Communities and Local Government

Implementation Stage Impact Assessment of Revisions to Parts F and L of the Building Regulations from 2010

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March 2010
Department for Communities and Local Government

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Impact Assessment

Summary: Intervention & Options		
Department /Agency: **Communities and Local Government**	**Title:** **Impact Assessment of Part L (energy efficiency) and Part F (ventilation) of the Building Regulations in 2010**	
Stage: Implementation	**Version:**	**Date:**
Related Publications: The Building and Approved Inspectors (Amendment) Regulations 2010		

Available to view or download at:

www.communities.gov.uk/publications/planningandbuilding

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

Because the damage cost of CO_2 emissions from buildings is not paid for by those constructing or occupying buildings there is likely to be underinvestment in energy saving measures which would reduce these emissions. Tightening of Part L of the Building Regulations is one means of overcoming this problem by requiring higher energy efficiency levels in new and existing buildings. This forms part of Government's wider policy of achieving zero net emissions from new buildings later in the decade. Amendments to Part F are necessary to offset any adverse health effects arising from the Part L changes.

What are the policy objectives and the intended effects?

To set energy efficiency standards for new domestic and non-domestic buildings that, when fully implemented, will achieve a 25% reduction in CO_2 emissions from these buildings relative to the level of emissions that result from the Part L standards introduced in 2006.

To set tighter standards for energy efficiency in existing buildings.

The achievment of a reduction using the standards proposed for 2010 is a step towards the target of zero net emissions from new domestic buildings from 2016 and from non-domestic buildings from 2019.

What policy options have been considered? Please justify any preferred option.

1. Do nothing. Keep the 2006 versions of Parts L and F. Baseline for comparison and is not costed.
2. Flat 25% reduction in domestic buildings and Aggregate 25% reduction in non-domestic buildings.

Option 2 was supported by consultees and offers a cost effective approach to meeting the policy objectives. The other two options considered at consultation and rejected provided similar or lower net benefits to the preferred option.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

Once a sufficient population of buildings has been constructed to the new standards an implementation review will be carried out to evaluate the impact of the 2010 changes and inform future changes.

Ministerial Sign-off For implementation stage Impact Assessments:

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:

J Healey

The Rt Hon John Healey MP,
Minister for Housing and Planning

Date: 9/3/10

Summary: Analysis & Evidence

Policy Option: 2	Description: **Flat 25% reduction in emissions in all new domestic buildings; Aggregate 25% reduction for new non-domestic buildings**

COSTS	**ANNUAL COSTS**		Description and scale of **key monetised costs** by 'main affected groups' Increased building costs. New and existing domestic dwellings NPV £11 bn. New and existing non-domestic buildings, NPV £8 bn. Costs borne intially by developers but ultimately borne by landowners and owners/users of buildings.
	One-off (Transition)	**Yrs**	
	£10m	1	
	Average Annual Cost (excluding one-off)		
	£731m		**Total Cost** (PV) **£20bn**
	Other **key non-monetised costs** by 'main affected groups'. No account taken of the effects of increased costs on the demand for new buildings or on the supply of land for development.		

BENEFITS	**ANNUAL BENEFITS**		Description and scale of **key monetised benefits** by 'main affected groups' Energy savings. Domestic (new build and existing), £17bn, non-domestic £10bn. Benefits accrue to occupiers of buildings. Carbon and other savings Domestic £8bn, non-domestic £3bn. National benefit. Avoided renewables, domestic £0.3bn, non-domestic £0.04bn
	One-off	**Yrs**	
	£0		
	Average Annual Benefit (excluding one-off)		
	£1,462m		**Total Benefit** (PV) **£39bn**
	Other **key non-monetised benefits** by 'main affected groups'. The savings to individual consumers will be greater than shown above because of reduced payments for network charges and VAT. No allowance made for contribution of reduced energy demand to fuel security, nor for the potential increase in business and employment opportunities from the development of energy saving products.		

Key Assumptions/Sensitivities/Risks Sensitivity to higher and lower values for energy and carbon prices tested following government guidelines. If grid decarbonisation takes place faster than assumed in the modelling, carbon savings in later years could be overstated.

Price Base Year	Time Period Years	Net Benefit Range (NPV)	NET BENEFIT (NPV Best estimate)
2008	70	**£8bn – £26bn**	**£19bn**

What is the geographic coverage of the policy/option?			England & Wales	
On what date will the policy be implemented?			2010	
Which organisation(s) will enforce the policy?			Building Control	
What is the total annual cost of enforcement for these organisations?			£	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£	
What is the value of changes in greenhouse gas emissions?			£11bn	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	No	No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices)		(Increase – Decrease)
Increase of £30m-£40m	Decrease of £0	**Net Impact £30m-£40m**

Key:	**Annual costs and benefits: Constant Prices**	**(Net) Present Value**

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	Results in Evidence Base?	Results annexed?
Competition Assessment	Yes	No
Small Firms Impact Test	Yes	No
Legal Aid	Yes	No
Sustainable Development	Yes	No
Carbon Assessment	Yes	No
Other Environment	Yes	No
Health Impact Assessment	Yes	No
Race Equality	Yes	No
Disability Equality	Yes	No
Gender Equality	Yes	No
Human Rights	Yes	No
Rural Proofing	Yes	No

Executive Summary

This update of the previous consultation stage impact assessment is summarised in the following Table. Present value benefits in the form of energy and carbon savings for the selected option i.e. a Flat 25 per cent reduction in emissions for every new home and an Aggregate 25 per cent reduction for all new non-domestic buildings; more than make up for the present value incremental costs, for both groups of new and existing buildings.

£m NPV	Incremental building costs	Energy Savings	Carbon And Other Savings	Avoided Renewables	Total Benefits	Total net benefit/ (cost)
New Domestic	(785)	2,589	1,291	22	3,903	3,118
Existing Domestic	(10,554)	14,584	7,009	295	21,888	11,335
New Non-Domestic Buildings	(2,942)	3,590	1,504	21	5,115	2,173
Existing Non-Domestic Buildings	(5,305)	6,473	1,498	18	7,989	2,684
Total	**(19,586)**	**27,245**	**11,302**	**356**	**38,895**	**19,310**

An important aspect of the policy is that the additional costs of construction fall primarily upon developers, often passed through to lower land prices, whilst the benefits are gained by occupants through lower energy bills or by society as a whole in the form of carbon savings.

Estimates of the incremental resource costs for property developers and fuel cost savingsfor occupiers are set out in the section "Sectors and groups affected by the policy" at Tables 19 and 20 respectively.

The carbon savings from this policy have been taken into account in the main cost benefit analysis, valued using DECC guidance and summarised at Table 30.

Summaries of the net benefits with energy price, CO^2 value and build rate sensitivities can be seen at Tables 31 and 32.

Section 1

Introduction

1.1 This impact assessment (IA) accompanies the Building and Approved Inspectors (Amendment) Regulations 2010, on implementing changes to Part F (Means of ventilation) and Part L (Conservation of fuel and power) of the Building Regulations. The Consultation Stage IA was published in June 2009 and set out estimates of the costs and benefits associated with a number of different policy options. This Implementation Stage IA updates the assessment of the costs and benefits of the preferred changes to Parts F and L taking into account comments received during the consultation period.

1.2 The Consultation Stage IA considered three options each of which was compared with the baseline option (Option 1) of making no change to the 2006 Regulations for Parts F & L. These options were:

- Option 2, Aggregate 25 per cent approach with 25 per cent reduction in emissions achieved based on standard specifications allowing some variation in emissions reductions between new building types.
- Option 3, Flat 25 per cent approach with 25 per cent reduction in emissions achieved by all new building types.
- Option 4, Flat 25 per cent reduction in emissions in all new domestic buildings; aggregate 25 per cent reduction for new non-domestic buildings.

1.3 Following the consultation, the Government has decided that the relative complexity and limited additional benefits of the Aggregate 25 per cent approach was not appropriate for new homes at this time. However, the considerable additional benefits of the Aggregate 25% approach for non-domestic buildings where there is much greater variation in the potential for and cost of improving energy efficiency, is appropriate. Government has therefore decided to adopt Option 4 as set out above i.e. a Flat 25% reduction in emissions for every new home and an Aggregate 25 per cent reduction for all new non-domestic buildings as the preferred approach for Part L 2010. This has now been re-analysed as Option 2 in this Implementation Stage IA and compared to the Option 1 baseline of no change.

1.4 A number of other important changes have been made which affect the assessment.

- The reduction in energy consumption and associated emissions reductions resulting from increased energy efficiency in buildings has been estimated using the Standard Assessment Procedure (SAP) model for domestic buildings and the Simplified Building Energy Model (SBEM) for non-domestic buildings. For the purposes of this IA, modelling has been based upon consultation versions of both models (cSAP and cSBEM) updated to reflect the 2010 amendment.
- Revised specifications for the main building fabric and service elements have been estimated and used in modelling the target 25 per cent reduction in CO_2 emissions
- Revised assumptions about the values to be attributed to energy savings and Carbon Dioxide (CO_2) reductions resulting from the implementation of the policy have been used. These values, which are higher than were used in the Consultation IA, are taken from revised government guidance issued in 2009 and are consistent with the assumptions used in the Consultation on Zero Carbon Homes published in July 2009 and Zero Carbon Non-domestic buildings published in November 2009.[1]

[1] A further revision to this guidance was published in January 2010, but it was not possible in the time available to update this IA to incorporate these latest changes. This also maintains consistency with the Consultation IA. http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx

Section 2

Background

2.1 In July 2007, the Government's *Building a Greener Future: policy statement*[2] announced that all new homes should emit zero net carbon from 2016 with a progressive tightening of Part L of the Building Regulations in 2010 and 2013. Similar ambitions for new buildings that are not dwellings were made in the Budget Report 2008[3]. The ambition for these buildings was to set net zero carbon standards from 2018 for new public sector buildings and from 2019 for other new non-domestic buildings. In addition to this, the Government is seeking to improve the energy efficiency standards that apply when building works are carried out on existing buildings. Consideration was also being given to changes to Part F of the Building Regulations dealing with ventilation to ensure that health standards are not undermined by the proposed Part L changes i.e. potential increase in air tightness of buildings.

2 www.communities.gov.uk/documents/planningandbuilding/doc/Buildingagreenerfuture.doc

3 www.hm-treasury.gov.uk/bud_bud08_repindex.htm

Section 3

Policy options considered

3.1 The June 2009 Consultation considered options for setting Part L standards for 2010 such that new housing developed to that standard would have CO_2 emissions resulting from the energy use covered by the Regulations that are 25 per cent lower than equivalent buildings developed to the 2006 Regulations.[4] For non-domestic buildings a 25 per cent reduction in emissions for 2010 against the base line of the 2006 Regulations was considered as the central target with additional analysis of 20 per cent and 30 per cent targets. These targets are a step on the way to reaching the objective of zero carbon new domestic buildings from 2016 and new non-domestic buildings from 2019.

3.2 The Consultation set out two ways of achieving the government's objective of a further 25 per cent reduction in emissions in 2010 for domestic and non-domestic buildings. The first approach, as used in the past, would be to continue using a 2002 notional building as the baseline and to introduce a larger improvement factor which would be the same for each building. The advantages of this approach are that it would minimise changes to the current framework and that it would provide the greatest certainty that the government would achieve its 25 per cent target. This is referred to as the Flat 25% approach.

3.3 A disadvantage of this approach is that by requiring all buildings to achieve the same percentage reduction in emissions, this may not achieve the overall target of 25 per cent in the most cost-effective way. This is because the breakdown of energy use between different end uses (space heating, cooling, hot water heating and lighting) varies between different types of buildings, and it is possible to make savings more cost-effectively for some types of energy use than it is for others.

3.4 Switching to a 2010 notional building for calculation of the compliance target would allow the overall 25 per cent target to be achieved more cost-effectively. The 2010 notional building would be based on a defined standard for the energy efficiency performance of each component of the building (i.e. roofs, walls, floors, windows, hot water system, lighting and so on). The specification would be developed such that, when applied across all new build, it would be

[4] Regulated energy covers energy used for space heating and cooling, hot water and fixed lighting. It does not cover energy used in household appliances or in commercial or industrial processes.

expected to give the required 25 per cent reduction in emissions on aggregate (although not necessarily for each individual building). The decision about which components of the building should be tightened most in developing this specification would broadly be based on the relative cost-effectiveness of different measures for reducing CO_2 emissions. This is referred to as the Aggregate 25 per cent approach.

