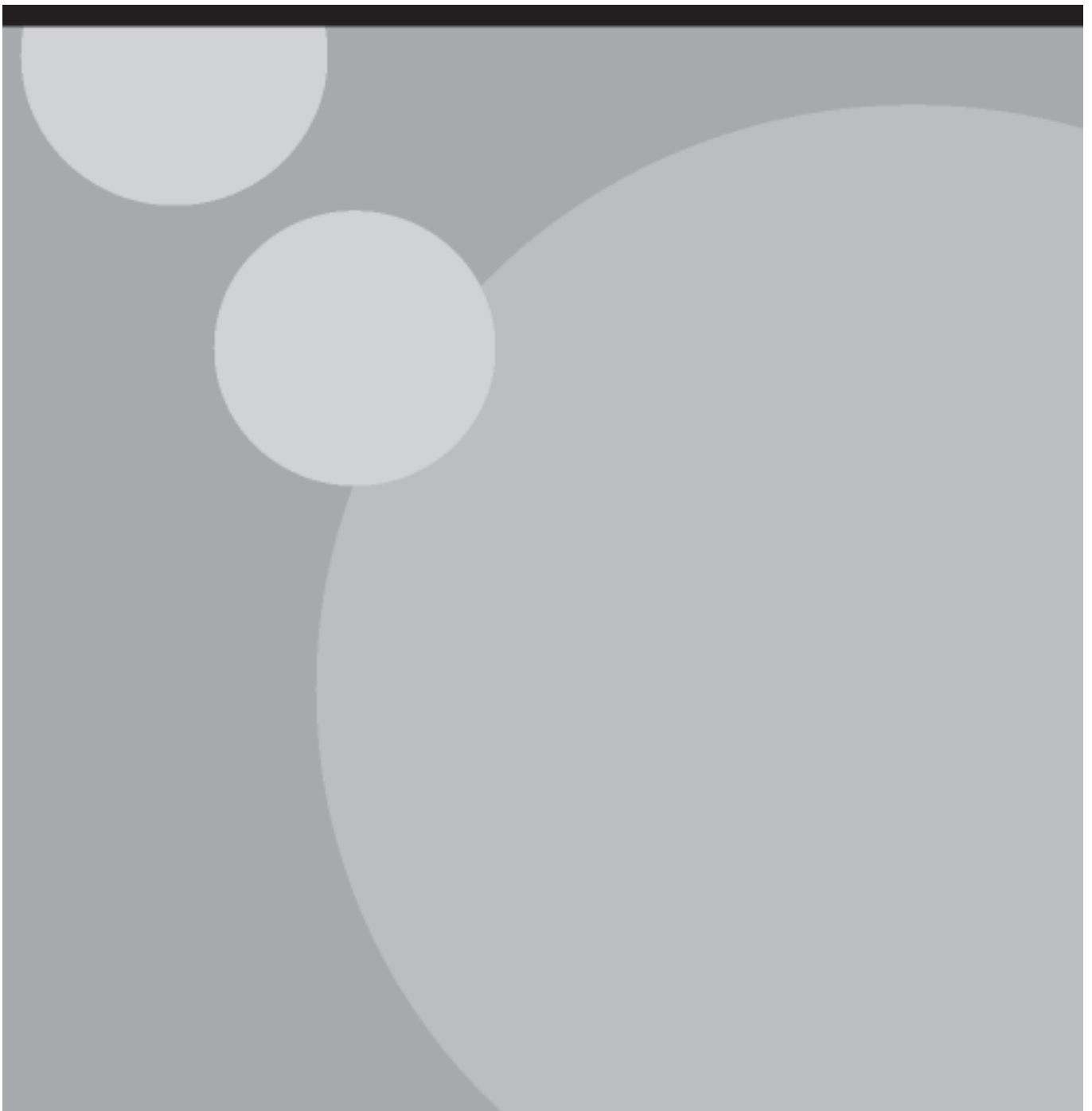




# Changes to Part C (Site preparation and resistance to contaminants and moisture) of the Building Regulations in England: Radon

Consultation stage impact assessment





Changes to Part C (Site preparation and resistance to contaminants and moisture) of the Building Regulations in England: Radon

Consultation stage impact assessment

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<b>Title: Changes to Part C (Site preparation and resistance to contaminants and moisture) of the Building Regulations in England: Radon</b>  <b>IA No: DCLG 0077</b>  <b>Lead department or agency:</b> Department for Communities And Local Government (DCLG) <b>Other departments or agencies:</b>	<b>Impact Assessment (IA)</b>			
	Date: 22/11/2011			
	Stage: Consultation			
	Source of intervention: Domestic			
	Type of measure: Secondary legislation			
Contact for enquiries: Guy Bampton				

<b>Summary: Intervention and Options</b>	<b>RPC: GREEN</b>
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Cost of Preferred (or more likely) Option				
Total Net Present Value	Business Net Present Value	Net cost to business per year (EANCB on 2009 prices)	In scope of One-In, One-Out?	Measure qualifies as
£7.3m	£-4.9m (minus)	£0.5m	Yes	IN

**What is the problem under consideration? Why is government intervention necessary?**

Radon is a naturally occurring radioactive gas linked to lung cancer deaths. It occurs with different intensity levels and so presents varying levels of risk across the UK. Government policy to address these risks includes a Health programme to raise awareness, measurement and remediation of radon risk in existing buildings. In addition Building Regulations require developers and builders to include reasonable precautions in new buildings to avoid radon impacts on occupants' health. However, the statutory guidance accompanying these Regulations refers to out of date maps and might be updated to ensure appropriate radon precautions are provided

**What are the policy objectives and the intended effects?**

We intend that the Building Regulations and supporting statutory guidance is clear on current radon risks, and ensures buildings are fitted with proportionate measures to prevent the ingress of radon and thus reduce radon-related lung cancers.

**What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)**

Three options have been considered in this impact assessment: (a) do nothing; (b) updating the Building regulations guidance to align it with the current radon risk maps (Option 1); and (c) extending the statutory guidance to require radon protective measures to be fitted to all new buildings in England (Option 2), in response to a Health Protection Agency recommendation that Building Regulations be extended so *all* new buildings across the UK are fitted with at least basic radon protective measures.

The Department for Communities and Local Government issued a Circular Letter in 2008 promoting the use of the new radon maps as good practice. Following this non-regulatory action a high proportion of industry started providing protective measures in line with these maps. Our preferred option is Option 1, maintaining a policy of targeted regulatory intervention aligned with the latest radon maps, to counter the risk that some do not voluntarily subscribe to a good practice approach. Our assessment is this option has a strong net benefit.

<b>Will the policy be reviewed?</b> It will be reviewed. <b>If applicable, set review date:</b> 04/2017					
Does implementation go beyond minimum EU requirements?			No		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	<b>Micro Yes</b>	< 20 Yes	<b>Small Yes</b>	<b>Medium Yes</b>	<b>Large Yes</b>
What is the CO2 equivalent change in greenhouse gas emissions? (Million tonnes CO2 equivalent)			<b>Traded:</b>		<b>Non-traded:</b>

***I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.***

Signed by the responsible Minister: \_\_\_\_\_ *Andrew Stunell* \_\_\_\_\_ Date: 25 November 2011

# Summary: Analysis & Evidence

# Policy Option 1

Description: Update Building Regulations requirement with 2007 radon maps

## FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: £5.5m	High: £9.1m	Best Estimate: £7.3m

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0	£0.67m	<b>£5.8m</b>
High	0	£0.95m	<b>£8.2m</b>
Best Estimate	0	£0.81m	£7.0m

### Description and scale of key monetised costs by 'main affected groups'

Much of industry has adopted a good-practice approach of installing radon protection in risk areas identified on the latest radon maps. This option aims to ensure **all** developers and builders who undertake extension building do. £5million of its total PV costs of £7million relate to new homes and fall to home builders who have not adopted - and currently are not incentivised to adopt - the industry good practice approach. The other £2million are costs for protecting extensions, which fall to consumers. This is explained further in paragraphs 42 and 46.

