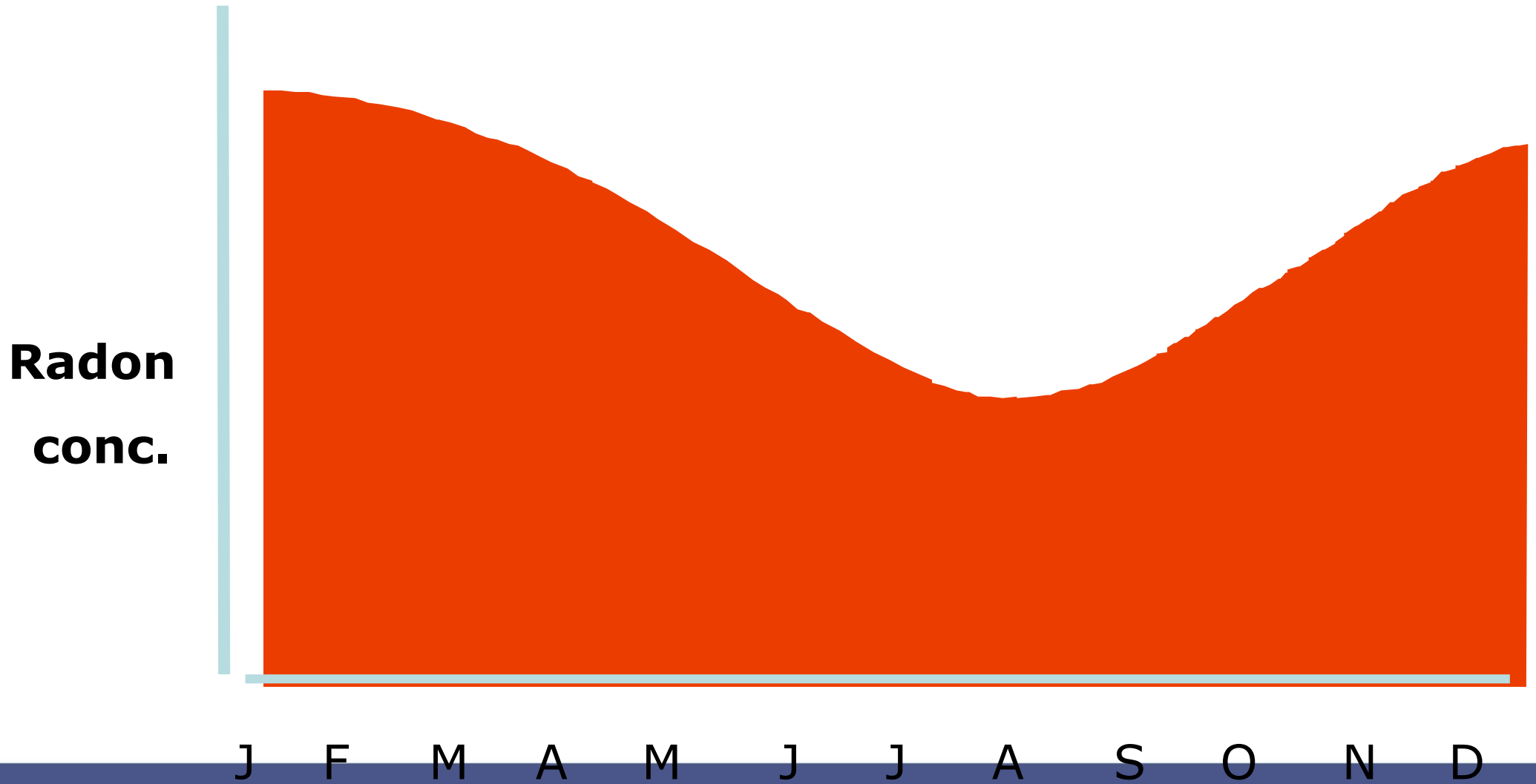
GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

Diurnal variations



Seasonal variations



**Radon
conc.**

Month



**GIG
CYMRU
NHS
WALES**

Iechyd Cyhoeddus
Cymru
Public Health
Wales


ACT

If radon workplace levels $>400 \text{ Bq m}^{-3}$

The manager owner has legal duties as *radiation employer*, and is required to:-

- Notify enforcer (IRR6 form to HSE)
- Provide information to employees and other people who use the workplace (public, students, workers of other companies...)
- Obtain expert advice from Radiation Protection Adviser (RPA)
- Monitor radon levels
- Control radon exposures
- Appoint person to manage information, monitoring, radon controls

Retrospective notification to HSE






Health and Safety Executive

The Ionising Radiations Regulations 1999

IRR6 - Notification of work with ionising radiation

Note: for 7 day site radiography notifications please use form IRR3

Zoom 100%   

*What is being notified?