3.5 Regardless of which method is used to calculate the compliance target for a building, developers would be free to choose their own solutions to ensure that the building complied with this target.[5] In other words, under the Aggregate 25 per cent approach developers would not be required to follow the specifications for each component contained in the Aggregate 25 per cent, provided that their alternative approach yielded the same reduction in CO_2 emissions. However, those following the Aggregate 25 per cent specifications would be assured that their building would meet the required standard.

3.6 Under the Aggregate 25 per cent approach, it is likely that some building types would be required to achieve a larger reduction than 25 per cent, whereas other building types would be required to achieve less. This is because the importance of different components varies between buildings (e.g. large offices require air conditioning that is not required in warehouses), and hence applying the same specifications for each component in both buildings would yield different percentage CO_2 reductions.

3.7 The Government's preferred approach at consultation stage, to adopt the Flat 25 per cent approach for domestic buildings and the Aggregate 25 per cent approach for non-domestic buildings, was broadly supported by the majority of consultation responses. In light of this, the Government has decided to adopt this approach for Part L 2010 and this Implementation Stage IA sets out the costs and benefits for this selected option. This is compared with the 'Do Nothing' option of making no change to the 2006 Regulations.

3.8 In summary, the options for Part L that have been considered in the modelling for this IA are:

- Option 1: Do nothing. The 2006 Regulations are used as the reference case against which the other options are compared.
- Option 2: 25 per cent reduction for each individual domestic building (Flat 25%) and 25 per cent reduction in aggregate for non-domestic buildings (Aggregate 25%).

[5] This is subject to meeting the other four criteria required for compliance with Part L of the building regulations, namely limits on design flexibility, limiting the effects of solar gains in summer, quality of construction and commissioning, and providing operating and maintenance information.

3.9 We have also included estimates of the costs and benefits from the introduction of improvements in energy efficiency standards when building work is taking place in existing buildings.

3.10 The option of using a voluntary code has been considered and rejected as in the absence of a mandatory requirement it is unlikely that the industry would take sufficient action to meet the Government's policy objectives.

3.11 In considering the impact of these options we also take into account emissions reductions from buildings which are expected to occur as a result of other policy initiatives which have already been agreed. These include reductions resulting from policies such as the Code for Sustainable Homes, the development of Energy Performance Certificates (EPCs), the Carbon Emissions Reduction Target (CERT) and the Carbon Reduction Commitment. As a result of these policies there would be CO_2 reduction in some buildings built after 2010 even in the absence of the changes to Part L of the Regulations proposed for 2010. The impact of these other policies is considered in more detail in the section on cost benefit analysis.

3.12 The introduction of improved energy efficiency standards in Part L is likely to result in a greater tendency for more airtight buildings. It is therefore necessary to change Part F at the same time to ensure adequate means of ventilation is provided. The policy options that have been considered for Part F reflect this interdependence:

- Option 1: Do nothing.
- Option 2: Amend Part F such that adequate ventilation levels are maintained given the amendments to Part L.

Structure of the Impact Assessment

3.13 The IA sets out:

- The key assumptions that have been made in order to arrive at an estimate of costs and benefits including the building specifications which should meet the Flat 25 per cent target for domestic buildings and the Aggregate 25 per cent target for non-domestic.
- Assessment of total costs and benefits for each policy option, the associated levels of CO_2 reductions and the cost effectiveness of each policy in reducing CO_2 emissions. This distinguishes between the immediate financial costs and benefits and the wider carbon and related impacts.

- The expected impact of the policy options on different groups within the economy distinguishing, in particular, between building developers and owners/occupiers.
- The specific assessments of the effect on areas of government policy which form part of a full Impact Assessment.
- More detailed material is provided in appendices.

Section 4

Methodology and key assumptions

4.1 For the Flat 25 per cent policy for new domestic buildings, specifications were identified using SAP that would result in a 25 per cent reduction in CO_2 emissions for each dwelling type.

4.2 The Aggregate 25 per cent specifications for new non-domestic buildings were developed using data on the energy savings and incremental costs associated with tightening standards for different parts of the building envelope (roofs, walls, etc.) and for different building services (heating, lighting and cooling). For each component of the building in turn, these data were used to calculate how the marginal abatement cost of reducing emissions changed as the energy efficiency of the component was tightened (e.g. as extra insulation was added to roofs or walls). Specifications were then chosen for which the marginal abatement cost was equal across all components and which yielded the required 25 per cent reduction in emissions on aggregate when applied to the projected mix of new buildings.

4.3 The costs and benefits of the preferred policy options were compared through estimation of the resulting building costs, energy savings, CO_2 reductions and value of avoided renewables[6] all measured as incremental changes compared to the 2006 baseline or 'Do Nothing' option. The application of this approach to domestic and non-domestic buildings is described in more detail in the following sections. This brings together three work streams – building specification and associated energy modelling carried out by AECOM, costing of building options carried out by Davis Langdon (cross checked where possible against cost information provided by industry) and the specification and cost-benefit model development, appraisal and reporting carried out by Europe Economics.

[6] Policies which reduce final energy consumption reduce the amount of renewables which the UK has to build to meet its 2020 target under the EU Renewables Directive.

Section 5

Domestic buildings

Flat 25 per cent improvement

5.1 Energy performance assumptions for building components were developed for a reference building (broadly representing a 2002 compliant building) and for three levels of improved energy performance which could be achieved for each of the building components by use of more energy efficient materials and service equipment. These improvement levels provide the basis for estimating the energy savings and emissions reductions that might be achieved and for assessing the incremental costs of the improvements relative to the reference case. The assumptions for domestic buildings are set out in Table 1.[7] Levels A to C in the table show increasing energy efficiency standards for each building component. The columns are not intended to represent whole building specifications. Specific building specifications are derived in the following sections.

5.2 Research shows that where party walls between connected buildings are untreated, considerable heat can escape through them.[8] The Part L consultation proposed an adjustment to the baseline notional building to take account of the average heat loss from typical party wall construction methods. However, responses to the consultation raised concerns that this would be less demanding in terms of external fabric and not reach the reduced level of emissions implied by the zero carbon policy when it was set out. In response to this feedback, the Part L 2010 changes now require the party wall heat loss to be tackled before starting to count the 25 per cent improvements. Credits for 100% low energy lighting and only counting secondary heating when actually installed, as proposed in the consultation are however included within the 25 per cent improvement.

7 The modelling also allowed for the introduction of ground source heat pumps and other LZC options but these were not selected in the preferred building specifications and are not shown in Table 1.

8 http://www.leedsmet.ac.uk/as/cebe/projects/stamford/index.htm

Table 1: Elemental performance assumptions – domestic buildings				
	Reference	**Level A**	**Level B**	**Level C**
Roof (U-value)	0.25	0.18	0.15	0.10
Walls (U-value)	0.35	0.30	0.20	0.15
Party Walls (U-value)	0.30[9]	0.00	..	..
Floors (U-value)	0.25	0.20	0.15	0.10
Windows and doors (U-value)	2.20	1.50	1.10	0.70
Lighting (type of bulb/fitting)	GLS	CFLs	..	..
MEV (specific fan power)	0.80	0.60	0.40	0.30
MVHR (specific fan power)	2.00	1.50	1.00	0.60
MVHR (heat recovery efficiency)	66%	75%	85%	90%
Natural ventilation	Part F	..	..	..
Gas boilers (seasonal efficiency)	86%	90%	..	..
Electric heat emitters seasonal efficiency)	100%	..	..	..
Air Permeability ($m^3/h.m^2$)	10	7	4	1
Thermal Bridging (y)	0.08	0.08	0.04	0.02
Hot water cylinder insulation (mm)	35	50	75	100

Source: AECOM

Dwelling specifications

5.3 As energy and cost data is supplied on a per m^2 or per installation basis, it was necessary to make assumptions regarding the areas of thermal elements and the number of fixed building services per dwelling. These were based on industry estimates.

Cost data

5.4 On the basis of the component specifications above, together with a detailed description of construction method for each specification, cost data were collected by Davis Langdon from industry sources. Cost data for building fabric were provided on a £/m^2 basis whilst data for fixed building services were generally provided on a £/installation basis. This approach allowed simple calculation of the cost per dwelling by multiplying the input cost by the relevant area or quantity assumption. Details on the development of the cost assumptions are set out in Appendix 2.

[9] In this IA we have used our best estimate of the average U-value of unfilled party walls across all types of dwelling and construction form. Although a U-value of 0.5 is representative of an unfilled party wall with no effective edge sealing, this will not be true in every case. For example, many flats may have fire stops at each floor level and this would tend to reduce the U value in those cases. Given our current state of knowledge 0.3 represents our best estimate of the stock average.

Energy data

5.5 Component level energy usage data were developed for the reference case and for each of the component improvement levels shown in Table 1. Separate component level data were provided for a three-bedroom gas heated semi-detached house and an electric resistance heated two-bedroom flat. These dwellings were modelled using cSAP. The component level data was subsequently used to model gas-heated detached, semi-detached and terraced houses, as well as electrically-heated flats.

Asset lives

5.6 Assumptions were made about the approximate asset life of each of the fabric and building services components. The longest assumed asset life is 60 years. For assets with shorter life (such as lighting and heating and ventilation equipment) the costs of replacement to 2010 standards have been included in order to maintain comparability of costs and benefits over the full 60 year life. Replacement to the 2010 standard is a requirement of this policy development and it is appropriate that the associated incremental costs and benefits should be included in this IA. The policy is assumed to apply to all building developments over a 10 year period from introduction. The estimated energy savings and incremental costs associated with tightening the Regulations are accumulated and discounted over the 60 year life of each building developed during the policy period.

Low and zero carbon (LZC) options

5.7 The model considered the possibility that it may be cheaper to reduce emissions by introducing LZC technologies than by further tightening fabric and/or building services standards. The specifications of LZCs, together with their cost and energy savings and asset lives were taken from the Definition of Zero Carbon Homes Impact Assessment.[10] This approach was employed to achieve consistency across the various CLG energy efficiency Impact Assessments and to avoid unnecessary duplication of existing work.

Emissions factors

5.8 One important benefit achieved through energy efficiency measures is a reduction in carbon dioxide emissions. SAP and SBEM modelling provided energy savings data in kWh and the conversion of these savings into carbon dioxide is simply a matter of multiplying the energy saving by an emissions factor for each energy source.

10 "Definition of Zero Carbon Homes: Impact Assessment", CLG, December 2008, available at www.communities.gov.uk/publications/planningandbuilding/zerocarbondefinitionia

5.9 cSAP and cSBEM incorporate emissions factors estimated by Building Research Establishment based on the expected fuel mix in electricity generation in the immediate future. These have been used in determining building specifications for the Flat 25% and Aggregate 25% options.[11] This was to ensure consistency between the sections of modelling conducted by Europe Economics and the sections conducted by AECOM.

5.10 In using these building specifications to carry out the cost-benefit analysis, which takes into account emissions over a 60 year building life, a separate set of emissions factors based on longer term expectations of electricity generation displaced by energy saving was used in order to ensure consistency with other Government IAs.

Valuation of savings

5.11 The valuation of savings in the Consultation IA was based on the guidance on greenhouse gas policy evaluation and appraisal in government departments published by DECC in December 2008 (the IAG guidance).[12] This guidance provided a common platform for evaluations and appraisals of greenhouse gas policies and proposals across Government. We have continued to use the 2008 guidance as the basis for this implementation stage IA but have incorporated revised values for energy and CO_2 emissions published during 2009.[13] These are consistent with the values used in the IAs for both zero carbon homes and zero carbon non-domestic buildings.

5.12 Emissions reductions from reduced gas consumption and reduced electricity consumption are valued separately and are calculated on the basis of emission factors published in the 2008 guidance. Later guidance published in 2010 sets out lower emission factors after 2030 but it has not been possible to incorporate these into the modelling in the final stage of the work.[14] As a result emissions reductions in later years may be overstated.

5.13 The 2009 guidance provided revised values for reduced emissions from use of natural gas which are consistent both with short term and long term targets. These are higher than the values based on the shadow price of carbon published in 2008 and start at £50/tonne CO_2 in 2008. For electricity emissions reductions continue to be valued at the price of EU Emission Trading Scheme (EU ETS) allowances but these estimated values have also been increased starting at £21/tonne CO_2 in 2008. The rational for this approach, which

[11] The Flat 25 per cent compliance target for new dwellings is adjusted to account for the change in CO_2 emission factors so that the baseline represents the same level of energy efficiency by multiplying by the ratio of the 2005 and 2010 emission factors. No adjustment is made to the fuel factors set out in ADL1A 2006 in response to the change in CO_2 emission factors.