### Other key non-monetised costs by 'main affected groups'

None.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	£1.31m	<b>£11.3</b>
High	0	£2.00m	<b>£17.3</b>
Best Estimate	0	£1.66m	£14.3

### Description and scale of key monetised benefits by 'main affected groups'

Option 1 delivers additional health benefits which are assessed in terms of the quality of life benefit gained. These are gained as a result of protective measures improving the population health risk.

### Other key non-monetised benefits by 'main affected groups'

Non-monetised social benefits may include the reduced emotional stress for families and friends of the people who do not suffer lung cancer as a result of this intervention. There are potential non-monetised health benefits from this option from potential reduction in cancer risk levels for visitors to the buildings fitted with protective measures. We believe these are in addition to the monetised benefits within the QALY value used in this assessment.

### Key assumptions/sensitivities/risks

Discount rate (%) 3.5%

Key assumptions in our assessment include: those based on Health Protection Agency publications about radon and cancer risks (including the cancer risks and the link to smoking), the efficacy of radon protective measures, the costs of these measures, the build rates for the coming decade from 2013, and the counterfactual of radon protective measures provided as good practice. These are described in more detail in paragraph 86.

## BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m: (2011 prices) Costs: £0.6m	Benefits: 0	Net: £0.6m	In scope of OIOO? Yes	Measure qualifies as IN
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# Summary: Analysis & Evidence

# Policy Option 2

Description: Extend Building Regulations to require basic radon protection for all new build

## FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 10	Net Benefit (Present Value (PV)) (£m)		
			Low: -£97.2m	High: -£127.7	Best Estimate: -£112.4m

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	£10.4m	£30.7m	£264.1m
High	£10.4m	£45.3m	£389.5m
Best Estimate	£10.44	£36.8m	£326.8m

### Description and scale of key monetised costs by 'main affected groups'

Costs of between about £188million and £313million from extended Building Regulations to ensure all new buildings are fitted with radon protective measures would fall to new home builders. It is considered that approximately £65million additional costs for building ground floor extensions will be passed to consumers. Transitional costs will all be borne by industry.

### Other key non-monetised costs by 'main affected groups'

None identified.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	£19.4m	£166.9
High	0	£30.4m	£261.8
Best Estimate	0	£24.9m	£214.4m

### Description and scale of key monetised benefits by 'main affected groups'

Option 2 delivers health benefits in addition to those secured by option 1, assessed in terms of the quality of life benefit gained. These are gained as a result of all new buildings and extensions being provided with protective measures improving the population health risk.

### Other key non-monetised benefits by 'main affected groups'

Non-monetised social benefits may include the reduced emotional stress for families and friends of the people who do not suffer lung cancer as a result of this intervention. There are potential non-monetised health benefits from this option from potential reduction in cancer risk levels for visitors to the buildings fitted with protective measures. We believe these are in addition to the monetised benefits within the QALY value used in this assessment.

### Key assumptions/sensitivities/risks

Discount rate (%) 3.5%

Key assumptions in our assessment include: those about radon and cancer risks (including cancer risks and the link to smoking), the efficacy and unit costs of radon protective measures, build rates for the decade from 2013, and the counterfactual of radon protective measures provided as good practice - described in more detail in paragraph 86 - and that costs and benefits of this Option are in addition to those of Option 1.

## BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m: (2011 prices) Costs: 30.3	Benefits: 0	Net: 30.3	In scope of OIOO? Yes	Measure qualifies as IN
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## Evidence Base (for summary sheets)

### What is the problem under consideration? Why is Government intervention necessary?

#### Background on the Building Regulations

- 1) The Building Regulations 2010 control certain building work - principally to protect the health, safety and welfare of people in or around buildings.
- 2) The Regulations themselves are expressed in “functional” terms and do not dictate how the desired level of performance *must* be achieved. However, for the benefit of both industry and building control bodies, advice on how the requirements of the Building Regulations *may* be met are contained in guidance approved by the Secretary of State, known as Approved Documents. These cover some of the more common building situations, but there may well be alternative ways of achieving compliance with the provisions. However, if followed, the guidance in Approved Documents may be relied upon in any proceedings as tending to indicate compliance with the Building Regulations.
- 3) Part C of Schedule 1 to the Building Regulations requires the buildings it addresses - generally new buildings and extensions including material changes of use - to be constructed in such a way as to deliver reasonable precautions to avoid danger to the health and safety of occupants which might arise from the site or contaminants it contains, and to provide them adequate protection from moisture such as groundwater and rain. Contaminants include radioactive substances including radon gas.
- 4) In a comparable way to other Approved Documents, the existing guidance in Approved Document C explains technical approaches which it states, if followed, will demonstrate compliance, but is not exclusive of other approaches being used to show compliance. Approved Document C (last updated in 2004) provides guidance relating to contaminants including guidance on radon probability maps and protective measures.

#### Background on radon

- 5) Since 1988 the contaminants addressed by Part C have included radon. Radon is a naturally occurring radioactive colourless and odourless gas that can seep out of the ground and build up in houses, buildings, and indoor workplaces. Epidemiological studies have established that exposure to radon is a cause of lung cancer, with a linear dose-response relationship. Exposure to radon is now recognised as the second largest cause of lung cancer in the UK after smoking and analysis for the Health protection Agency indicates that about 1100 UK deaths from lung cancer each year are caused by exposure to radon (most caused jointly by radon and smoking).
- 6) Radon concentrations within buildings are determined by various factors including the geology of the ground, construction details and factors such as the methods of heating and ventilation. The concentration is measured in Bequerels per cubic metre (Bq m<sup>-3</sup>). Advice published by the Health Protection Agency<sup>1</sup> explains how health experts estimate that an increase in radon concentration of 100 Bq m<sup>-3</sup> in a dwelling increases an occupant's risk of lung cancer by up to 31%, with a central estimate of 16%.

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<sup>1</sup> “Limitation of Human Exposure to Radon – Advice from the Health Protection Agency” – [www.hpa.org.uk](http://www.hpa.org.uk)

- 7) The available evidence suggests this percentage increase in lung cancer risk applies for men and women, across all age groups and for current smokers, ex-smokers and lifelong non-smokers. Since the baseline risk of lung cancer is much higher among smokers than non-smokers, and as radon appears to act to increase cancer risks in smokers in a multiplicative way, this means that - in absolute terms - the increase in lung cancer risk due to radon is much higher among smokers than non-smokers. The respective cumulative risks of lung cancer affecting people by age 75 years in the UK at 100 and 200 Bq m<sup>-3</sup> are 0.42% and 0.47% for non-smokers and 17% and 19% for continuing smokers. The risks for ex-smokers will be in between the risks for these two groups, with a risk level which varies according to when they stopped smoking.
- 8) The Health Protection Agency and others are carrying out additional work examining radon related health risks and the Department welcomes the continued advice from the Agency on this.