*Into which category do the source/sources of ionising radiation fall (select all that apply)?

Sealed source Unsealed radioactive substance Electrical equipment An atmosphere containing the short lived daughters of radon 222

About you

*Title *Forename *Family Name

*E-Mail

Phone No

About the organisation undertaking the work

*Organisation Name


Address Line 1 (eg building name)

Address Line 2 (eg street)

Address Line 3 (eg district)

*Town

County

*Post Code Remember me 

Organisation contact details (where you, as the notifier, are not the organisation contact)

E-Mail

Phone No

*What is the nature of the organisation's business?

Premises where (or from where) the work activity is to be carried out

Organisation address only Organisation address and other premises Other premises only

- When radon levels in workplace $>400 \text{ Bq m}^{-3}$ (mid-winter corrected), HSE must be informed
- Web search for IRR6 notification



Action Level and Target Level - Homes

Action Level

- PHE recommends radon be reduced in homes where $>200 \text{ Bq m}^{-3}$
- Refers to annual average concentration, so radon measurements are carried out with two detectors (in a bedroom and living room) over three months, to average out short-term fluctuations.

Target Level

- Target Level of 100 Bq m^{-3} is the ideal outcome for remediation works in existing buildings and protective measures in new buildings.
- If result of assessment between Target and Action Levels, action to reduce should be seriously considered, especially if smoker / ex-smoker in the home.

Building Regulations

- Buildings can be made radon-resistant at the construction stage
- The Building Regulations 2010 Approved Document Part C (Resistance to contaminants and moisture)

"...all new buildings, extensions and conversions, whether residential or non-domestic, built in areas where there may be elevated radon emissions, may need to incorporate precautions against radon."

- Do not assume that this has been carried out
- **Do not assume that it has been effective – test all new buildings in radon Affected Areas.**

Mitigation reasons

Where radon levels are more than Action Level

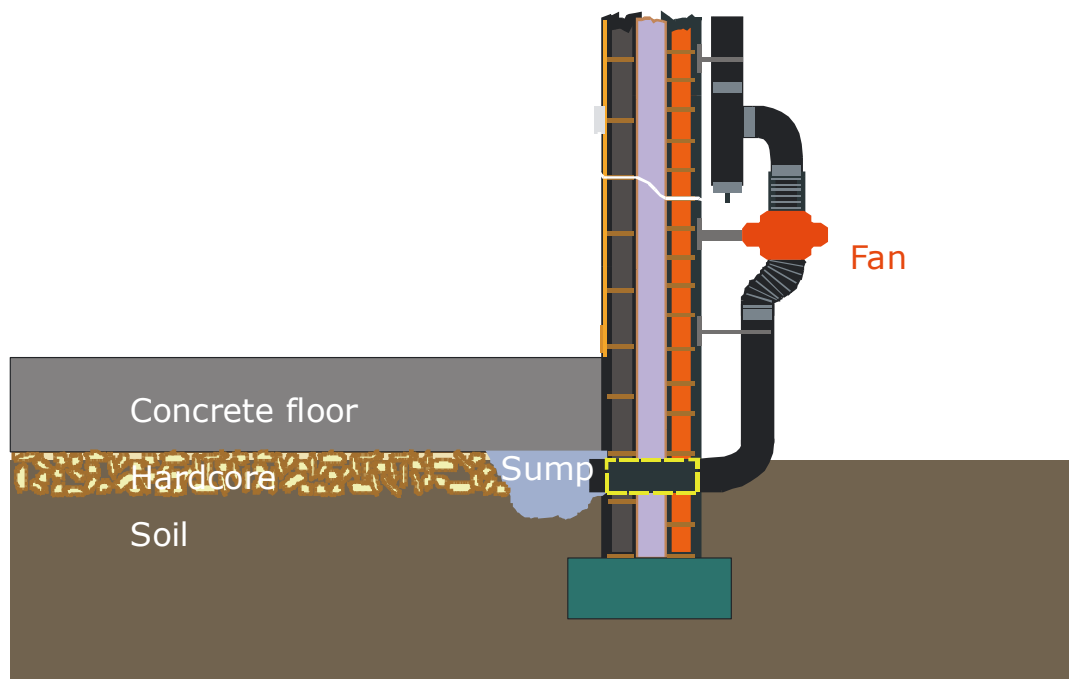
- Cannot remove source, i.e. ground
- Regulations require employee protection
- Routinely occupied areas
- Mitigation is usually straightforward
- Proven, effective, long term solution



GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

Radon sump



Effective over about 250 m².