[12] Greenhouse Gas Policy Evaluation and Appraisal in Government Departments. DECC 2008. www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/greengas-policyevaluation.pdf

[13] www.communities.gov.uk/documents/planningandbuilding/pdf/1284609.pdf

[14] www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx

avoids the double counting of CO_2 savings which have already been taken into account in the evaluation of the EU ETS, is set out in more detail in the IAG Guidance. In addition a benefit of £1.13/MWh is placed on reduced damage costs associated with marginal electricity generation. This is based on the assumption that the marginal plant is a CCGT generator.

5.14 Reductions in energy consumption are valued using the variable element of the price of gas and electricity (excluding any carbon value) as set out in the IAG guidance. The 2009 updated values have been used which are between 25 per cent and 50 per cent higher than the values used in the Consultation IA.

5.15 The IAG guidance also contains provision for attributing an additional value to reductions in energy consumption which reduces the level of delivered renewable energy the UK is required to achieve. In line with the guidance, a value of £18/MWh is attributed to the avoided costs of renewables for energy saved in 2020. This reflects the high marginal cost of delivering additional renewable energy. Given the uncertainty associated with this value the final costs and benefits are shown with and without the value of avoided renewables.

Build mix

5.16 Both total costs and benefits are dependent on assumptions concerning the number of new dwellings that will be built each year. For the basis of calculating total cost and benefit figures for this assessment, a constant build rate of 150,000 dwellings per year has been assumed to take place over a 10 year period. Given uncertainty about future build rates sensitivity tests have been carried out on build rates of 100,000 and 200,000 dwellings per year.

5.17 To split this total figure between different types of dwellings, we applied the proportions used in a report produced for CLG, which fed into the later Zero Carbon Homes IA.[15] The assumed build mix is shown in Table 2.

Table 2: New build mix – domestic housing

Detached House	Semi-detached house	Mid-terrace house	Flat
25%	18%	25%	32%

Source: CLG

5.18 For this policy option, specifications were identified using SAP that would result in a 25 per cent reduction in CO_2 emissions for each dwelling type. These are set out in Table 3.

[15] "Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development", CLG, 2008, available at: www.communities.gov.uk/publications/planningandbuilding/housingcarbonfootprint

Table 3: Domestic building specifications – Flat 25% option

	Detached	Semi detached	Mid terrace	Electric flat
Roof (U-value)	0.18	0.18	0.19	0.16
Walls (U-value)	0.23	0.24	0.23	0.18
Party walls (U-value)	N/A	0.00	0.00	0.00
Floor (U-value)	0.21	0.21	0.21	0.19
Windows and doors (U-value)	1.7	1.7	1.6	1.3
Gas boilers (seasonal efficiency)	90%	90%	90%	N/A
Electric heat emitters (seasonal efficiency)	N/A	N/A	N/A	100%
Secondary heating	None	None	None	N/A
Air permeability (m^3/hm^{-2})	5	5	5	5
Thermal bridging (y)	0.04	0.04	0.04	0.04
Hot water cylinder insulation (mm)	100	100	100	100
Ventilation system	Natural	Natural	Natural	Natural
Lighting – CFLs	100%	100%	100%	100%

Source: AECOM

Section 6

Non-domestic buildings

Aggregate 25 per cent improvement

6.1 Because of the high degree of variance in building types in the non-domestic sector a larger number of building types were considered:

- shallow plan office
- deep plan office
- warehouse
- hotel
- school
- retail unit
- out-of-town supermarket.

6.2 Based on the elemental performance assumptions, two sets of specifications were developed for the aggregate approach: one outlining the specification for "roof-lit" buildings (e.g. warehouses and supermarkets) and another for "side-lit" buildings (e.g. offices, hotels, schools and retail units). As most non-domestic buildings are gas-heated, a separate specification for electric heated buildings was not developed. On an aggregate basis, the new build mix would emit 25 per cent less CO_2, but each individual building may not necessarily yield a 25 per cent reduction in isolation.

Specifications

6.3 Component specifications were created for a "reference" building broadly representing a 2002 compliant building, and for three levels of improvements in building performance. These specifications, set out in Table 4, formed the basis of the component level analysis.

Table 4: Elemental performance assumptions – non-domestic buildings				
	Reference	**Level A**	**Level B**	**Level C**
Roofs (U-value)	0.25	0.20	0.15	0.10
Walls (U-value)	0.35	0.25	0.20	0.15
Floors (U-value)	0.25	0.20	0.15	0.10
Windows, doors and rooflights (U-value)	2.20	1.50	1.10	0.70
Lighting (lm/W)	45	50	65	–
Multiburner radiant system (thermal/radiant efficiency)	80%	82%/52.5%	86%/65%	–
Central mechanical ventilation (SFP)	2.50	1.80	–	–
Gas boiler (seasonal efficiency)	84%	86%	88%	91%
Air cooled chiller (SEER)	2.25	2.70	3.50	4.50
DX Cooling (SEER)	2.50	3.00	3.50	–

Source: AECOM

Building specifications

6.4 As the cost data were provided on a per m^2 of fabric and a per service installation basis and the energy data were provided on a per m^2 of floor area basis, it was necessary to make assumptions regarding the areas of thermal elements and the number of fixed building services per building, in order to compare the two. These were based on the size of the building types in question, the heating loads, cooling loads and number of light fittings in each of the building types used in the energy modelling.

Cost data

6.5 Cost data for the reference specifications and incremental capital and maintenance costs were provided for each of the components listed above, based on the three different levels of improvement. The fabric data were provided on a "£ per m^2 of element" basis. The services data were generally on a "£ per fitting" basis and converted to a "£ per unit" basis (e.g. £/kW) where appropriate based on the size of the fitting costed. The data from Davis Langdon were obtained by speaking directly to people in the construction industry. Details on the cost assumptions are set out in Appendix 2.

Energy data

6.6 Energy data for these building types were derived using the 2010 version of SBEM. The SBEM energy modelling provided estimates of the gas and electricity use of each building type based on varying the specification of an individual component, while keeping the specifications of the other components constant. For each component, a range of specifications were modelled. Incremental gas and electricity savings were then calculated from this analysis. Energy data for each of the buildings for the "reference" case and for 2006 compliant buildings were developed to provide the baseline for comparison.

Asset lives

6.7 Assumptions were made about the approximate asset life of each of the fabric and building services components. The longest assumed asset life is 60 years. For assets with shorter life (such as lighting and heating and ventilation equipment) the costs of replacement to 2010 standards has, as with domestic buildings, been included in order to maintain comparability of costs and benefits over the full 60 year life. The energy savings and incremental costs associated with tightening the Regulations are summed and discounted over 60 years.

Renewable technologies

6.8 The model considered the possibility that it may be cheaper to reduce emissions by introducing LZC technologies than by further tightening fabric and/or building services standards. The specifications of relevant LZCs, together with their cost and energy savings and asset lives were derived from industry sources.

Valuation of savings

6.9 As described above for domestic buildings, the IAG guidance has been followed in valuing the savings from reduced energy consumption and associated emissions.

Build mix

6.10 An indicative growth rate of 8.6 million m^2 of new non-domestic buildings per annum over the 10 year policy period has been assumed. This has been broken down between building types as shown in Table 5. These data were used to calculate weights for each of the building types within the total and applied to the costs and benefits which were calculated for each component in each building type (see later section). The costs and benefits are weighted by the amount of new build for each building type in order to avoid giving undue importance to a particular building type.

Table 5: New build rates – split by non-domestic building type	
	Per cent
Shallow plan (heated)	1
Shallow plan (Air conditioned)	1
Deep plan (Air conditioned)	40
Warehouse	33
Hotel	6
School	4
Retail	12
Supermarket	2

Source: BRE

Initial component level analysis

6.11 Using the data described above, the following were calculated for each building type:

- the value of lifetime gas and electricity savings relative to the baseline (£/unit, e.g. m^2 of wall) valued at the variable element of the gas and electricity price
- the value of lifetime carbon savings (£/unit) valued at the shadow price of carbon for gas and at the EU ETS allowance price for electricity
- the additional maintenance and capital costs.

6.12 All values were discounted over 60 years using the Government's discount rate of 3.5 per cent for the first 30 years and 3 per cent thereafter.

6.13 Taking the output of these calculations, considering each component in isolation, we determined the elemental specification that yielded the greatest net benefit. It was necessary to interpolate between the data points for the reference case and the improvement level specifications, as the specifications for each component achieving the highest net benefit need not necessarily be one of these.

Weighted component level analysis

6.14 Weights were calculated for the two specifications for each component based on the build mix. These weights were then applied to the relevant building types to generate a weighted average of the costs and benefits for each component, calculated in the initial component level analysis described above. This analysis provided the most cost-effective choice for each component within each specification. The optimal specifications were then calculated by equalising marginal abatement costs across all components subject to the constraint that the elemental specifications for fabric measures would be the same for both "roof-lit" and "side-lit" buildings. We also took account of industry views that it was unrealistic to push certain fabric measures to the highest achievable levels shown in Table 4. The calculation of the specifications is described further in Appendix 1.

6.15 Energy usage data for each of the building types as a whole were calculated using the relevant specification in SBEM. This additional stage was required to take into account interaction effects between components, which could have a significant impact on total energy savings. These effects could not be accounted for in the component level analysis and hence it was necessary to model energy savings at the building level. These energy savings data were used to calculate whether or not the 25 per cent CO_2 reduction target would be achieved using the optimal specifications.

6.16 The two non-domestic specifications estimated in this way are set out in Table 6 below.

Table 6: Specifications for aggregate 25% approach – non-domestic building

	"Roof–lit"	**"Side–lit"**
Roofs (U-value)	0.18	0.18
Walls (U-value)	0.26	0.26
Floors (U-value)	0.22	0.22
Windows, doors and rooflights (U-value)	1.8	1.8
Air permeability	5	5
Lighting (lm/W)*	55	55
Multiburner radiant system (thermal/radiant efficiency)	86%/65%	–
Central mechanical ventilation (SFP)	1.8	1.8
Fan coil units (SFP)	–	0.5
Gas boilers (seasonal efficiency)	90%	88%
Cooling (SEER)**	4.5	4.5
DX Cooling (SEER)	–	3.5

Source: Europe Economics modelling

Thermal bridging (Psi value): roof-wall – 0.12; wall-ground floor – 0.28; wall-wall (corner) – 0.09; wall-floor (not ground floor) – 0.18; lintel above window or door – 0.53; sill below window – 0.21; jamb at window or door – 0.2

** Dimmable daylight lighting control is assumed in the following building types: Office (shallow and deep plan), warehouse (with rooflights), school, retail unit, and supermarket*

*** The energy benefits for cooling are based on SEERs, whereas the costs are based on EERs*

6.17 Some of the building services are pushed harder than the fabric measures because there are larger electricity savings that can be achieved cost effectively. The option of using LZCs was included in the modelling but these were not cheaper than the energy efficiency measures.

6.18 Daylight control was assumed in certain building types because this increased the level of savings. The modelling for the consultation stage impact assessment showed that in the absence of daylight control, a 25 per cent reduction in annual emissions could not be met without the use of high cost LZCs.

6.19 Under the Aggregate 25 per cent option different building types would contribute different amounts of CO_2 reductions in order to meet the overall 25 per cent annual reduction. The level of emissions reduction expected from each building type is dependent on the cost of achieving those reductions. If the cost of achieving further reductions is high, as it is for hotels and retail units, then reduction of less than the average level of 25 per cent would be required. This is offset by higher percentage reductions from other building types such as warehouses and shallow plan offices, where the costs of achieving the additional savings are lower. Based on the specifications above, each building type would need to achieve the percentage reductions in CO_2 emissions shown in Table 7.

Table 7: Percentage CO_2 reductions by non-domestic building type

Shallow plan (heated)	Shallow plan (Aircon)	Deep plan (Aircon)	Warehouse	Hotel	School	Retail	Supermarket
22%	40%	26%	34%	16%	27%	21%	26%

Source: Europe Economics modelling

6.20 The target reductions above are based on a combination of the build mix and the energy intensity of the buildings modelled. Based on the build mix alone, the percentages above would yield an overall improvement greater than 25 per cent; however, when the energy intensity of these buildings is taken into account the overall improvement is 25 per cent. In particular, the higher than average energy intensity of the retail unit (and to a lesser extent the hotel) counters the much higher build rate for the warehouse, as the warehouse has a much lower energy intensity.