### The Problem

- 9) In addition to examining the health risk evidence, the Health Protection Agency carries out surveys and tests of radon activity in existing buildings in the UK. The information from these is used in radon mapping by the Agency with the British Geological Survey. The Agency publishes atlases of probabilistic radon activity maps for the UK. The Building Research Establishment has, since 1998, published guidance<sup>2</sup> that shows the areas of increased radon levels and technical details of measures that can be installed to provide precautions against radon.
- 10) The current (2004) edition of Approved Document C, by reference to the Building Research Establishment (1999) guidance, outlines the radon action areas (areas of elevated risk) in England where radon protective measures should be installed. These are described as areas where either “basic” or more comprehensive “full” protective measures should be provided: these respectively are the areas where between 3-10% and where more than above 10% of homes surveyed were found to have radon levels above 200 Bq m<sup>-3</sup>, respectively. This publication also provides technical guidance on different construction approaches that can be used in these areas to provide reasonable precautions against radon.
- 11) In 2007, following detailed surveys and studies, the Health Protection Agency and the British Geological Survey published an updated atlas of radon maps. These show how the areas of higher levels of radon are more widespread than those identified in 1999. BRE also published a revised BR211 “Radon: Protective Measures in New Homes” in 2007, with the maps of areas where radon protection is required updated in line with the revised atlas.
- 12) In outline, “basic” radon protective measures involve the fitting of a gas tight ground barrier to protect against radon ingress. This, which also acts as a damp-proof membrane, should cover the whole building foot print and be lapped to the damp proof course in the walls and sealed around service penetrations.
- 13) “Full” radon protective measures require the radon-proof ground barrier together with a sump in the foundation ready to take a fan if high levels of radon are detected after occupancy.

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<sup>2</sup> This guidance includes BR211 “Radon: Protective Measures in New Homes” - published in 1999, revised in 2007



## Rationale for intervention

- 14) In 2008, the Department for Communities and Local Government issued a Circular Letter highlighting the revised radon maps, their implications and the updated BR211 guidance. It also indicated that we would look to update Approved Document C to align it with this revised guidance – work we are now doing. The Department also used that Circular Letter to recommend as good practice the use of the latest revised guidance in BR211.
- 15) Evidence from Building Control<sup>3</sup> indicates that the 2008 Circular Letter has had considerable influence in promoting this good practice and as a result at least 70% of development in the new areas of higher radon risk is now carried out using appropriate protective measures. However, it appears the Letter has not been successful in ensuring all new homes, major alterations and extensions are being built with suitable radon protection measures in the relevant areas. We will use the consultation process to firm up our current estimates.
- 16) This market failure may result from builders lacking sufficient incentive to build radon precautions into work in the new areas, when it is not seen as a regulatory requirement described in Approved Document C. They are exposed only to costs that arise from installing protective measures and do not receive the benefits that subsequently accrue. Furthermore, as householders and homebuyers often lack awareness of or interest in radon, they may not make informed decisions about their homes and radon precautions and so fail to create a demand for these precautions as good practice.
- 17) If a significant minority of development activity is not providing appropriate radon precautions in line with the latest maps, because this is not seen as a requirement described by the statutory guidance in Approved Document C, the absence of suitable radon protective measures in new developments will place occupants at higher risk of exposure to radon and associated health impacts. We consider intervention to address this in Option 1.
- 18) Additionally, in its 2010 advice on the limitation of human exposure to radon, the Health Protection Agency repeated its Board's 2008 recommendations including "*Building Regulations and supporting documents should be amended to ensure all new buildings, extensions, conversions and refurbished buildings in the UK include (at least) basic radon protective measures*". The Agency has also published analysis by its Advisory Group on Ionising Radiation to support this recommendation. We have considered these recommendations alongside the examination of updating the current policy of targeted intervention with the current radon maps outlined above. We consider this in Option 2. The Health Protection Agency also, at the same time, recommended that we amend Building Regulations to require radon tests to be carried out in new homes built with "full" measures in the first year of occupation. We lack the evidence to analyse this as an option, but we continue to discuss it with the Agency and the Department for Health and we will examine it further during the consultation.

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<sup>3</sup> This includes advice to us from NHBC – which provides the building control service for the majority of new housing developments in England – that it looks to developers to provide protective measures in line with the 2007 versions of BR211 and radon maps.

- 19) Building Regulations apply to “building work” as defined (typically the erection, extension, alteration or conversion of a building) and seek to ensure buildings meet certain standards for minimum health, safety, welfare and sustainability. Part C seeks to ensure that building work is carried out to provide reasonable precautions to avoid danger to health and safety from contaminants including radon in the ground covered by and associated with the building.
- 20) As the legislative provision is “functional”, statutory guidance contained in the Approved Documents sets some of the ways, for the more common buildings, of ensuring baseline levels of health, safety etc are achieved when constructing buildings. This provides clarity for building control bodies and industry alike as it sets out what is sufficient (whilst allowing flexibility to provide alternative building approaches where beneficial). Importantly, it also ensures that a proper cost/benefit assessment and consultation with industry has been undertaken by Government to assess what reasonable minimum standards are appropriate (and avoids the risk of unnecessarily onerous and costly standards being imposed on industry).
- 21) DCLG undertook an exercise in the latter half of 2010 to determine what changes were necessary to the Building Regulations to ensure they remained fit-for-purpose, with a particular emphasis on identifying measures to reduce the cost of regulation to business and any other “must do” regulatory changes.
- 22) There were 248 responses from our external partners to this exercise. In addition, DCLG drew upon ideas and suggestions submitted to the Cabinet Office’s *Your Freedom* and DCLG’s own website. A summary and analysis of responses and details of the work being considered in advance of the consultation this proposal forms a part of is contained in *Future changes to the Building Regulations – next steps*<sup>4</sup>. As set out in this document:

*“Few responses questioned the principle of regulations setting national standards that ensure buildings are built to baseline standards, although there was some comment that they were on firmest grounds in relation to health and safety rather than wider sustainability objectives. Many specifically recognised the positive role Building Regulations played and welcomed the fact that there was a nationally applied set of minimum requirements.”*
- 23) The exercise undertaken last year demonstrated, therefore, that the general approach to regulating through the Building Regulations (functional requirements supported by guidance as to how to comply) was supported by external partners. In relation to Part C, those that responded did not question the existing approach to radon protection.

## **Policy Objective**

- 24) To ensure buildings are fitted with proportionate measures to prevent the ingress of radon and thus reduce radon-related lung cancers.

## **Policy Options considered**

- 25) Three options are considered in this Impact Assessment:
  - i. Option 0 – do nothing / leave industry to provide radon protective measures as good practice.