Low pressure zone under floor.

Diverts radon laden air from room

Unaffected by room conditions

but:-

- requires permeable ground
- sub floor detail can interfere
- constant fan operation
- needs floor excavation

Installation - requires no special skills, but understanding of mechanism generally within scope of local builder

Effectiveness: high

Average reduction factor = 14; maximum reduction factor = 110

Sump and fan



Note exposed fan near window - noise can be intrusive, especially at night



GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

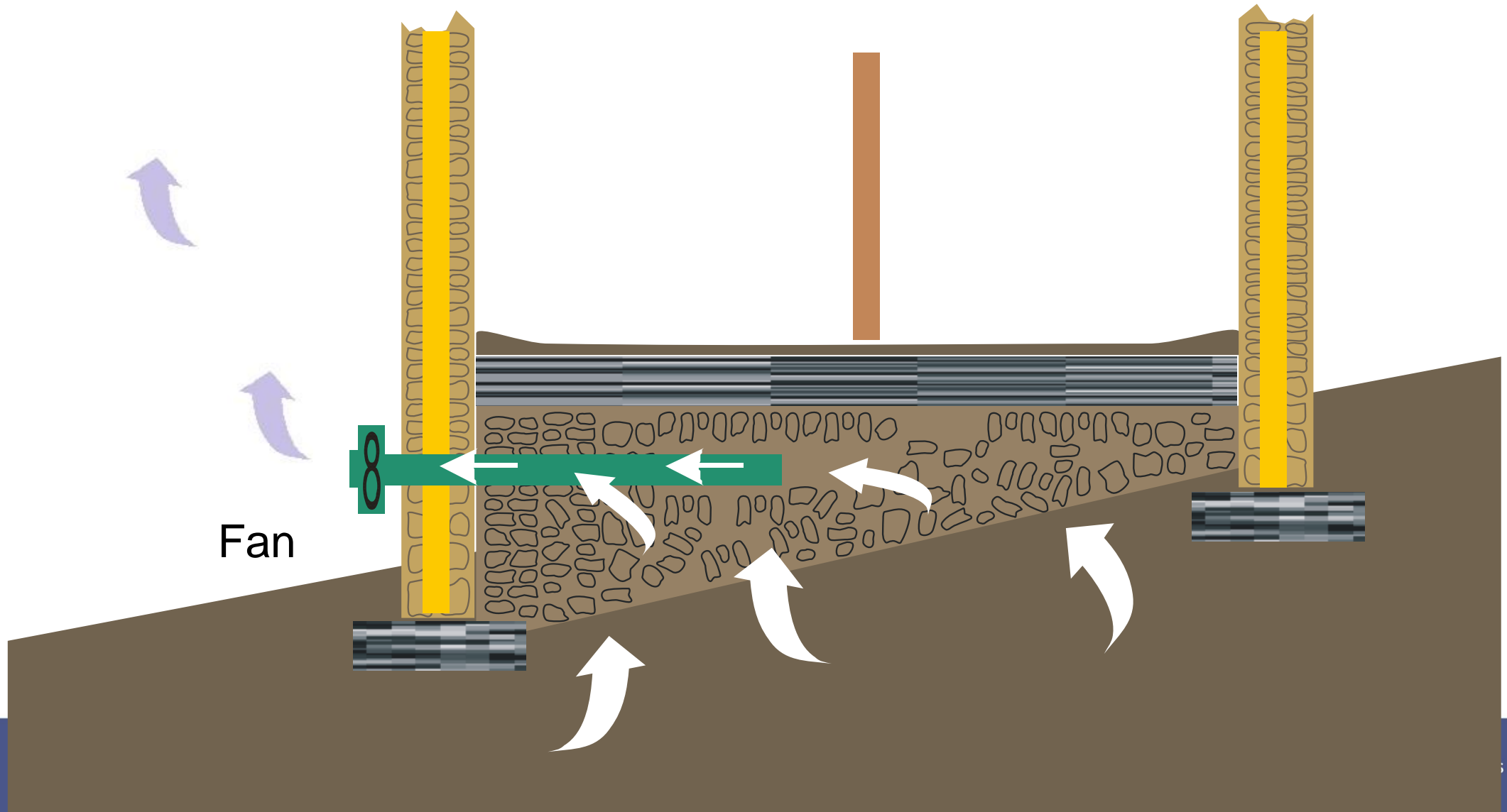