6.21 The targets for individual building types have changed since the consultation. This results from changes to the SBEM modelling and revised assumptions, (following industry comment), in fabric and services efficiency levels as set out in Table 6. In particular, the target for supermarkets has increased considerably from 11 per cent shown in the Consultation IA to 26 per cent. This is because the way the supermarket has been modelled in SBEM has changed. It was thought that a chilled sales retail area would be more applicable to a supermarket than a general sales retail area. The result is higher small power gains and larger internal gains; less heating is required and there is a shift towards cooling. With the higher level of efficiency for air cooled chillers assumed, the supermarket is now able to achieve much greater reductions than was previously considered possible.

Section 7

Cost benefit analysis

Domestic buildings

Impact of existing policies

7.1 The model as described operates by comparing buildings meeting the 2010 standards with buildings meeting the 2006 standard. However that may overstate the impact of the policy changes. Government has introduced a wide range of policies directed at improving energy efficiency and reducing emissions. As a result it is likely that there will be some reductions in emissions from new and existing buildings even if there was no change in the Part L regulations. The modelling outlined takes this into account in respect of the EU Emissions Trading Scheme in that no credit is taken for CO_2 reductions resulting from reduced use of electricity in buildings. However the possible impact of other policies needs to be taken into account in order to establish the appropriate counterfactual of what would have happened in the absence of the Part L policy initiative.

7.2 For domestic buildings we have identified a number of relevant existing policies. For new homes the most significant of these is the commitment that all social housing should be built to the standard of Code level 3 in the Code for Sustainable Homes.[16] Code level 3 energy section requires buildings to achieve the same 25 per cent reduction in CO_2 emissions as is being proposed under the Part L revisions. These new buildings should therefore achieve that level of reduction in the absence of amendment to Part L.

7.3 In recent years social housing has accounted for between 10 and 15 per cent of all new dwellings with 23,750 dwellings completed in England and Wales in 2007/08.[17] The government has set a target of 45,000 new social homes by 2010/11 rising to 50,000 a year in later years.[18] This suggests that social homes built to Code level 3 standards could account for 30 per cent or more of the new homes that have been included in the modelling. The costs and benefits associated with the reduced emissions from these homes are attributable to other policies and should be excluded from the costs and benefits of the Part L revisions.

[16] The Code for Sustainable Homes. Setting the standard for sustainability in new homes. CLG 2008. www.communities.gov.uk/documents/planningandbuilding/pdf/codesustainhomesstandard.pdf

[17] www.communities.gov.uk/documents/housing/xls/323495.xls

[18] Homes for the future: more affordable, more sustainable. http://www.communities.gov.uk/documents/housing/pdf/439986.pdf

7.4 The mandatory labelling of new homes under the Code may also lead private sector developers to build to higher levels of energy efficiency as a marketing opportunity. The IA for the mandatory labelling policy estimated that 22 per cent of new homes would be built to higher standards as a result of the policy. However that policy assessment only took into account benefits which went beyond Part L requirements and so no adjustment is necessary in the current IA.

7.5 Other existing policies which may result in new buildings having lower emissions levels than required by the current regulations include the requirements of local planning authorities (such as the Merton Rule) for higher standards to be met as a condition of planning consent. It has not been possible to quantify these effects and no adjustment is proposed. However this may result in some over-attribution of costs and benefits to the Part L changes.

7.6 In considering the impact of Part L on existing dwellings, there are two policies that are of particular relevance. The requirement for Energy Performance Certificates, introduced in 2007, is expected to result in increased awareness of the options for improving energy efficiency and increased take up of these measures. This will be further stimulated by supplier obligations under which energy companies provide financial support for energy efficiency measures in homes. This includes support for insulation etc.

7.7 The European Energy-using Products (EuP) Directive[19] will lead to the phase out of tungsten filament lamps and the introduction of more efficient compact fluorescent lamps (CFLs). However there is little overlap as the impact of Building Regulations is minimal, given that many millions of lamps are sold each year on a replacement basis whilst approximately 150,000 new homes are built per annum.

7.8 Take up of energy efficiency measures as a result of these policies will mean that the scope for emissions reductions from building work in existing homes will be reduced because some of the actions assumed in that estimate will already have been taken by householders. It is difficult to assess the scale of this effect but given the high profile attached to both the EPC and supplier obligation policies we suggest that up to 50 per cent of the costs and benefits and CO_2 reductions (excluding boiler and window replacements) should not be attributed to the Part L changes.

7.9 The assumptions on the impact of other policies are unchanged from the Consultation IA.

[19] http://ec.europa.eu/enterprise/policies/sustainable-business/sustainable-product-policy/ecodesign/index_en.htm

New domestic buildings

7.10 The total costs and benefits of the Flat 25 per cent policy options have been estimated using four dwelling types:

- four bedroom detached house
- three bedroom semi-detached house
- two bedroom terraced house
- two bedroom flat/block of flats.

7.11 Of these, the analysis assumed that only flats would use electric resistance heating whilst all other dwelling types are heated by gas.

7.12 The total net present value benefit/cost of moving from the 2006 to the 2010 Regulations is calculated by subtracting the total incremental cost from the sum of the present values of energy savings, CO_2 savings and avoided renewables. The total national values were calculated using the projected new build rates over a ten year period (2012-2021) adjusted, as described above, to allow for the impact of other policies implemented ahead of the Part L changes. Buildings were assumed to have a 60 year life with replacement of shorter life assets during that period. A discount rate of 3.5 per cent has been used for the first 30 years and 3 per cent thereafter.

7.13 The costs and benefits for the Flat 25 per cent options are summarised in Table 8.

Table 8: Present value of costs and benefits – new domestic buildings £m NPV

	Flat 25%
Energy savings	2,589
Total incremental cost	(785)
Sub-total	**1,804**
Carbon savings – ETS	841
Carbon savings – non-ETS	429
Reduced damage costs	21
Total Carbon and other savings	1,292
Net benefit/cost exc. avoided renewables	**3,096**
Avoided renewables	22
Net benefit/cost inc. avoided renewables	**3,118**

Source: Europe Economics modelling

7.14 The value of energy savings presented in Table 8 is significantly greater than the value that was presented in the consultation phase impact assessment. This is partly explained by a change in DECC guidance concerning the monetary value of 1MWh of energy and partly because of the change in methodology in light of the consultation response concerning the treatment of party walls, such that a greater volume of energy and carbon is saved with the specifications presented earlier in this document. Similar arguments can be used to explain the increase in the value of carbon savings, whilst it should be noted that the total incremental cost has increased as a result of the party wall methodological change.

Existing dwellings

7.15 Several possible alterations to existing buildings were considered in the analysis. Estimates have been prepared for the following broad categories:

- extensions
- renovations to thermal elements, replacement windows and replacement boilers
- loft and garage conversions.

7.16 There was however concern, particularly from property owners and occupiers, over the costs and bureaucracy of removing the exemption for all conservatories from Part L and the Government has decided against including this in the 2010 changes.

7.17 Details on the main assumptions that have been used in arriving at these estimates are set out in Appendix 3. The estimates for renovations have been adjusted to allow for 50 per cent of the potential for improvement having already been achieved as a result of the EPC and supplier obligation policies.

7.18 Summaries of the net present values of costs and benefits for existing buildings are set out in Table 9.

Table 9: Present value of costs and benefits – existing dwellings £m NPV

	Total	Extensions	Replacement windows/boilers	Renovations	Loft/garage conversions
Energy savings	14,584	445	13,760	73	307
Total incremental cost	(10,554)	(149)	(9,770)	(515)	(120)
Total financial cost/benefit	**4,031**	**296**	**3,990**	**(443)**	**187**
Carbon savings – ETS	1,910	41	1,858	0	10
Carbon savings – non-ETS	4,971	290	4,413	38	231
Reduced damage costs	128	62	66	0	0
Total Carbon and other savings	7,009	393	6,337	38	241
Net benefit/cost exc. avoided renewables	**11,040**	**689**	**10,326**	**(404)**	**428**
Avoided renewables	295	8	284	2	0
Net benefit/cost inc. avoided renewables	**11,335**	**697**	**10,114**	**(402)**	**430**

Source: Europe Economics modelling

7.19 The total amount of CO_2 reduction from the policy over the 70 years covered in the modelling is shown in Table 10.[20] Savings over the period to 2020 are shown in Table 11. Improvements in existing buildings are expected to deliver greater CO_2 savings than are the building regulations for new buildings. The majority of carbon saved from existing buildings results from a reduction in the usage of gas.

Table 10: Lifetime volume of CO_2 reductions – domestic buildings ($MtCO_2$)

	New buildings	**Existing buildings**
ETS sectors	27	46
Non-ETS sectors	12	145
Overall	**39**	**191**

Source: Europe Economics modelling

Table 11: Annual CO_2 reductions ($MtCO_2$) – Domestic buildings to 2020

	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
New buildings	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.45	0.50
Existing buildings	0.55	1.03	1.65	2.20	2.75	3.30	3.84	4.39	4.94

7.20 Two separate measures of cost effectiveness are shown in Table 12. Cost effectiveness provides an estimate, for each policy option, of the net social cost per tonne of CO_2 saved. This takes into account all of the costs and benefits of the policy shown in Table 8 other than avoided renewables. The existence of the EU ETS requires that emissions in ETS sectors are treated separately to those in non-ETS sectors and separate cost effectiveness values have been prepared for each sector. A negative value (denoted by brackets) indicates that the policy has an overall net benefit.

Table 12: Cost effectiveness in reducing emissions – domestic buildings

	New buildings	**Existing buildings**
ETS sectors (£/tonne CO_2)	(83)	(196)
Non-ETS sectors (£/tonne CO_2)	(219)	(42)

Source: Europe Economics modelling

[20] The modelling takes into account new build over a 10 year period with each building having a 60 year life. The last building included in the analysis therefore reaches the end of its assumed life 70 years after the start of the policy.

7.21 The cost effectiveness figure is negative indicating that there is a net benefit for both new and existing buildings. In other words, the present value of incremental costs is lower than the sum of the present values of energy savings, non-sector carbon savings and reduced marginal damage costs. Avoided renewables are excluded from these calculations.

Non-domestic buildings

Impact of other policies

7.22 As described above for domestic buildings, we have considered whether there are other existing policies which can be expected to lead to improvements in energy efficiency and reduced emissions from new non-domestic buildings even without the proposed amendments to Part L. The main policies that appear to be relevant are the Carbon Reduction Commitment[21] and any requirements imposed by local authorities as part of planning consent. We have not proposed any adjustments to the costs and benefits in new non-domestic buildings to allow for other existing policies. It is likely that some improvements in existing buildings will take place as a result of the EPC and Display Energy Certificate (DEC) policies under the Energy Performance of Buildings Directive[22] but it is difficult to identify the level of this impact and no adjustment has been made to the estimates for refurbishment of existing buildings.

7.23 Once the optimal specifications for the Aggregate 25 per cent approach were calculated the costs and benefits of this policy option could be calculated at the national level to see whether the policy yielded a net benefit.

7.24 The input for the cost benefit analysis was annual building-level energy usage levels as modelled in SBEM. These data were provided for the 2010 specifications, 2006 compliant specifications and the "reference" case such that annual gas and electricity savings for each building type could be calculated.

7.25 The total net benefit was calculated by subtracting the total incremental cost from the sum of the present values of energy savings, CO_2 savings, avoided renewables and reduced damage costs associated with marginal electricity generation.

21 www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

22 www.communities.gov.uk/planningandbuilding/theenvironment/energyperformance/

7.26 National annual CO_2 savings relative to the 2006 baseline were calculated by scaling up the incremental saving using the new build rate projections. The total national savings were calculated using the projected new build rates over a ten year period (2012-2021). Buildings were assumed to have a 60 year life. A discount rate of 3.5 per cent has been used for the first 30 years and 3 per cent thereafter.

7.27 The costs and benefits of the two policy options modelled in this way are summarised in Table 13.

Table 13: Present value of costs and benefits – new non-domestic buildings £m NPV

	Aggregate 25%
Energy savings	3,590
Incremental cost	(2,942)
Sub-total	**648**
Carbon savings – ETS	1,334
Carbon savings – non-ETS	126
Reduced damage costs	44
Total Carbon and other savings	1,504
Net benefit/cost exc. avoided renewables	**2,152**
Avoided renewables	21
Net benefit/cost inc. avoided renewables	**2,173**

Source: Europe Economics modelling

7.28 The revised building specifications shown in Table 6 put more emphasis on higher efficiency standards in building fabric than in the Consultation IA. As a result the estimated incremental cost of the policy has increased. This is offset by the higher value now attributed to energy savings. As a result the Aggregate 25% policy shows a substantial net benefit; even before carbon benefits are taken into account with the incremental energy savings outweighing the incremental cost of the policy. The value attributed to CO_2 reductions has also increased significantly and taking this into account the policy has a net present value in the region of £2 billion.