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<sup>4</sup> Future changes to the Building Regulations – next steps. Published by DCLG in December 2010. Available at [www.communities.gov.uk/publications/planningandbuilding/buildingregsnextsteps](http://www.communities.gov.uk/publications/planningandbuilding/buildingregsnextsteps)

- ii. Option 1 – update Approved Document C to align the current policy of targeted intervention with the 2007 radon maps.
  - iii. Option 2 – update and amend the Approved Document C to require radon protective measures in all new buildings and extensions, as recommended by the Health Protection Agency.
- 26) The “do nothing” option is not preferred because:
- i. The current Approved Document guidance is not aligned with the latest maps of radon risk, and buildings and extensions may be built in the additional areas of higher risk shown on the latest maps without reasonable levels of radon precautions
  - ii. This would leave occupants exposed to what are considered to be unacceptable levels of radon exposure and lung cancer risks
  - iii. There is evidence to indicate that this might be happening.
- 27) Option 1 is preferred to avoid the adverse impacts set out under the “do nothing” option above. It will require either basic or full radon protective measures, as appropriate, to be provided to new buildings in the newly mapped areas of higher radon risk. This maintains but extends the current policy of targeted intervention in areas of higher risk and has clear health benefits over the current situation. Our analysis shows that this targeted approach has a significant benefit to cost ratio.
- 28) In Option 2 we have examined the recommendation to require all new homes irrespective of locality and level of radon risk to have basic radon protection installed at the point of construction. This option is not preferred because we have not been able to establish a compelling assessment showing that the health benefits justify the additional costs.
- 29) More information on the costs and benefits is contained below.

### **Costs and benefits**

- 30) In developing this Impact Assessment DCLG has drawn upon work carried out by the Health Protection Agency and its Advisory Group on Ionising Radiation. The costs and benefits detailed below are calculated using 2011 prices. For the purposes of calculating the Equivalent Annual Net Cost to Business in the summary sheet at the beginning of this Impact Assessment we have rebased to 2009 prices using the Treasury's GDP deflator.
- 31) Although the Building Act currently allows Building Regulations to be made for England and Wales, from the end of 2011 Building regulations for Wales will be a devolved matter. The costs and benefits presented in this section therefore only reflect those related to new homes and domestic extensions for England.
- 32) Radon in the workplace - effectively all non-domestic buildings in which people spend significant amounts of time - is addressed by workplace safety regulations and guidance<sup>5</sup> which the Health and Safety Executive has already updated in line with the 2007 radon maps. It is assumed that non-domestic buildings will be fitted with appropriate radon protective measures (in line with the 2007 maps) or, unlike homes, if they are not management action will identify the need for and introduce remedial work to provide reasonable levels of precautions to safeguard the health of occupants. This is in line with

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<sup>5</sup> Relevant HSE guidance provided in accordance with the requirements of the Health and Safety at Work Act 1974, the Management of Health and Safety at Work Regulations 1999 and the Ionising Radiation Regulations 1999 - <http://www.hse.gov.uk/radiation/ionising/radon.htm>

the approach in 2004 when reference to non-domestic buildings was first included in Approved Document C.

Costs – Option 0, do nothing

33) There are no costs for this option since it is the baseline.

Benefits – Option 0, do nothing

34) There are no benefits associated with this option.

Costs – Option 1

35) The costs associated with this option are the additional build costs which will result from updating Approved Document C so it explicitly refers to BR211 2007 and requires that appropriate radon protective measures are installed in all new homes and extensions built in the additional radon risk areas identified on the 2007 maps. We have, as outlined above, identified the counterfactual that industry practice is already delivering at least about 70% of what is intended, and so we have adjusted (reduced) the costs and benefits to reflect this assumption which will be examined further during the consultation.

Costs – Option 1, targeted protective measures in new homes

- 36) Estimates of the additional cost of basic radon measures for new houses (ie over and above the cost of installing a normal damp-proof membrane) vary with the size, type and proposed construction of the building. Discussions with industry have identified cost estimates for “basic” radon protective measures for new houses between £100 and £400, and £85 extra for the additional sump needed for “full” measures. Our working assumption has been to take a mean value of £250 for “basic” protection for a house and an additional £85 for “full” measures (taking the cost of “full” measures up to £335 for a house).
- 37) Our assessment of the costs of radon protective measures for apartment flats has the following assumptions: protective measures are only required at ground level; the cost per ground floor square metre of radon protective measures for an apartment block is the same as for a two storey house; a typical flat has a floor area of about 60m<sup>2</sup>, equivalent to about 70 per cent of the entire floor area of a typical house<sup>6</sup>; and the ground floor area of a typical block of flats is about 6 times that of a typical house. Assuming that the cost of protection is proportional to ground floor area<sup>7</sup>, our working assumptions are that the average cost of providing protection for the ground floor of a typical block of flats would be £1,400 for “basic” protection and £1,880 for “full” protection.

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<sup>6</sup> Research to assess the costs and benefits of the Government's proposals to reduce the carbon footprint of new housing development. CLG September 2008.

<sup>7</sup> Taking the average area of a typical house being 85.6m<sup>2</sup>, the ground floor area is 42.8 m<sup>2</sup>. And so £250 is £5.84 per square metre and £335 is £7.83 per square metre.

- 38) These unit costs are summarised in Table 1 below. We will examine the assumptions behind these in the consultation.

**Table 1 Working assumptions of costs of protective measures**

“Basic” radon protective measures to a 82.5m <sup>2</sup> house (typically £5.84 per square metre, ground floor of 42.8m <sup>2</sup> )	£250
Cost of providing full provision to houses (£250+85 for sump, or £7.83m <sup>-2</sup> )	£335
Cost of providing “basic” provision to a typical block of apartments. (16 over four floors. Ground floor area of 4x60m <sup>2</sup> , @ £5.84m <sup>-2</sup> )	£1400
Cost of providing “full” provision to a typical block of apartments. (Ground floor areas of 4x60m <sup>2</sup> , @ £7.83m <sup>-2</sup> )	£1880

- 39) When appraising the costs over 10 years associated with updating the requirement in Approved Document C we extrapolated from DCLG housing projections to identify that 6830 additional new homes should be built in 2013 with radon protective measures as a result of the 2007 map changes. Government projections indicate that this annual figure will rise to 10,814 in 2022, with a 10 year total of 90,494. However, assuming a counterfactual that industry good practice is already delivering 70% of this target, we have calculated the costs of regulating as the incremental increase in costs that would occur by a change in Approved Document C to ensure the remainder (up to 30%) are provided with appropriate protective measures. This adjusts the figures the unit costs need to be applied to down to 2049 in 2013, rising to 3244 in 2022 with a 10 year total of 27,147.
- 40) Furthermore, when comparing the additional radon risk maps with housing projections we also have also established that 72% of these new homes will require “basic” protective measures and 28% will require “full” measures in accordance with the guidance in BR211 2007. We have also adopted a working assumption that these new homes will follow the national pattern of 68% houses and 32% apartment flats<sup>8</sup>. Our calculation establishes the year 1 (2013) undiscounted costs as £436,430.
- 41) In our 10 year appraisal, using a 3.5% discount factor, we have then identified that the change in new build costs associated with updating Approved Document C to align it with the 2007 radon maps has a total (present value cost) of £4.9million, an average annual cost of £0.56million (both at 2011 prices). We have also calculated the range of present value costs if housing supply varies by 25% either side of government projections: this gives a range £3.7million to £6.1million.
- 42) It is unlikely that home builders would be able to pass these costs on to buyers and so we have assessed that all the additional costs fall to home builders. As all these costs fall to business, we have calculated the annual equivalent net cost to business of the central estimate: £0.6million at 2011 prices or £0.5million when recalculated at 2009 prices for “One In One Out” purposes. The equivalent annual net cost to business ranges between £0.375 and £0.625million.

<sup>8</sup> Housing estimates and projections, United Kingdom, 1961-2013, DCLG 2009.