Externally sited low level mini-sump



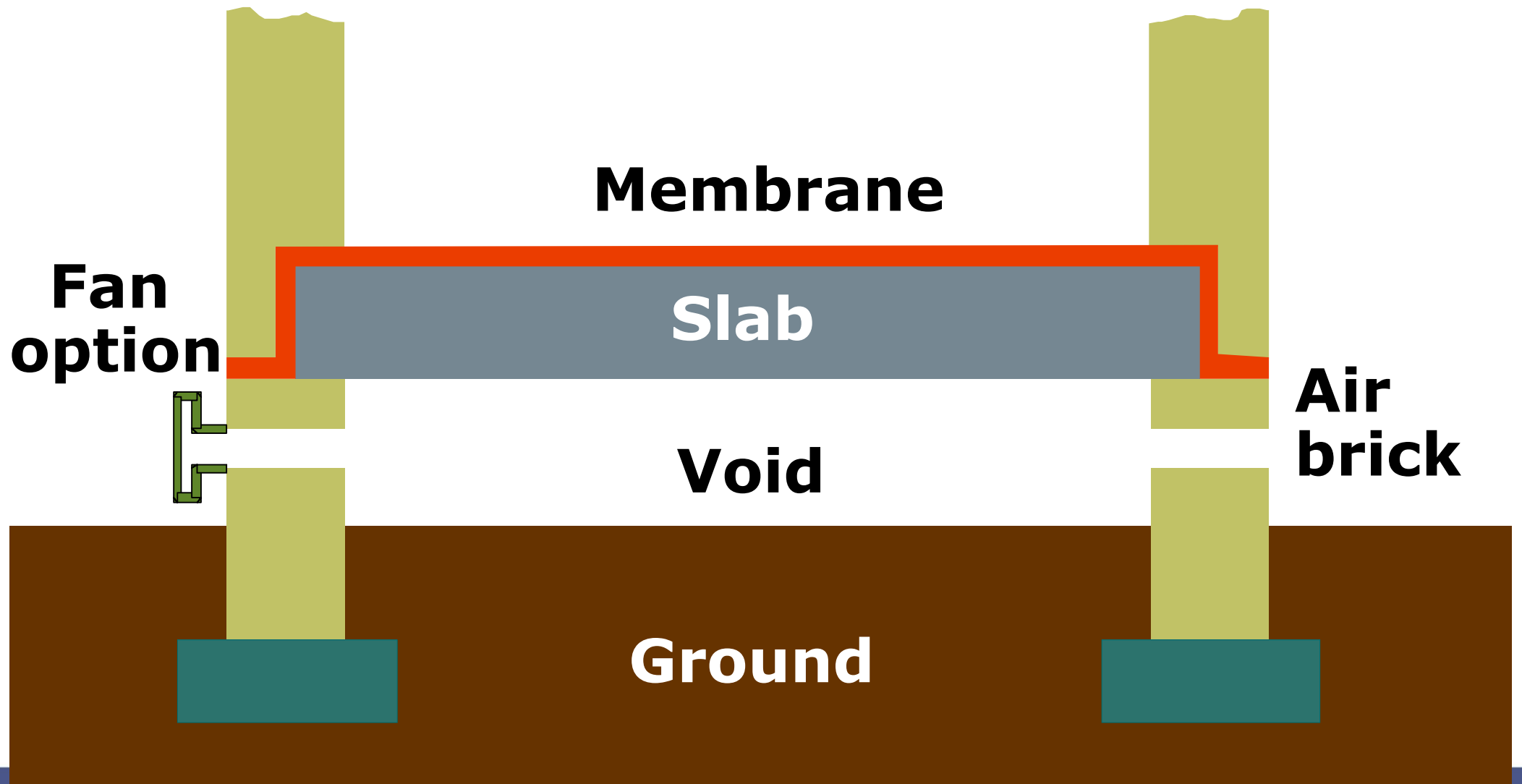
GIG
CYMRU
NHS
WALES

Iechyd Cyhoeddus
Cymru
Public Health
Wales

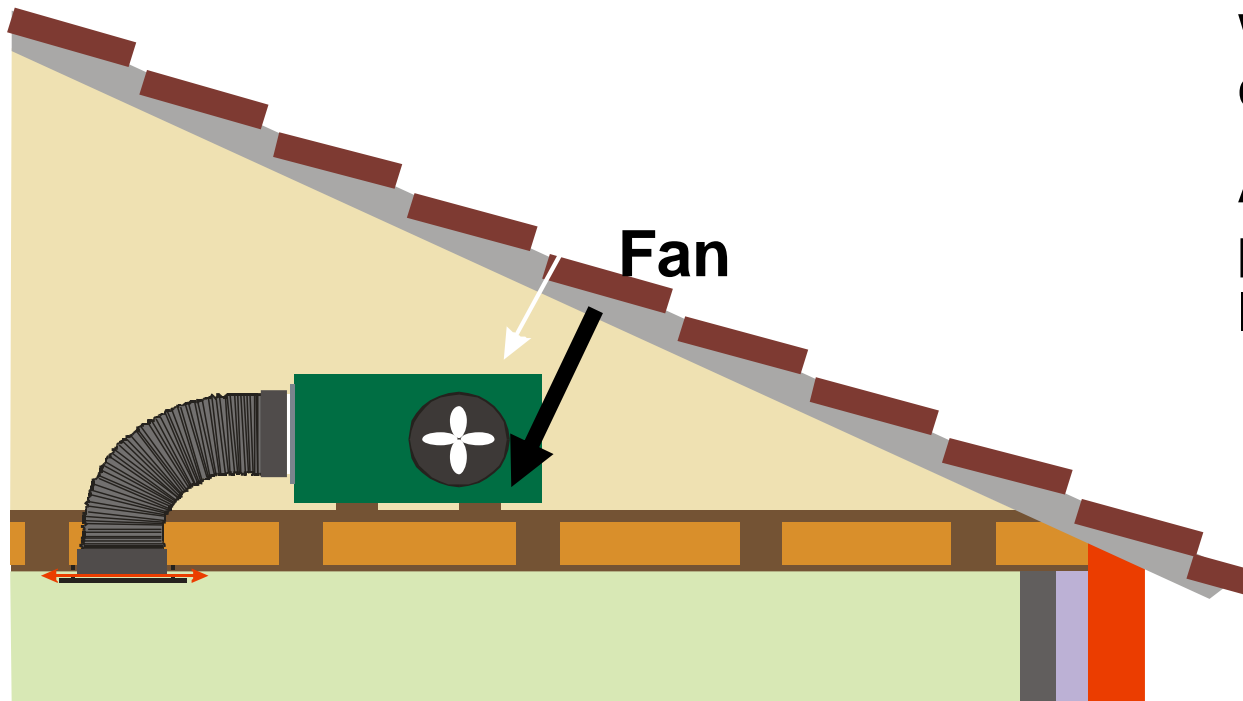
Sub-soil extraction – fan and pipe



Anti-radon design



Operation of roof fan



Can produce radon reduction within localised zone (and solve condensation problems)

Air delivery increases indoor pressure, reducing flow of radon laden air from the ground.

Depends on indoor conditions

- requires low ventilation
- localised effect
- constant fan operation

Installation - specialist installer, effect cannot be guaranteed so would need agreement on target reduction and recourse.

Effectiveness: moderate (in favourable situations)

Average reduction factor = 3.4; maximum reduction factor = 24

Radon resources

- UK Radon

<http://www.ukradon.org/>

- HSE Radon in the workplace

<http://www.hse.gov.uk/radiation/ionising/radon.htm>

- Welsh Government

<http://gov.wales/topics/health/protection/environmental/radon/?lang=en>

- Public Health Wales

<http://www.wales.nhs.uk/sitesplus/888/page/81979/>

- UK Radon Association

<http://www.radonassociation.co.uk/guide-to-radon/information-for-landlords-and-tenants/>

END

publichealth.environment@wales.nhs.uk