7.29 The total reduction in CO_2 is accumulated over the life of the buildings, i.e. 60 years after the final year of new build considered in the ten year policy. This is shown in Table 14 below:

Table 14: Lifetime CO_2 reductions ($MtCO_2$) – Non-domestic buildings

	Aggregate 25%
ETS sectors	56
Non-ETS sectors	4
Overall	**60**

Source: Europe Economics modelling

Table 15: Annual CO_2 reductions ($MtCO_2$) – Non-domestic buildings to 2020

	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Aggregate 25%	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

Source: Europe Economics modelling

7.30 A measure of the cost effectiveness of each policy in contributing to the government's emissions reductions targets can be obtained by comparing the NPV cost per tonne of avoided CO_2 for each option. This is broken down between savings in the ETS and non-ETS sectors. This is shown in Table 16. The negative values indicate net benefits.

Table 16: Cost effectiveness of policy overall – new non-domestic buildings

	Aggregate 25%
ETS sectors (£/tCO_2)	(14)
Non-ETS sectors (£/tCO_2)	(508)

Source: Europe Economics modelling

Existing buildings

7.31 There is little data available on the existing non-domestic stock to accurately estimate the overall improvement in energy efficiency that would occur as a result of amendments to the Building Regulations. However, based on the broad assumptions below, some indicative results can be ascertained.

- Assuming that approximately half of the emissions from the existing non-domestic stock come from the maintenance of building internal environments, the CO_2 emissions from the building internal environments is about 105 $MtCO_2$ each year.

- It is assumed that the refurbishment rate for existing buildings is four per cent, i.e. a building is refurbished once every 25 years.
- Assuming that each refurbishment yields a ten per cent improvement in performance, there is an improvement in the overall existing non-domestic stock performance of about 0.4 per cent.
- For the purpose of estimation, it is assumed that the cost of these improvements will be equal to the same proportion of the net financial benefit/cost (i.e. the energy savings from energy efficiency improvements minus the cost) as in new non-domestic buildings.

7.32 The results in Table 17 should be considered with caution. They are for illustrative purposes only, and indicate that there would be a large net benefit from improving efficiency standards in existing non-domestic buildings.

Table 17: Present value of costs and benefits – existing non-domestic buildings £m NPV	
Energy savings	6,473
Incremental cost	(5,305)
Sub-total	**1,168**
Carbon savings – ETS	667
Carbon savings – non-ETS	825
Reduced damage costs	6
Total Carbon and other savings	1,498
Net benefit/cost exc. avoided renewables	**2,666**
Avoided renewables	18
Net benefit/cost inc. avoided renewables	**2,684**

Source: Europe Economics modelling

7.33 A summary of the costs and benefits for each of the categories of building set out above is provided in Table 18

Table 18: Summary of present value of costs and benefits – all buildings £m NPV

£m NPV	Incremental building costs	Energy Savings	Carbon And Other Savings	Avoided Renewables	Total Benefits	Total net benefit/ (cost)
New Domestic	(785)	2,589	1,291	22	3,903	3,118
Existing Domestic	(10,554)	14,584	7,009	295	21,888	11,335
New Non-Domestic Buildings	(2,942)	3,590	1,504	21	5,115	2,173
Existing Non-Domestic Buildings	(5,305)	6,473	1,498	18	7,989	2,684
Total	**(19,586)**	**27,245**	**11,302**	**356**	**38,895**	**19,310**

Source: Europe Economics modelling

Section 8

Part F

8.1 One of the effects of the continued tightening of Part L requirements is that developers are encouraged to construct buildings with a higher level of air tightness, in order to claim the associated CO_2 savings towards meeting the compliance target. As a result consequential changes are needed in Part F in order to ensure that the improved levels of air tightness do not result in reduced indoor air quality with adverse impact on health. Because these changes are driven by the changes to Part L their impact has been assessed together with the wider appraisal of Part L

8.2 In the non-domestic sector, the required ventilation rates set out in Approved Document F do not assume any air leakage in the building. Hence, these ventilation rates should continue to be sufficient as air permeability tightens and there is no additional impact to be taken into account.

8.3 However, greater air tightness does raise possible ventilation issues in the domestic sector. The ventilation systems for dwellings recommended in Approved Document F 2006 are designed for buildings with air permeability equal to or leakier than about 3 or 4 $m^3/(h.m^2)$ at 50 Pa. Since 2006, surveys have indicated that a growing but not yet significant number of new dwellings are being built with levels of air permeability that approach or are better than these levels, and this trend is likely to continue as Part L requirements are tightened further. There is a risk that current Part F ventilation rates could become inadequate for such dwellings, leading to deterioration in indoor air quality with potentially negative consequences for human health. The key health concern addressed by the ventilation provisions of Part F is the effect of indoor pollutants on respiratory illnesses, particularly asthma.

8.4 CLG commissioned a study[23] of 22 homes built to Part L and F 2006 to monitor ventilation, indoor air quality and air tightness. One key highlight of the research was inadequate ventilation provisions compared to Part F 2006.

- 72 per cent of homes had trickle ventilator areas less than recommended in ADF 2006
- many had extract provisions less than recommended in ADF (89% of kitchen extract, 79 per cent of bathroom and 42% WC extract less than ADF 2006)

[23] www.communities.gov.uk/planningandbuilding/planningbuilding/buildingregulationsresearch/buildingdivisionresearch/

- 52 per cent of door undercuts were less than 10 mm recommended in ADF 2006.

8.5 Overall, 55 per cent of dwellings had ventilation rates lower than Part F 2006. Indoor air quality levels were also poor in some of the dwellings. It is unclear what proportion of this is due to inadequate provisions due to design and installation and what proportion is due to the need for additional ventilation provisions in more airtight homes. However, analysis does suggest that even if the ventilation provisions were constructed to meet Part F 2006, it is likely that there would be inadequate ventilation for more airtight homes which provides justification for the increased provisions proposed for Part F 2010.

8.6 To address this issue, the draft Approved Document F for 2010 contains higher purpose-provided ventilation rates for more air tight dwellings (those with a design air permeability of equal to or better than 5 $m^3/(h.m^2)$ at 50 Pa). In our assessment of the Flat 25 per cent emissions reduction target for dwellings we have assumed an air tightness value of 5. The modelling results for the different building types presented in this IA include allowance for the incremental costs associated with additional natural ventilation. These costs are included in the main cost benefit analysis. In addition it has been assumed, based on industry discussions, that there could be a 15 per cent increase in installation of continuous mechanical ventilation, either Mechanical Extract (MEV) or Mechanical Supply and Extract with Heat Recovery (MVHR) systems, to comply with Part F 2010, compared with the installation rate seen in recent years for compliance with Part F 2006. Based on industry estimates of the number of additional units and associated costs this could result in an additional annual cost to industry of around £10m.

8.7 There is a new requirement for ventilation systems, in new and existing buildings, that these systems should be properly installed and commissioned in accordance with a procedure approved by the Secretary of State. This is implicit in the current Part F requirement for providing ‘adequate means of ventilation’ and is also a requirement under Part L for installation and commissioning to ensure the systems are energy efficient. The Domestic Ventilation: Installation and Commissioning Compliance Guide provides details of how this new requirement may be met for dwellings. We have assumed that there is no additional cost as such an installation and commissioning procedure should already be in place.

8.8 It is also a requirement that air flow rates should be measured in all new dwellings and that the measured flow rates be given to the building control body. There will be an additional cost associated with this measurement. It has been estimated that if these tests are carried out on all new dwellings this could have an annual cost of around £10m. This is based on individual test costs of £125 for MVHR, £90 for MEV and £60 for intermittent extraction. There will also be a requirement that sufficient information on the ventilation system be given to the owner/occupier of all new dwellings to allow it to be operated to provide adequate ventilation. There should not be any significant additional cost associated with this requirement.

8.9 There will also be guidance on a check list of ventilation issues to be addressed in new buildings but this will not be a statutory requirement.

8.10 Because the changes to Part F are designed to maintain the health benefits associated with ventilation that were established for Part F 2006, there are no additional benefits to be taken into account. The changes are consequential on the changes required under Part L 2010. As noted above the net benefit of the Part L proposals for new dwellings is substantial and well in excess of the additional Part F costs identified here.

8.11 At the Consultation stage it was proposed that there should be a requirement for continuous domestic ventilation systems to be acoustically type-tested in a laboratory. This was to ensure that systems were quiet to minimise disturbance to the occupier who might otherwise reduce the air flow rate or turn the ventilation system off. In an 'air tight' house, this could lead to indoor air quality problems. In the time available, it has not been possible to develop a robust test and calculation method to convert the type test value into room noise levels for the Part F 2010 changes so this is not costed. Commentary as to what good indoor ambient noise levels in habitable rooms should look like is included in the Approved Document.

8.12 Approved Document F 2006 says that where original windows in dwellings are fitted with trickle ventilators, replacement windows should have trickle ventilators (or an equivalent means of ventilation). However where the original windows are not fitted with trickle ventilators it would be good practice only to fit trickle ventilators. The Consultation set out the option of requiring the use of trickle ventilators for all replacement windows in dwellings subject to ongoing cost benefit analysis supporting such a change. Although many consultees support the proposals, they also suggest that the costs in the IA were too low.

8.13 The now complete cost-benefit analysis[24] indicates that the total cost of such installation could be £61m. The benefit measured in terms of Quality Adjusted Life Years (QALYs) attributable to the policy was estimated at just over 600 QALYs. This gave a cost per QALY of around £100,000 and can be compared with the guideline used by the National Institute for Clinical Excellence (NICE) that health treatments costing no more than £30,000 per QALY as being effective. In the light of this research and consultation response it has been decided that there is not sufficient evidence to justify a change to the current provisions.

[24] www.communities.gov.uk/planningandbuilding/planningbuilding/buildingregulationsresearch/buildingdivisionresearch/

Section 9

Compliance and enforcement issues

Existing compliance issues

9.1 Apart from the results of air pressure tests, which suggest new homes have become more air tight over time, there is limited evidence available on the extent of compliance with Part L of the Building Regulations. However, there is perception that there are problems relating to compliance with this part of the Building Regulations. In some cases, this may relate to wilful non-compliance (e.g. the use of lower specification products than specified in SAP or SBEM calculations). However, a wider problem relates to buildings performing more poorly than they should, even when the developer has sought to comply with the requirements of Part L. This may be due to errors in the way in which the energy performance of buildings is modelled,[25] or it may be due to poor construction and commissioning.

9.2 Some limited evidence relating to the gap between theoretical and realised energy performance comes from the Stamford Brook project, which looked at the energy performance of a new housing development.[26] In this instance, the development benefited from substantial input from the research team aimed at achieving a good performance, yet even so emissions were significantly higher than their modelled level. Some of this was due to heat loss through party walls due to thermal bypass effects not captured in the SAP modelling, but even excluding this effect emissions were around 10 per cent higher than modelled due to underperformance of fabric and building services.

9.3 Overall the limited evidence available suggests that for buildings being constructed to the 2006 regulations, emissions may be in the region of 15 per cent higher than the regulatory performance level.

[25] For instance, in the past a U value of zero has been assumed for party walls in SAP modelling, whereas in fact there may be significant heat loss through such walls as a result of thermal bypass effects.

[26] http://www.leedsmet.ac.uk/as/cebe/projects/stamford/index.htm

Proposed measures to improve compliance

9.4 The policy proposals include a number of measures aimed at improving compliance with Part L of the Building Regulations and closing the performance gap described above. These are as follows:

- An Accredited Construction Details (ACD) scheme aimed at ensuring that developers only claim enhanced benefits in their SAP modelling from using accredited construction details where these details have actually been used. The proposed scheme(s) would require developers to register their use of accredited details in order to receive a unique reference number which they could input into SAP. The operators of the scheme would validate the thermal performance of construction joint details and carry out random spot checks on a sample of developments to ensure that the accredited details were being used in practice.
- An improved procedure for allowing Building Control Bodies (BCBs) to check that the energy performance of new buildings. This would involve developers providing BCBs with a design-stage submission containing not just the SAP/SBEM calculation but also the component specifications which the developer is going to use to deliver this result. The submission would also place greater emphasis on a list of key features generated by SAP showing the aspects of the building design which are most important, thus assisting BCBs in prioritising what to check when onsite. This design-stage submission would be in addition to the existing SAP/SBEM submission required later in the process.
- A doubling of the size of the sample on which developers must undertake air pressure testing.

9.5 No change is proposed to the existing sanctions provided for in the Building Act in the event that non-compliance is identified.