### Costs – Option 1, targeted protective measures in domestic extensions

- 43) We have based our estimates of the cost of radon protective measures for extensions on the estimates for protective measures for houses. Assuming that on average an extension covers an area of land about one third of that covered by a new build house, we estimate that the costs of “basic” protective measures for an extension are about £100. This is more than a third of those for a new house because there are some cost items that are proportionately more expensive, such as construction-details at the edges. Where a sump as part of “full” radon measures is provided to an extension, we believe it is reasonable to assume this will cost the same as for a new house. Our working assumptions therefore have been to use a cost estimate of £100 for “basic” protection for an extension and an additional £85 for “full” measures (taking the cost of “full” measures up to £185 for an extension).
- 44) In appraising the costs over 10 years associated with updating the requirement in Approved Document C we have established from DCLG housing statistics that there are 1.73 million dwellings in the new radon affected areas and we have assumed that, in line with national trends, 68% of these are houses and 0.57% are extended on the ground floor each year. From this we have calculated that there are likely to be 6811 extensions in these new areas. Using the same counterfactual assumption as for new homes, ie that 70% are already being built with appropriate radon protective measures as a result of industry good practice following the 2008 Circular Letter, we have calculated the costs of regulating as the incremental increase in costs that would occur by a change in Approved Document C to ensure the remaining 30% are provided with appropriate protective measures. This adjusts the figures the unit costs need to be applied down to 2043 per annum. There are upward pressures on this figure if more householders extend their homes instead of moving house. There may also be downward pressures as some householders delay plans to build extensions due to income, work or other concerns. We have, therefore, used a working assumption in our assessment that this level will remain broadly constant and we will examine this further during consultation.
- 45) We have in our assessment adopted the same assumption as for new houses that 72% of these new extensions will require “basic” protective measures and 28% will require “full” measures in accordance with the guidance in BR211 2007. We identified the year 1 (2013) undiscounted costs as £242,982. Our 10 year appraisal, using a 3.5% discount factor, shows the change in build costs for extensions associated with updating Approved Document C to align it with the 2007 radon maps has a total (present value cost) of £2.1million, an average annual cost of £0.24million (both at 2011 prices).
- 46) The extension market operates differently from the new build market, and builders are able to pass additional construction costs that might arise from regulatory requirements and changes onto their customers. We have assumed that the additional build costs for extensions arising under Option 1 will fall to owners and occupiers and so there is no cost to business. Therefore we have not calculated an annual equivalent net cost to business for this element of Option 1.

47) We have assumed for this assessment that as at least 70% of developments are already being built with radon protection as good practice in the additional radon areas of the 2007 maps, significant market transformation in these areas has already occurred and no additional transitional costs will result from this option, as designers, constructors and building control already have experience of radon protective measures. However, we will use the consultation to test this assumption and to examine if small amounts of transitional activities and costs might arise from this option causing any builders with no experience of radon precautions to encounter the requirements for the first time.

### **Costs – Option 1, summary**

48) **Our 10 year appraisal, using a 3.5% discount factor, shows that Option 1, updating Approved Document C to align it with the 2007 BR211 radon maps, has established:**

- **Year 1 (2013) undiscounted costs as £0.68million**
- **A present value cost estimate of £7million (£4.9million for new homes and £2.1 million for extensions)**
- **A present value cost range of £5.8million to £8.2million (£3.7million to £6.1million for new homes and £2.1million for extensions)**
- **An average annual cost of £0.81million (£0.56million and £0.24million) with average annual costs ranging from £0.67million to £0.95million**
- **An EANCB, annual equivalent net cost to business - the regulatory “In” (for consideration of “One In One Out” impacts) - of £0.5 million at 2009 prices.**

### **Benefits – Option 1, targeted protective measures in new homes**

- 49) Radon is linked with lung cancer, and therefore the benefit of the requirement for and provision of radon protective measures will be a reduced number of lung cancers.
- 50) It is known that both radon and smoking can cause lung cancer and that the combination of radon and smoking increases the risk further in a multiplicative relation. People have about a 25 times greater risk of lung cancer in a high radon atmosphere if they smoke. Indeed, most radon-related lung cancers occur in smokers.
- 51) In a large population the lung cancers which can be attributed to radon will therefore occur in both smokers and non-smokers, and the average population risk will be a weighted average of the risks to smokers and non-smokers. The Health Protection Agency estimate this risk increases by 16% per 100 Bq m<sup>-3</sup>. Survival rates from lung cancer remain low so the major health benefit of increased radon protection is the additional years of life resulting from the reduction in the number of cancers. Earlier studies have estimated that around 13.5 life years are lost per lung cancer occurrence and this value has used in this evaluation<sup>9</sup>.
- 52) It is known that radon protective measures reduce radon levels in building and the occupants' exposure to radon. To work towards the number of lung cancers averted we need to estimate the reduction in radon exposure. Different studies take different views on the effectiveness of membranes in reducing the level of radon. Our assessment follows Gray et al and assumes an average 50% reduction in the radon level when a membrane is

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<sup>9</sup> Kennedy CA, Gray AM, Denman AR and Phillips PS. A Cost Effectiveness Analysis of a Residential Radon Remediation Programme in the United Kingdom. *British Journal of Cancer*; 1999; 81(7), 1243-7.

installed, an assumption we will examine during the consultation as some studies suggest this level may fluctuate, possibly with different construction practices.

- 53) Table 2 below presents the radon levels before and after the installation of a membrane with a 50% effectiveness:

**Table 2 – Mean radon levels with and without a membrane in existing houses**

	Percentage of homes over 200 Bq m <sup>-3</sup>	Arithmetic mean radon level (Bq m <sup>-3</sup> )	Reduction	Mean with membrane (Bq m <sup>-3</sup> )
Minimum in areas requiring “basic” protection	3%	52	50%	26
Mean in areas requiring “basic” protection	5%	64	50%	32
Max in areas requiring “basic” / minimum in areas requiring “full” protection	10%	87	50%	43.5
Mean in areas requiring “full” protection	17%	116	50%	58

- 54) A linear relationship between lung cancers and radon exposure is assumed (consistent with HPA publications on radon protection). In calculating the benefit from Option 1 - extending regulatory requirements by updating Approved Document C to ensure all new homes in higher radon areas are provided with appropriate protective measures – we have assumed the same counterfactual as for the costs and assessed the potential for cancers to be averted in the 30% of new homes which currently may not receive appropriate radon measures.
- 55) The mean radon risk reductions (from Table 2) were combined with typical occupancy levels (an average of 2.23 occupants per dwelling) and an assumed 15% smoking prevalence (broadly in line with Department of Health projections) to identify how many cancers would be averted by this option for each year of the ten year appraisal period. From this we identified, for each year, how many life-years per annum would no longer be lost if this policy for new homes is adopted
- 56) For each of the 10 years of the policy period assessed we have taken an estimate of the discounted costs incurred in that year. On the benefits side we have taken an estimate for each of those years of the discounted benefits achieved over a notional forty year building life. We have also assumed in our calculation of the benefits a 5 year lag before the benefits start to accrue. We factored in a lag to reflect the construction process and the corresponding time it would take before people move into buildings provided with protection as a result of changing Approved Document C in 2013. We also factored in a period for latency as lung cancers attributable to radon will not occur for a few years after the exposure event, and counting benefits in terms of lung cancers averted from the point of first occupation of the building would overstate the benefits gained. We also explored the significance of different assumption on latency and lag (see paragraphs 93 to 96).