9.6 The impact of the above measures is difficult to predict however it is estimated that the level of underperformance could be reduced to around 10 per cent on average. These actions should therefore deliver additional reductions in CO_2. However, given the uncertainty about the scale of improvement that might be achieved, these additional reductions have not been taken into account in the main analysis.[27]

[27] If a 2006 compliant building has a designed level of emissions of 100 units but in practice produces 115 units (15 per cent more than designed) and if a 2010 compliant building has a designed emissions level of 75 units but in practice produces 82.5 units (10 per cent more than designed) then the designed level reduction of emissions between 2006 and 2010 would be 25 per cent but the achieved reduction would be nearly 29 per cent. The additional reduction is attributable to improved compliance.

Section 10

Sectors and groups affected by the policy

Property developers and landowners

10.1 Property developers will be directly affected by the policy, since the legal obligation to comply with the new policy would lie with them.

10.2 The policy will increase the costs of constructing new buildings, as property developers will need to invest to a greater extent in energy efficient building fabric and services in order to comply with the lower limit on carbon emissions. The fabric and service elements which contribute to improving the energy efficiency can account for a relatively small proportion of the total building cost. For the purpose of this analysis we have assumed that other costs e.g. structural components and labour costs are not changed by the policy. The estimated cost impact varies across different types of property in both the domestic and non-domestic sector. The estimated impact on capital cost for different types of building is shown in Table 19 below.

Table 19: Estimated impact on capital costs for some typical properties

	Assumed cost of 2006-compliant building (£)	Additional capital cost	
		£	Percentage increase
Domestic sector (flat 25%)			
Gas-heated detached house	93,167	526	0.6%
Gas-heated semi-detached house	93,268	547	0.6%
Gas-heated terraced house	86,388	600	0.7%
Electric-heated flat	60,813	1,050	1.7%
Non-domestic sector (aggregate 25%)[28]			
Shallow plan office (heated)	3,098,086	40,662	1.3%
Shallow plan office (air conditioned)	3,162,610	90,723	2.9%
Deep plan office (air conditioned)	26,531,913	294,635	1.1%
Warehouse	1,745,002	3,245	0.2%
Hotel	1,848,347	8,063	0.4%
School	1,990,313	13,185	0.7%
Retail	853,309	7,522	0.9%
Supermarket	347,682	9,084	2.6%

Source: Davis Langdon and Europe Economics modelling

10.3 For domestic buildings, the (upfront) incremental capital cost increase in the Flat 25 per cent option varies between building types but all increases are relatively small.

10.4 For non-domestic buildings, the capital cost increase is quite varied across building types. This is not surprising, given that not all buildings will achieve a 25 per cent reduction in annual CO_2 emissions in the Aggregate 25 per cent option – some will achieve more while others will achieve less.

10.5 It is worth noting that the costs in Table 19 are based on specific sizes of buildings, so for example, a larger retail unit would not necessarily see the same increase in capital costs compared to a 2006 compliant building.

[28] The assumed costs of 2006-compliant buildings have changed substantially for some building types. This is because the costs in the consultation stage Impact Assessment were based on different building models to those that had been used in the energy modelling. Those costs have been realigned with the energy models. The additional capital costs have also changed because the percentage reductions (see Table 7) for the different building types have changed.

10.6 In addition to the higher capital costs of constructing new buildings, developers may also incur additional administrative costs associated with the proposed Accredited Construction Details (ACD) scheme(s), the provision of a design-stage submission to BCBs, an increased sample size for air pressure testing for Part L and the introduction of airflow measurement for Part F. These are considered later in this IA.

10.7 Although developers will incur these costs in the first instance, in long-run market equilibrium it is likely that these costs will be passed on to other parties. To the extent that buildings with lower carbon emissions can be sold for a premium, some of the cost may be passed on to purchasers of property. The rest of the cost is likely to be reflected in the long run in reduced prices for land sold for property development, and hence will ultimately be borne by landowners. (Developers that own significant land banks bought at fixed prices may bear the increased capital cost themselves in the short run.) If in combination with other policies this were to reduce the value of land for property development below the value that the land has in alternative uses, then it is theoretically possible that the supply of new properties might be reduced. However, we have no evidence to suggest that this would happen.

Suppliers

10.8 There will be both winners and losers among suppliers to the building industry, since demand is likely to fall for products with lower energy efficiency and rise for products with higher energy efficiency and for LZC products. Overall, however, the increased capital cost of constructing buildings will mean a larger market for suppliers in total.

10.9 The policy is likely to promote innovation by suppliers seeking to offer developers low carbon solutions at lower cost. This is considered further in the section below on the effects of the policy on competition.

Purchasers and occupiers of property

10.10 As mentioned above, purchasers of properties may bear some of the increase in capital costs if buildings with lower carbon emissions command a premium in the property market. The introduction of Energy Performance Certificates (EPCs) may facilitate the emergence of such a premium, by providing information to buyers and raising awareness of energy performance issues.

10.11 The occupier of a property will sometimes be identical to the purchaser (e.g. owner-occupied homes). In the rental sector, however, the occupier and the purchaser will be different. The extent to which any purchase premium for lower carbon properties is passed on to tenants will depend on pricing trends in the rental market, although the introduction of EPCs may again facilitate the emergence of a rental premium for such properties.

10.12 The occupiers of properties built to the new standards should benefit from lower energy bills. Table 20 below presents estimated savings in annual gas and electricity bills for some typical properties.

Table 20: Estimated annual energy bill savings for some typical properties

	Saving on gas bill	Saving on electricity bill
	£	£
Domestic sector (flat 25%)		
Gas-heated detached house	39	128
Gas-heated semi-detached house	59	104
Gas-heated terraced house	64	92
Electric-heated flat	N/A	141
Non-domestic sector (aggregate 25%)		
Shallow plan office (heated)	407	2,509
Shallow plan office (air conditioned)	452	11,473
Deep plan office (air conditioned)	2,567	36,873
Warehouse	701	1,580
Hotel	–85	6,460
School	395	3,261
Retail	75	463
Supermarket	0	1,355

Source: Europe Economics modelling

10.13 The impact on fuel bills is reasonably consistent across different types of domestic buildings, with a range of savings of £141 to £167 per annum. The larger the dwelling, the greater is the annual fuel bill saving.

10.14 There is also considerable variation in savings in energy bills across non-domestic buildings. Given that different building types are achieving different reductions in CO_2 emissions and the variety of building types, sizes and uses, this is not surprising.

10.15 In some instances, the policy may also affect the ongoing maintenance costs incurred by owners and/or occupiers of buildings. For instance, if the policy leads to the installation of an additional system in a building (such as mechanical ventilation in place of natural ventilation), then additional maintenance costs are likely to be incurred. In other cases, however, maintenance costs may be unaffected – for instance, the cost of servicing a higher efficiency gas boiler is unlikely to differ from the cost of servicing a lower efficiency boiler.

10.16 The policy will also have an impact on replacement costs incurred by owners and/or occupiers of buildings when building services and fittings reach the end of their asset life. The Building Regulations already require replacement controlled services and fittings in existing buildings to be no worse in terms of energy performance than the service or fitting being replaced. This means that if tighter specifications are used for services and fittings in the original building due to the policy change, then the owner or occupier will need to buy a service or fitting with at least equivalent energy performance when replacing it. Hence, the replacement cost may be greater than it would have been.

10.17 Table 21 below shows estimates of the impact of the policy on maintenance and replacement costs for some typical buildings.[29] Replacement costs would be incurred at different time intervals for different services and fittings and hence the table presents these costs on an annualised basis to allow an overall figure to be calculated for each building.

[29] It should be noted that the table shows the *incremental* effect of the policy on maintenance and replacement costs, and not the *total* maintenance and replacement cost which would be incurred by the owner or occupier.

Table 21: Estimated impact on maintenance and replacement costs for some typical buildings

	Incremental maintenance cost per year £	Incremental annualised replacement cost £
Domestic sector (flat 25%)		
Gas-heated detached house	0	13
Gas-heated semi-detached house	0	13
Gas-heated terraced house	0	14
Electric-heated flat	0	5
Non-domestic sector (aggregate 25%)		
Shallow plan office (heated)	55	1,205
Shallow plan office (air conditioned)	127	2,869
Deep plan office (air conditioned)	709	16,165
Warehouse	38	2,164
Hotel	0	2,329
School	106	878
Retail	9	208
Supermarket	62	278

Source: Europe Economics modelling

10.18 Maintenance costs for dwellings are unaffected by the policy. Incremental replacement costs are incurred, however, and their level differs slightly between electrically-heated and gas-heated dwellings, though all increases are small.

10.19 The analysis of incremental replacement costs assumes that the replacement will be of a performance level no worse than the original. Therefore, the standard of the element for new build dwellings affects the cost of replacing it.

10.20 In addition, the incremental replacement cost is affected by the elemental standard in a 2006 compliant dwelling and this is the driving force behind the observed pattern across dwellings. In particular, gas boilers in the baseline 2006 semi-detached and terraced houses had a seasonal efficiency of 90 per cent compared to 86 per cent for those installed in detached houses and flats.

10.21 In the non-domestic sector, the incremental maintenance costs are very different for different building types. The replacement costs were calculated following the same methodology as in the domestic sector (described above). All building services were assumed to have a 15 year life and were therefore replaced three times over the life of the building; it was assumed that light fittings would also be replaced every 15 years while the lamps themselves would be replaced every five years. These replacement costs are generally higher than those estimated for the consultation impact assessment. This results from the revised fabric and services specifications shown in Table 6 which have been set as part of the Aggregate 25 per cent approach

Local authorities

10.22 The policy will affect local authority BCBs who will be responsible for enforcing compliance with the policy. BCBs will need to ensure their staff are familiar with the new policy (e.g. through the provision of training). In addition, as part of the policy it is intended that developers should be required to provide additional information to BCBs to assist them in determining whether new buildings are complying with Part L and Part F requirements. These changes to enforcement procedures are discussed below under "Compliance and enforcement issues".

10.23 Under the new burdens doctrine, the government would be expected to fund fully any new burdens placed on local authorities. There is no new net burden for enforcement by Local Authority Building Control as costs are fee recoverable.

Risk, uncertainty and unintended consequences

10.24 There is a degree of risk and uncertainty attached to the central results of any Impact Assessment. Indeed, changes in the values of certain key input variables can make a considerable difference to the costs and benefits of the policy as a whole. It is therefore necessary within the IA to assess the impact of changes in key variables on the results. In the present IA, we focus particularly on the impact of changes in energy and carbon price assumptions.

10.25 Guidance on greenhouse gas policy evaluation and appraisal, published by DECC, provides low and high energy prices to be for the purposes of sensitivity analysis. Low energy prices are approximately 25 per cent below the central case whilst high prices are approximately 30 per cent above. Table 22 and Table 23 below show the results of the energy price sensitivity analysis for new domestic and non-domestic buildings respectively. Sensitivity analysis for changes to existing buildings are shown in Table 24 and Table 25.