- 57) In health economics, impacts are conventionally assessed using Quality Adjusted Life Years (QALYs). The NICE (National Institute for Health and Clinical Excellence) approach to assessing the cost effectiveness of medical treatments, described in “Measuring effectiveness and cost effectiveness: the QALY”, looks at how many extra months or years of life of a reasonable quality a person might gain as a result of treatment, measured in Quality Adjusted Life Years. In the NICE approach a treatment which costs more than £20,000-30,000 per QALY would not be considered cost effective. We have taken the upper end of this range for our assessments of benefits and used a QALY value of £30,000 for each year gained, discounted using a 3.5% discount rate for the first 30 years and 3% for later years. We also describe in the section below on Risks and Assumptions the impacts on the preferred option if a higher QALY value is adopted
- 58) The benefits gained from new homes as a result of Option 1 are shown in Table 3. These provide a total benefit assessed to have a present value at 2011 prices of £11,998,400 (£12million), with a range of £9million to £15million. This has an average annual benefit of £1.39million. A sensitivity test on the prevalence of smoking showed that even if the rate of smoking fell to 10% prevalence, the total benefit over 10 years would have a present value of £8.9million. These are added to the benefits from extensions and taken forward to the summary paragraph 63 to 65 and the summary sheet on page 2.

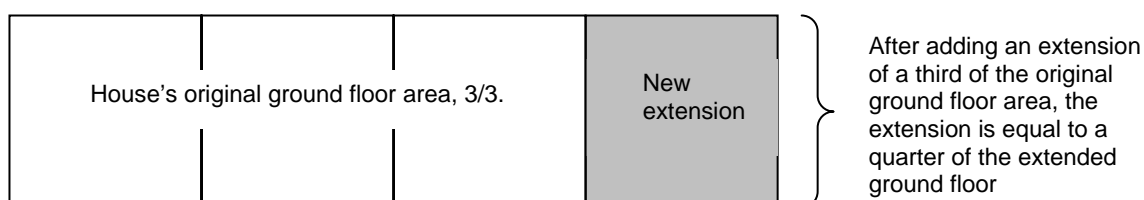
**Table 3 – Option 1 benefit gained each year, for new homes**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of new homes receiving protective measures (30%)	2049	2220	2390	2390	2561	2732	3073	3244	3244	3244
Annual lung cancers averted	0.16	0.17	0.19	0.19	0.20	0.21	0.24	0.25	0.25	0.25
Estimate of life-year loss averted, each year	1.89	2.05	2.20	2.20	2.36	2.52	2.83	2.99	2.99	2.99
Value of QALYs gained discounted over 40 years/ £000's	1061	1112	1159	1121	1162	1200	1306	1334	1292	1250

Benefits – Option 1, targeted protective measures in extensions

- 59) When assessing the health benefits from Option 1 requiring all new extensions in the (additional) areas shown on maps in BR211 to be provided with at least “basic” radon protective measures, we started with a working assumption that a typical extension adds at least a third to the ground area covered by the house. The extension then amounts to a quarter of the resulting ground floor area (illustrated in Diagram 1). This might suggest that an extension with protective measures results in an increase in protection for the occupants of 25% of the level of protection from protective measures provided in a new house. We will examine this assumption during the consultation.

**Diagram 1: The effect of adding an extension**



- 60) There is a competing assumption that householder awareness of radon and protective measures may increase during their purchase of an extension, with some subsequently subscribing to measures which also reduce radon levels in the original house with a consequent increase in the benefits from Option 1. However, the effectiveness of protective measures in extensions might also be slightly reduced if there is migration of radon from the original house, if this is not fitted with protective measures, into the extension. We propose to examine these as well as our working assumption during consultation.
- 61) In line with appraising the costs, our working assumptions are also that a change in Approved Document C will generate benefits from protective measures being installed in a constant number of 2,043 extensions per annum (30% of extensions in the new BR211 areas); and that 72% of these new extensions will require “basic” protective measures and 28% will require “full” measures in accordance with the guidance in BR211 2007.
- 62) Using these assumptions in a similar approach to assessing the new homes benefits, including the same assumptions about smoking and radon impacts on health and the same discounting approach, we have calculated the 10 year benefit from extensions being provided with protective measure associated with updating Approved Document C, shown in Table 4. This has a total (present value) benefit of £2.3 million, an average annual benefit of £0.26million (both at 2011 prices).

**Table 4 – Option 1 benefit gained each year, for extensions**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of additional extensions receiving protective measures (30%)	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043
Annual lung cancers averted	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Estimate of life-year loss averted, each year	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
Value of QALYs gained discounted over 40 years/ £000's	265	256	248	240	232	224	217	210	203	197

**Benefits – Option 1, summary**

- 63) **Our appraisal of Option 1, updating Approved Document C to align it with the 2007 BR211 radon maps, has established the following benefits:**
- **A total 2011 present value of £14.3million (£12million for new homes and £2.3 million for extensions)**
  - **A range of £11.3million to £17.3 million (£9.0million to £15.0million for new homes and £2.3million for extensions)**
  - **An average annual benefit of £1.66million (£1.39million and £0.26million).**

### **Costs and Benefits – Option 1, summary**

- 64) **Our appraisal shows that Option 1, updating Approved Document C to align it with the 2007 BR211 radon maps, has a net benefit with a present value of £7.3million and a range of £5.5million to £9.1million.**
- 65) **This option would however constitute a new regulatory burden and so is within scope for assessment under the “One In One Out” policy. Our appraisal has established an Annual Equivalent Net Cost to Business for this option that would have to be taken as the new regulatory “In” of £0.5million (at 2009 prices).**

### **Costs - Option 2, protective measures, all new homes and extensions**

- 66) The Health Protection Agency Board recommendation of 2008, repeated in 2010, was that Building Regulations should be amended to require all new build including homes and extensions, irrespective of locality and level of radon risk, to have basic radon protective measures installed at the point of construction. It would apply to all new homes and extensions built with the exception of those within the areas currently addressed by Approved Document C and the maps in BR211 1999.
- 67) This recommendation was made following detailed analysis and assessment of costs and benefits by the Agency and its Advisory Group on Ionising Radiation which appeared to show a positive case for this intervention, with benefits in excess of costs. We examined this case as we prepared our initial recommendations to ministers on the approach for consultation, with enthusiasm to establish whether we would be able to identify and present a compelling case for this level of intervention. The following provides detail on our subsequent assessment of this option.
- 68) We have assessed this option to identify the additional costs and benefits which would arise if we applied the HPA recommendation to the areas not covered currently and by Option 1. In this we used the same working assumptions about the ratio of houses to flats, build rates, the unit costs for radon protective measures, the 15% smoking prevalence, and the five year latency as in the assessment of that option, and the counterfactual that no protection is provided to new build or extensions in these areas as industry was not encouraged in the 2008 Circular Letter to adopt this approach in these areas as good practice.

### **Costs - Option 2, transitional costs**

- 69) We consider that with this option, unlike Option1, market transformation would be required and there would be associated transitional costs. Our working assumption for the assessment of these was that the major firms building 80% of new homes already have experience of providing radon protective measures and the other 20% of new homes are built by smaller firms with a more local presence and who may not have the same knowledge, expertise or experience. We have used an average annual new homes build rate of 149,400 for Option 2, 20% of which is 29,880 homes. If these are built by local firms building on average 10 units per annum, there will be about 3000 firms that will need to adapt to new construction processes, giving rise to Year One transitional costs. We have estimated the costs for each firm to be £725 (£200 for purchasing training, £75 for purchasing literature including the 2007 BR211 guides, and £450 for two days of lost productivity whilst attending training).

- 70) Our assessment is that the majority of extension builders are more locally-based firms, and 80% of the 76,291 additional extensions required under Option 2 to have “basic” radon protective measures under Option 2 will be built by firms with no experience of these measures. Assuming each firm builds three extensions a year, there will be about 20,000 extension building firms which will need to adapt to new construction processes and incur transitional costs in year one. We have estimated the costs for each firm to be £400 (£100 for purchasing training, £75 for purchasing literature including the 2007 BR211 guides, and £225 for one day of lost productivity whilst attending training).
- 71) In line with the assumptions on extensions, we have also assumed that as local authority building control bodies are locally focussed, about 80% or 295 will have no experience of radon protection and so will incur Year One transitional activities and costs. We estimate the average costs for each of these will be £900 (four surveyors each spending four hours researching and gaining the necessary awareness, at £50 per hour, with £100 for the purchase of literature including the 2007 BR211 guides).
- 72) Our estimate of the Year One transitional costs associated with Option 2 is £10.44million: £2.175million for home builders, £8million for extension builders and £265,500 for Building Control Bodies. In our assessment these are included in the total costs. We have assumed that the local authority reflect their transitional costs in the building control fees the charge, and so these costs are passed on to builders of new homes and extensions.
- 73) However, we have also assumed that neither extension nor home builders will be able to pass on the transitional costs which fall indirectly or directly to them, and so we have included all these costs for “One In One Out” purposes.

#### Costs - Option 2, protective measures, all new homes

- 74) Using DCLGs housing projection statistics, and extrapolating from these, we have identified that this option would require “basic” protective measures to be provided to a number of extra new homes in England from 112,733 in 2013 rising to 178,529 in 2022. We also calculated a range of present value costs as with Option 1 for housing supply variance from government projections
- 75) We identified a non-discounted Year One cost of £22,325,207 and from a 10 year appraisal, using a 3.5 % discount rate, this element of Option 2 has a present value cost at 2011 prices of £250.7million and average annual costs of £29.1million for the new homes it impacts upon.
- 76) All these costs are likely to fall to business and would have to be considered as a new “One In One Out” regulatory “In”. We have calculated the annual equivalent net cost to business for this option in the costs summary below.

#### Costs - Option 2, protective measures, all extensions

- 77) Applying the same assumptions as before – that 0.057% of houses are extended in a given year; that 68% of homes are houses – to the housing stock numbers after removing the number of homes currently covered and those covered by Option 1, we identified that this option would require “basic” protective measures to be provided to 76,291 extra new extensions in England per annum. As with the approach to Option 1 we assumed this to be constant.

- 78) Taking the same unit cost for basic radon protective measures to extensions as in Option 1, £100, we identified a non-discounted Year One cost of £7,629,100, a present value cost at 2011 prices of £65.7million and average annual costs of £7.6million for new extensions under this option.
- 79) We have assumed that the additional build costs for extensions will all be passed onto consumers and as the costs fall to owners and occupiers that there is no cost to business. Therefore we have not calculated an annual equivalent net cost to business for this element of Option 2.

### **Costs - Option 2, summary**

- 80) **Our 10 year appraisal, using a 3.5% discount factor, shows that Option 2 has:**
- **Year 1 (2013) undiscounted build costs of £29.95million, and transitional costs of £10.44million**
  - **A present value cost estimate of £316.4million (£250.7million for new homes and £65.7 million for extensions), and £326.4million when transitional costs are included**
  - **A present value cost range of £253.7million to £379.1million (£188.0million to £313.4million for new homes with £65.7million for extensions), and a present value cost range of £264.1million to £389.5million when transitional costs are included**
  - **An average annual cost estimate of £36.8million (£29.1million and £7.6 million), with a range from £30.7million to £45.3million**
  - **As costs fall to business which would have to be considered as a new “One In One Out” regulatory “In”, we have calculated the annual equivalent net cost to business for this option of £28.6million at 2009 prices.**

### **Benefits – Option 2, new homes**

- 81) In our assessment of the benefits that would be obtained if this option were adopted we used the same principles as above for the assessment of Option 1 benefits. We established that an average of 3.36 cancers per annum would be averted, with an average annual benefit of 39.56 QALYs saved, as a result of additional new homes being fitted with “basic protective” measures under this option, producing a present value benefit of £189.8million. We calculated the range of additional new homes’ present value benefit from this option as £142.3million to £237.2million.

### **Benefits – Option 2, extensions**

- 82) In our assessment of the benefits that would be obtained if this option were adopted, using the same principles as before, we established that an average of 0.43 cancers per annum would be averted, with an average annual benefit of 5.05 QALYs saved as a result of additional extensions being fitted with “basic protective” measures under this option, producing a present value benefit of £24.6million.

### **Benefits - Option 2, summary**

- 83) Our appraisal of Option 2, extending Approved Document C to align it with the HPA recommendation, has established the following benefits:
- A total present value of £214.4million (£189.8million for new homes and £24.6 million for extensions)
  - A total present value range of £166.9million to £261.8million (£142.3million to £237.2million for new homes and £24.6million for extensions)
  - A central average annual benefit estimate of £24.9million (£22.1million and £2.9million), in a range from £19.4million to £30.4million.

### **Costs and Benefits – Option 2, summary**

- 84) Our appraisal shows that there is a significant negative net benefit that would be delivered by adopting Option 2, extending Approved Document C to align it with the HPA recommendation. The central estimate of this is a net present value of minus £112.4million.
- 85) This option would constitute a new regulatory burden and so is within-scope for assessment under the “One In One Out” policy. Our appraisal has established an Annual Equivalent Net Cost to Business for this option that would have to be taken as the new regulatory “In” of £30.3million, or £28.6million at 2009 prices.

### **Risks and Assumptions**

- 86) Most risks and assumptions have been explained in the text above. We intend to use our planned consultation to examine these further and specifically seek evidence and views on the approach taken in this consultation stage Impact Assessment. In particular, given the impact on final estimates of costs, we will seek views on the following:
- The counterfactual assumption about the level of good practice (at least 70%) generated by the 2008 Circular Letter, and so the reduced level of cost (and benefits) associated with changing the regulatory approach in Approved Document C (paragraph 15)
  - The unit costs of radon protective measures (paragraphs 36 to 38)
  - The assumption that additional costs under Option 1 and Option 2 for new homes fall to industry but additional costs for extension fall to consumers (paragraphs 42 and 46)
  - The nil (or negligible) Option 1 transitional costs (paragraph 47)
  - That radon protective measures have the potential to reduce radon in homes by at least 50%. We will also do more to explore this in light of suggestions by the Health Protection Agency and others that this might vary, possibly due to variances in construction practice<sup>10</sup> (paragraph 52)
  - The relative area of domestic extensions and the efficacy of radon protective measures in extensions (paragraph 59)
  - The Option 2 transitional costs, including the number of extension-building firms these might apply to (paragraphs 69 to 73).

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10 M. Green, Effectiveness of radon protection measures in new homes, Environmental Radon Newsletter, Summer 2009.