Table 22: Energy Price Sensitivity – new domestic buildings £m NPV

	Flat 25%		
	Low	**Central**	**High**
Energy savings	1,606	2,589	3,238
Total incremental cost	(785)	(785)	(785)
Sub total	**821**	**1,804**	**2,453**
Carbon savings – ETS	841	841	841
Carbon savings – non-ETS	429	429	429
Marginal damage costs	21	21	21
Total Carbon and other savings	1,292	1,292	1,292
Net benefit/cost exc. avoided renewables	**2,113**	**3,096**	**3,744**
Avoided renewables	22	22	22
Net benefit/cost inc. avoided renewables	**2,134**	**3,118**	**3,766**
Change in energy saving	(38%)	0%	25%
Change in NPV	(32%)	0%	21%

Source: Europe Economics modelling

Table 23: Energy Price Sensitivity – new non-domestic buildings £m NPV

	Aggregate 25%		
	Low	**Central**	**High**
Energy savings	1,990	3,590	4,118
Total incremental cost	(2,942)	(2,942)	(2,942)
Sub total	**(952)**	**648**	**1,176**
Carbon savings – ETS	1,334	1,334	1,334
Carbon savings – non-ETS	126	126	126
Marginal damage costs	44	44	44
Total Carbon and other savings	1,504	1,504	1,504
Net benefit/cost exc. avoided renewables	**552**	**2,152**	**2,680**
Avoided renewables	21	21	21
Net benefit/cost inc. avoided renewables	**573**	**2,173**	**2,701**
Change in energy saving	(45%)	0%	15%
Change in NPV	(74%)	0%	24%

Source: Europe Economics modelling

Table 24: Energy Price Sensitivity – existing domestic buildings £m NPV

	Total			Extensions			Replacement windows/ boilers			Renovations		
	Low	**Central**	**High**	**Low**	**Central**	**High**	**Low**	**Central**	**High**	**Low**	**Central**	**High**
Energy savings	8,436	14,584	18,680	240	445	578	7,999	13,760	17,602	38	73	96
Total incremental cost	(10,554)	(10,554)	(10,554)	(149)	(149)	(149)	(9,770)	(9,770)	(9,770)	(515)	(515)	(515)
Sub total	**(2,118)**	**4,031**	**8,126**	**91**	**296**	**429**	**(1,772)**	**3,990**	**7,832**	**(477)**	**(443)**	**(419)**
Carbon savings – ETS	1,910	1,910	1,910	41	41	41	1,858	1,858	1,858	0	0	0
Carbon savings – non-ETS	4,971	4,971	4,971	290	290	290	4,413	4,413	4,413	38	38	38
Marginal damage costs	128	128	128	62	62	62	66	66	66	0	0	0
Total Carbon and other savings	7,009	7,009	7,009	393	393	393	6,337	6,337	6,337	38	38	38
Net benefit/cost exc. avoided renewables	**4,891**	**11,040**	**15,135**	**484**	**689**	**822**	**4,565**	**10,326**	**14,169**	**(439)**	**(404)**	**(381)**
Avoided renewables	295	295	295	8	8	8	285	285	285	2	2	2
Net benefit/cost inc. avoided renewables	**5,186**	**11,335**	**15,430**	**491**	**697**	**830**	**4,850**	**10,611**	**14,454**	**(437)**	**(402)**	**(379)**

Table 24: Energy Price Sensitivity – existing domestic buildings £m NPV *(continued)*			
	Loft/garage conversions		
	Low	**Central**	**High**
Energy savings	160	307	403
Total incremental cost	(120)	(120)	(120)
Sub total	**39**	**187**	**283**
Carbon savings – ETS	10	10	10
Carbon savings – non-ETS	231	231	231
Marginal damage costs	0	0	0
Total Carbon and other savings	241	241	241
Net benefit/cost exc. avoided renewables	**280**	**428**	**524**
Avoided renewables	0	0	0
Net benefit/cost inc. avoided renewables	**281**	**428**	**524**

Source: Europe Economics modelling

Table 25: Energy Price Sensitivity – existing non-domestic buildings £m NPV			
	Low	**Central**	**High**
Energy savings	3,779	6,473	7,767
Incremental cost	(5,305)	(5,305)	(5,305)
Sub-total	**(1,526)**	**1,168**	**2,462**
Carbon savings – ETS	667	667	667
Carbon savings – non-ETS	825	825	825
Reduced damage costs	6	6	6
Total Carbon and other savings	1,498	1,498	1,498
Net benefit/cost exc. avoided renewables	**(64)**	**2,666**	**3,960**
Avoided renewables	18	18	18
Net benefit/cost inc. avoided renewables	**(46)**	**2,684**	**3,978**

Source: Europe Economics modelling

10.26 In addition to fuel price sensitivity analysis, DECC guidance recommends that sensitivity analysis be conducted for variations in the prices attributed to CO_2 emissions. The results of the CO_2 price sensitivity analysis for new buildings are shown in Table 26 and Table 27 and for existing buildings in Table 28 and Table 29.

Table 26: Carbon Price Sensitivity – new domestic buildings £m NPV

	Flat 25%		
	Low	**Central**	**High**
Energy savings	2,589	2,589	2,589
Total incremental cost	(785)	(785)	(785)
Sub total	**1,804**	**1,804**	**1,804**
Carbon savings – ETS	407	841	1,259
Carbon savings – non-ETS	206	429	653
Marginal damage costs	21	21	21
Total Carbon and other savings	634	1292	1,932
Net benefit/cost exc. avoided renewables	**2,439**	**3,096**	**3,737**
Avoided renewables	22	22	22
Net benefit/cost inc. avoided renewables	**2,460**	**3,118**	**3,758**
Change in carbon saving	(52%)	0%	50%
Change in NPV	(21%)	0%	21%

Source: Europe Economics modelling

Table 27: Carbon Price Sensitivity – new non-domestic buildings £m NP

	Aggregate 25%		
	Low	**Central**	**High**
Energy savings	3,590	3,590	3,590
Total incremental cost	(2,942)	(2,942)	(2,942)
Sub total	**648**	**648**	**648**
Carbon savings – ETS	676	1,334	1,962
Carbon savings – non-ETS	63	126	189
Marginal damage costs	44	44	44
Total Carbon and other savings	783	1,504	2,195
Net benefit/cost exc. avoided renewables	**1,431**	**2,152**	**2,843**
Avoided renewables	21	21	21
Net benefit/cost inc. avoided renewables	**1,452**	**2,173**	**2,864**
Change in carbon saving	(49%)	0%	47%
Change in NPV	(33%)	0%	32%

Source: Europe Economics modelling

Table 28: Carbon Price Sensitivity – existing domestic buildings £m NPV

	Total			Extensions			Replacement windows/ boilers			Renovations		
	Low	Central	High	Low	Central	High	Low	Central	High	Low	Central	High
Energy savings	14,584	14,584	14,584	445	445	445	13,760	13,760	13,760	73	73	73
Total incremental cost	(10,554)	(10,554)	(10,554)	(149)	(149)	(149)	(9,770)	(9,770)	(9,770)	(515)	(515)	(515)
Sub total	**4,031**	**4,031**	**4,031**	**296**	**296**	**296**	**3,990**	**3,990**	**3,990**	**(443)**	**(443)**	**(443)**
Carbon savings – ETS	957	1,910	2,865	20	41	61	932	1,858	2,789	0	0	1
Carbon savings – non-ETS	2,482	4,971	7,469	139	290	440	2,213	4,413	6,621	19	38	57
Marginal damage costs	128	128	128	62	62	62	66	66	66	0	0	0
Total Carbon and other savings	3,567	7,009	10,463	221	393	564	3,210	6,337	9,476	19	38	58
Net benefit/cost exc. avoided renewables	**7,598**	**11,040**	**14,493**	**517**	**689**	**860**	**7,200**	**10,326**	**13,465**	**(423)**	**(404)**	**(385)**
Avoided renewables	295	295	295	8	8	8	285	285	285	2	2	2
Net benefit/cost inc. avoided renewables	**7,893**	**11,335**	**14,788**	**525**	**697**	**867**	**7,485**	**10,611**	**13,750**	**(421)**	**(402)**	**(383)**

Table 28: Carbon Price Sensitivity – existing domestic buildings £m NPV *(continued)*			
	Loft/garage conversions		
	Low	**Central**	**High**
Energy savings	307	307	307
Total incremental cost	(120)	(120)	(120)
Sub total	**187**	**187**	**187**
Carbon savings – ETS	5	10	15
Carbon savings – non-ETS	111	231	351
Marginal damage costs	0	0	0
Total Carbon and other savings	116	241	366
Net benefit/cost exc. avoided renewables	**303**	**428**	**553**
Avoided renewables	0	0	0
Net benefit/cost inc. avoided renewables	**303**	**428**	**553**

Source: Europe Economics modelling

Table 29: Carbon Price Sensitivity – existing non-domestic buildings £m NPV			
	Low	**Central**	**High**
Energy savings	6,473	6,473	6,473
Incremental cost	(5,305)	(5,305)	(5,305)
Sub-total	**1,168**	**1,168**	**1,168**
Carbon savings – ETS	369	667	853
Carbon savings – non-ETS	414	825	1,239
Reduced damage costs	6	6	6
Total Carbon and other savings	789	1,498	2,098
Net benefit/cost exc. avoided renewables	**1,957**	**2,666**	**3,266**
Avoided renewables	18	18	18
Net benefit/cost inc. avoided renewables	**1,975**	**2,684**	**3,284**

Source: Europe Economics modelling

10.27 The range of total net benefit/(cost) revealed by these energy and CO_2 value sensitivity tests is summarised in Table 30.

Table 30: Summary of net benefit (cost) with energy price and CO_2 value sensitivity analysis. £m NPV

	Energy prices			Carbon values		
	Low	**Central**	**High**	**Low**	**Central**	**High**
New Domestic	2,134	3,118	3,766	2,460	3,118	3,758
Existing Domestic	5,186	11,335	15,430	7,893	11,335	14,788
New Non-Domestic Buildings	573	2,173	2,701	1,452	2,173	2,864
Existing Non-Domestic Buildings	(46)	2,684	3,978	1,975	2,684	3,284
Total	**7,847**	**19,310**	**25,875**	**13,780**	**19,310**	**24,694**

Source: Europe Economics modelling

10.28 A final element of the sensitivity analysis is to assess the impact on the overall costs and benefits of the policy options under different build rate assumptions. As discussed above, our central results are based on an assumption that 150,000 dwellings are built each year. The sensitivity analysis considered changes to the total number of dwellings built but does not consider changes to the build mix. Given this, the build rate is a simple scaling factor – changing the build rate by a particular percentage results in the same percentage change for the new-build net benefit. For instance, if 100,000 dwellings are built each year – a reduction of 33 per cent – the total net benefit of each policy option falls by 33 per cent. This is shown in the Table 31.

Table 31: Build Rate Sensitivity – new domestic buildings

Policy option	**Flat 25%**		
Build rate (per year)	100,000	150,000	200,000
Net benefit (£m NPV)	2,079	3,118	4,157

Source: Europe Economics modelling

Dissemination and training strategy

10.29 CLG has developed a strategy for delivery of training and dissemination to support implementation of the 2010 changes, to help raise awareness of the changes to regulations and technical guidance, the problems of underperformance and the need for good design and installation of ventilation systems.

10.30 CLG have budgeted to develop material to support delivery of this training and dissemination however all sectors of industry are likely to bear some training costs associated with becoming familiar with the new technical requirements and the new ways of showing compliance. It is suggested that existing training budgets may cover a proportion of this and that it will occur in the first year only.

10.31 Some indication of the scale of costs comes from consideration of the numbers of building control inspectors, around 4000, and their possible ratio to people engaged in the construction industry who will need training. If the ratio were 50 to 1 then there would be 200,000 people requiring training. Training courses run to support the previous Part L and F amendment in 2006 cost around £100 per head per day. Assuming that half of this could be set against existing training commitments then the net non-reoccurring cost in the first year could be around £10m.

10.32 In the longer term, the understanding and skills of those involved with the design and construction of low carbon buildings needs to be improved. Delivery of such a wide ranging set of ongoing training objectives is beyond the scope of this IA and will require input across the full range of organisations that deliver education and training to the construction industry.

Monitoring and post-implementation review

10.33 To help inform the 2010 proposals, CLG has completed an implementation review of the 2006 Part L changes including a joint project with the Energy Efficiency Partnership for Homes (EEPfH)[30] to monitor the energy performance of new homes. An initial study commissioned by CLG looking at the ventilation and air quality of more airtight homes has been completed. Once a sufficient population of buildings has been constructed to 2010 standards, it is the intention that such monitoring would continue.

10.34 CLG is also developing a more comprehensive programme of evaluation of all parts of the Building Regulations, including levels of compliance. This will provide evidence to underpin the development of any further changes – either to the Regulations and guidance themselves as part of the periodic review programme, or other actions such as targeted communications, further training, and changes to the building control system.

[30] www.eeph.org.uk/partnership/index.cfm

Section 11

Competition assessment

11.1 According to the Office of Fair Trading (OFT) competition assessment guidance[31] when analysing competition impacts the following questions should be addressed:

- In any affected market would the proposal:
  - directly limit the range of supplier?
  - indirectly limit the number or range of suppliers?
  - limit the ability of suppliers to compete?
  - reduce suppliers' incentives to compete vigorously?

11.2 The principal markets affected by the policy are those for the development of new domestic and non-domestic buildings and the production of construction materials used in those developments.

11.3 As a result of the policy, building developers would have to comply with the higher TER and as a result would see costs rise. Landowners will bear some of these costs in reduced purchase prices for land due to reduced land value uplift and some of the costs would be passed through to purchasers of buildings. As the increase in costs will affect all developers equally and any proportion that cannot be passed on is likely to be small when compared to the overall costs of construction, any competitive effects in the market for building development are likely to be negligible.

11.4 However, it is possible that there could be differential impacts on the producers of construction materials. How these producers will be affected will depend on the specification of the range of products they are currently producing and their ability to produce products of a higher specification which may be required to meet the new compliance target. The flexibility to choose building specifications to meet the compliance target should encourage innovation amongst firms in order to produce products with higher energy efficiency. The main construction product markets likely to be affected are: insulation materials, windows and doors, lighting, ventilation equipment and boilers.