- 87) We will also invite comments during consultation on our assumptions on the rates of new build and constant rates of domestic extensions.
- 88) We considered the risk that housing supply, and so the number of new homes used in this appraisal, might vary from government projections to be a highly significant risk. We have in our assessment produced a range showing what would happen if housing supply varied by either 25% above or 25% below government projections. This affects the costs and benefits of both options. The results of this are shown in the relevant sections in Option 1 above. Our reanalysis demonstrates that Option 1 has an always positive net benefit across the range:

**Table R1, impact of changing new build rates**

	<b>Total Costs (NPV over 10 years, 3.5% discount rate, 2011 prices)</b>	<b>Total Benefits (NPV over 10 years, 3.5% discount rate, 2011 prices)</b>	<b>Net Benefits (NPV over 10 years, 3.5% discount rate, 2011 prices)</b>
Low end build rates - 25%	£3.7million	£9.0million	£5.3million
Mid range build rates (Government 2013- 1022 projections)	£4.9million	£12.0million	£7.1million
Higher end build rates +25%	£6.1million	£15.0million	£8.9million

- 89) We have used a QALY value of £30,000 in this impact assessment which is in line with the value used by NICE in their assessments of health care options. However, we are aware of developing views that a higher QALY value might be more appropriate for use in impact assessments and so we have applied a QALY value of £60,000 in the sensitivity test shown in Table R2. This demonstrates how an increased QALY value increases the benefits assessment.

**Table R2, sensitivity of assessment to changing QALY value**

	<b>Option 1 present value costs, new homes</b>	<b>Option 1 present value benefits, new homes</b>	<b>Option 1 net benefits</b>
£30,000 QALY value	£4.9million	£12.0million	£7.1million
£60,000 QALY value	£4.9million	£24.0million	£19.1million

- 90) Another factor that might change is the smoking prevalence rate, for which we used a working assumption of 15% smoking prevalence rate, broadly in line with forecasts. To explore this we carried out a sensitivity test of this on the analysis of Option 1, and recalculated the benefits achieved if the smoking prevalence fell further to 10%. The result of this, shown in Table R3 below, shows how it reduces the net benefits from (new homes, the major net benefit provider in) preferred Option 1 by about 50%. This demonstrates the rigour of this as our preferred option, but it also demonstrates that with the multiplicative effects of smoking and radon exposure, significant benefit can be achieved by reducing the smoking component of lung cancer risks.

**Table R3, sensitivity of assessment to changing smoking prevalence**

	<b>Option 1 present value costs, new homes</b>	<b>Option 1 present value benefits, new homes</b>	<b>Option 1 net benefits</b>
15% smoking prevalence	£4.9million	£12.0million	£7.3million
10% smoking prevalence	£4.9million	£8.9million	£4.1million

- 91) The policy period which has been covered in this assessment is the 10 years from 2013. It was assumed that there is a two year lag before new buildings covered by changing Approved Document C in 2013 are occupied, so that the first year in which benefits might accrue is 2015. We also took into account a consideration that lung cancers attributable to radon will not occur for a few years after the exposure event, and counting benefits in terms of lung cancers averted from the point of first occupation of the building will overstate the benefits gained. We made an allowance for this and extended the assumed lag to five years, by simply shifting the future stream of benefits back in time so that in net present value terms they are less valuable.
- 92) However, as it has been suggested that most of the cancers appear in the period 5 to 14 years after exposure. This would suggest a mid-range latency of about 8 years might be added to the two year lag as a sensitivity test. To explore the significance of this on overall costs and benefits we shifted the future stream of benefits further back by another 5 years.
- 93) The results are shown in Table R4. A ten year period reduced the benefits by around 20 per cent, although the reduced net benefit is still greater than the total present value costs, and thus Option1 remains our preferred option.

**Table R4, sensitivity of assessment to changing latency**

	<b>Option 1 present value costs, new homes</b>	<b>Option 1 present value benefits, new homes</b>	<b>Option 1 net benefits</b>
5 year lag	£4.9million	£12.0million	£7.3million
10 year lag	£4.9million	£10.2million	£5.3million



- 94) Our assumed counterfactual that 70% of industry practice is already delivering appropriate radon protective measures that would be required by an updated Approved Document C under Option 1 will be examined further during the consultation, particularly as there are indications that in some parts of industry it might be higher than this for new build. To examine this further we applied a simple sensitivity test by adjusting the costs and benefits for new homes under Option 1 to see what would happen to the assessment of this option if the counterfactual for new homes is increased to 80%. And 90%. The results of this are in Table R5 which shows how the corresponding reduced net benefit are still greater than the total present value costs, and this would still remain our preferred option.

**Table R5, sensitivity of assessment to changing counterfactual**

	<b>Option 1 present value costs, new homes</b>	<b>Option 1 present value benefits, new homes</b>	<b>Option 1 net benefits</b>
70% already, counterfactual	£4.9million	£12.0million	£7.3million
80 % already, counterfactual	£3.3million	£8.0million	£4.9million
90% already, counterfactual	£1.6million	£4.0million	£2.6million

## **Wider impacts**

### Equalities Impact Test

- 95) An initial equalities screening of the proposed policy was carried out and determined that a full equalities impact test was not required as the proposal does not adversely affect any equalities groups.

### Competition Assessment

- 96) The preferred option is not expected to alter the home building or extension building markets and the competition within those. Whilst it would require some technical changes to construction approaches, these are done within the current set of Building regulations that apply to these types of activities and it is not considered to set up barriers to entry and is considered unlikely to affect the size, number or profitability of firms.

### Small firms Impact Test

- 97) We have assumed in line with the counterfactual used in this assessment that firms operating in the areas covered by BR211 maps are already aware of the maps and radon protective approaches and so there are no transitional costs associated with our preferred option – something we will examine further during consultation. There may be transitional costs associated with Option 2 and if there are these would be likely to fall on locally based small and medium sized developers and constructors who do not currently operate in radon areas. These, unlike the larger firms with a wider geographic coverage, would have

to up-skill and adapt their construction approaches – we will also examine this during the consultation.

### Environmental impact

98) We do not expect this either of these options to affect the wider environment outside the homes and it will not result in additional greenhouse gases being emitted.

### Health and Well Being Impact

99) These options are primarily focussed on population health improvement. The proposed amendments are likely to lead to a positive impact on public health and welfare which will bring a number of non-monetised social benefits including those that will be received by families and friends of people who have avoided cancers which might otherwise have been caused by radon.

### Sustainable Development

100) We do not expect the proposal to have any sustainable development implications, although ensuring buildings are built with appropriate precautions for the occupants supports the principle of building the right buildings in the right places, suitable for future generations.

## **Summary and preferred option with description of implementation plan**

- 101) We have examined the cases for extending the current Building Regulations effectiveness in ensuring buildings are provided with radon protection measures.
- 102) We have assessed Option 1, maintaining the current policy of intervention targeted at the higher risk areas by aligning Approved Document C with the 2007 radon maps, as delivering net benefits with a range from £5.5million to £9.1million. Our central estimate is of a net benefit of £7.3million delivered by a cost of £7million.
- 103) From our assessment Option 2, extending the regulations to require all new buildings across England to be fitted with basic radon protective, appears to have costs significantly higher than benefits. Our central estimate has a 10 year present value net benefit of minus £97.2million delivered by a corresponding present value cost of £326.8million.
- 104) Option 1 is preferred as it provides a well targeted regulatory framework into the future that continues to ensure buildings are provided with proportionate radon protective measures as a precaution against the health effects on occupants from radon exposure. This option has a strong supporting impact assessment.
- 105) We believe this Impact Assessment supports further, more detailed public consultation on a proposal to introduce this update of existing provisions on radon protection. We will use this consultation to invite information to inform further development of our assessment and the underpinning assumptions. We will also consult on not taking forward Option 2 and our assessment of this and conclusion.