[31] OFT – Completing competition assessments in Impact Assessments, guidance for policy makers, August 2007, OFT876.

Directly limit the range of supplier

11.5 The proposals could limit the range of supplier of construction materials if they required a particular specification of construction material to be used which could only be produced by a proportion of the current range of suppliers. In theory this could lead to suppliers producing low specification materials exiting the market and hence a higher market concentration amongst the remaining suppliers.

11.6 However, the way in which the policy has been formulated should mitigate this potential impact. The proposal will allow developers the freedom to choose their own solutions to ensure that their building complies with the relevant compliance target for the building type. Although there are backstops which set out the minimum allowable level for particular elements these are also performance based.

Indirectly limit the number or range of suppliers

11.7 The proposals may limit the range of suppliers indirectly by having an impact on the profitability of producing products of particular specifications. Following the new policy it would be more profitable for firms to produce higher specification products due to their increased demand. Firms currently producing lower specification products that become less profitable as a result of the policy may cease business or may instead switch to producing higher specification products.

11.8 There may be upfront costs to firms of developing products to meet the higher energy efficiency standards. This may confer a temporary advantage on firms who had already made the investment and so were able to commence production of the higher specification products immediately. However, unless there are some technologies that are only available to a limited number of firms (e.g. patented technologies) the effects should not be long term, and manufacturers would be able to adapt to compete with products of the higher specification.

11.9 The effects in the respective markets will be influenced by the specifications of the products currently being produced by the majority of suppliers. We now briefly discuss the likely effects of the policy in the following markets: insulation; windows, roof-lights and doors; lighting; ventilation; and boilers.

Insulation

11.10 The market for insulation is dominated by three or four major suppliers. There are unlikely to be any adverse competitive effects as the market moves towards greater energy efficiency as higher levels of insulation do not generally require the development of new products (but rather increased thicknesses of existing products).

11.11 Where there are space constraints there may be greater demand for particular (thinner) products. However, this is unlikely to confer any substantial advantage on the producers of these products as there are alternative products available which could be used if prices for particular types of insulation rise above certain levels.

11.12 The requirements to meet higher standards for insulation may increase demand for insulation and provide new opportunities for entrants to challenge existing suppliers.

Windows, rooflights and doors

11.13 In this sector there are both established and emerging glazing technologies. The British Fenestration Rating Council (BFRC) has rated more than 600 windows in its scheme where ratings range from A to G. Taking figures from the paper "Part L 2010: Strategic Issues and Existing Buildings", of over 600 products rated the split by rating is:

Rating	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Window numbers	110	160	250	55	45	0	0

Source: Part L 2010: Strategic issues and existing buildings

11.14 The BFRC ratings are based on factors other than u-values including glass type; air gap; gas fill and spacer. Windows with the same u-value may therefore have widely differing ratings. The table below lists some u-values corresponding to windows of particular BFRC bands.

BRFC band	**u- value**
A	1.4, 1.3,
B	1.4,
C	1.5, 1.6,
D	1.6, 1.8
E	2.0

Source: MTP: BNDG02: BFRC ratings of known window types

11.15 As with insulation the market for glass manufacturers is dominated by a small number of large international manufacturers which compete mainly on coatings for glass. This is not expected to change as a result of the policy

11.16 There are a large number of firms making up the glass to double and triple glazed IGU (insulating glass units). The Glass and Glazing Federation (GGF) has 491 window manufacturer members and 333 glazing manufacturer members.

11.17 As well as being more expensive, high energy efficient windows tend to have a trade off in terms of light transmission and solar gains and so there is currently not much demand for the highest specifications. However, there is capacity in the sector to produce higher specification windows if the market demands it. There are therefore unlikely to be any adverse competitive effects resulting from the proposed changes to regulations.

11.18 There is currently a large number roof-light manufacturers who would be capable of producing a higher specification of roof-light if the market demanded it.

11.19 There may be difficulties for the manufacturers of some bespoke products, such as wooden window frames and doors, in adapting to producing their products to a higher specification. Particular concern was expressed during the consultation that the new Regulations would have a serious effect on steel framed window manufacturers, particularly if demanding specifications were set for the replacement market. However developers would continue to be able to choose how to meet energy targets and so would not be prevented from continuing to use particular bespoke products (assuming products met the backstop levels of energy efficiency). There will continue to a wide choice of products and suppliers.

Lighting

11.20 The lighting market may be considered to be comprised of three distinct product types:

- lamps/bulbs
- luminaires/fittings
- lighting controls.

11.21 According to a May 2008 AMA Research report, this is a mature market which is primarily dependent on replacement applications. Over 1200 lighting businesses are listed on the Lightingdirectory.com website, 917 of which are UK based.

11.22 There is already a scheme to phase out lower efficiency GLS (general lighting service) lighting. The initiative to phase out these bulbs comes from a joint and voluntary initiative between the UK lighting industry, retailers and the Government. Additionally tungsten filament lamps are being phased out as a result of an EU Regulation under the Energy-using Products Directive.

11.23 In view of these developments, the Part L 2010 changes set out that 'reasonable provision' would be to install compact fluorescent lamps in fixed light fittings.

11.24 It is likely that the lighting market will be able to adapt to producing higher specification lighting without any adverse competitive effects.

Ventilation

11.25 Air conditioning equipment and systems may be categorised into three main types: all-air, all-water and all-refrigerant. However, in every case, refrigerant is used as the final cooling source or medium. Most current systems are also referred to as air cooled rather than water cooled. That is, the final rejection of heat to external atmosphere is via air, using a dry coil and fans. Water-cooled systems use a cooling tower.

11.26 There are a number of large manufacturers of ventilators. Ventilation technology is such that manufacturers should be able to adapt to producing products of a higher specification, although the changes to regulations may confer a short term advantage on some firms.

Boilers

11.27 There are now two common categories of boilers in the UK, condensing and non-condensing. Condensing boilers are more efficient with efficiency levels of around 90 per cent whereas new non-condensing boilers typically achieve efficiency levels of 75 per cent. Older boilers are less efficient and may have a seasonal efficiency as low as 55 per cent. The fuel source may be gas, oil or LPG. Standards in Building Regulations introduced in 2005 for gas fired domestic boilers and 2007 for oil fired ones, set out that these should be condensing boilers other than in exceptional cases where this is impracticable to do so.

- Condensing boilers are the most commonly installed type of boiler in the UK today. There are three main types of condensing boiler: Combination boilers, Conventional Boilers and System Boilers.

- Combination boilers are the most popular type and account for more than half of new boiler sales in the UK. The boilers combine the production of hot water for taps with that needed for the central heating system.
- A conventional boiler system has more parts than a combination boiler system. In addition to the boiler, a hot water storage tank and a feed and expansion tank is generally installed. The system is usually fed by a cold water storage tank (typically in the loft).
- System boilers fall in between combination boilers and conventional boilers and have some of the advantages of both, while avoiding some of the disadvantages of both. Hot water is stored in a hot water tank in the same way as a conventional boiler but some of the other components of a conventional boiler system are built into the boiler and water is taken directly from the mains.

11.28 In addition to the standard boiler types listed above, alternative methods of heating hot water have been developed. These alternatives include:

- Biomass boilers, which automatically feed fuel into the stove and remove the ash. As they do not burn fossil fuels, they have very low carbon emissions.
- Solar hot water. Installing solar panels on a roof can result in 50 to 70 per cent of hot water demand being supplied simply by trapping and using solar energy and hence without using any fuel.

11.29 The SEDBUK Boiler Efficiency database rates each boiler from 131 participating manufacturers on the basis of its seasonal efficiency. The rating bands are as follows:

Rating	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Efficiency (%)	> 90	86 – 90	82 – 86	78 – 82	74 – 78	70 – 74	<70

Source: SEDBUK

11.30 Under the policy it is proposed to raise the minimum boiler standard from rating B to A on the current SEDBUK rating scale. A rated boilers are being installed in most new build houses and comprised 83 per cent of total sales in 2008.

11.31 Fourteen per cent of 1.5 million sales per annum (in the UK, not just England and Wales) are B rated (86 per cent efficiency). Following the change in standard all boilers would have to be A rated efficiency and so manufacturers would have to switch from production of B boilers.

11.32 Firms currently producing B rated boilers have the capability to switch to producing A rated boilers. There are no apparent barriers to entry or expansion in this market and this change should not have an adverse effect on competition in the supply of A rated boilers.

Limit the ability of suppliers to compete?

11.33 A policy may limit the ability of suppliers to compete, for example, by limiting the price that they may charge or the characteristics of the product supplied, e.g. by setting minimum quality standards.

11.34 It is unlikely that the policy will limit the ability of suppliers to compete, apart from perhaps a small number of suppliers who are currently only producing products below the levels of the backstops. In the vast majority of cases manufacturers will have the capability to switch to producing products of a higher specification.

11.35 The policy may, on the other hand, encourage firms to compete by providing an added incentive for increased innovation to produce higher specification construction materials and by drawing attention to the differing energy efficiency of individual products.

Reduce suppliers' incentives to compete vigorously?

11.36 A policy may reduce suppliers' incentives to compete vigorously by for example, increasing the costs to customers of switching between suppliers. The policy would not reduce suppliers' incentives to compete vigorously with one another in this respect.

Overall competition impact

11.37 Although there may be some limited effects on the number of suppliers in the market due to the increased demand for higher specification construction materials, we do not expect these to be significant. In the vast majority of cases producers of low specification products will be able to switch to producing products of a higher specification.

11.38 There is also the potential for new firms to enter the market due to the increased scope for competition on energy efficiency criteria presented by the proposals.

11.39 There may be increased demand for LZCs and hence increased opportunities for suppliers in this area. However this is more likely to come from later policy developments than from the 2010 changes.

Section 12

Small firms impact test

12.1 The small firms impact test regards all firms with less than 50 full time employees as being small businesses. The majority of small firms have fewer than 10 employees and guidelines state that a concerted effort should be made to consult them over policy proposals.

12.2 The UK construction industry is dominated by small firms. The Department for Business Innovation and Skills publishes its Construction Statistics Annual every year[32]. The latest, 2009, covers 2008. According to statistics from this publication: there are 202,407 private contractors in the UK; 93 per cent of which employ less than 14, and 99 per cent of which employ less than 60. There were 78,826 sole proprietorships which accounted for 39 per cent of the industry in terms of legitimate firms.

12.3 According to research by LEK Consulting for the Confederation of British Industry's (CBI), construction contributes 8.5 per cent of UK GDP directly and is worth approximately £124 billion per annum (based on 2008 figures).[33]

12.4 Parties affected by the proposals would include both small firms involved in the construction of new buildings and extensions and those involved in the production of construction materials.

12.5 There are a number of ways in which small firms may be disproportionately affected by the proposals when compared to how larger firms are affected. Smaller builders and developers may find it more difficult to react to the changes than larger ones. There may be some higher specification products which can only be produced by large manufacturers and/or it may be more difficult for smaller manufacturers to switch to producing higher specification construction materials than larger manufacturers.

12.6 Manufacturers of bespoke products (such as a particular type of door or window frame) may find that they are unable to adapt to producing the product to meet a higher energy efficiency specification.

[32] ONS: Construction Statistics Annual 2009.

[33] Research by LEK Consulting for the CBI: Construction in the UK economy: The Benefits of Investment (2009).

12.7 A particular area where smaller firms may be affected is costs of compliance such as training staff. Larger firms may be better set up for dealing with changes in regulation at the lowest cost than smaller ones. These compliance costs are highlighted in the section on Administrative Burdens.

12.8 During the consultation period we contacted nine associations representing small firms involved in the construction trade in order to gather the views of small firms on the effects of the policy (either directly via being put in touch with trade association members, or through a summary response from the trade association). It was not feasible to consult formally on the proposals earlier due to there being insufficient clarity on what the final proposals would be, although a general industry perspective was obtained through industry working groups.

12.9 Unfortunately amongst the small firm representatives we contacted there did not appear to be much awareness/ understanding of the proposed changes to the regulations, with most small firm representatives describing them as "very complex" and "difficult to understand". As a result of this it was difficult to find representatives with sufficient understanding of the changes as to be able to share their views.

Changes small firms are likely to need to make as a result of the policy

12.10 It was thought that small firms would need to change their understanding of what is required from the relevant building regulations as the changes represent quite a major shift in thinking, particularly with the introduction of mechanical ventilation into houses.

12.11 However, it was thought that the technology was not new and so the skill sets of mechanical and electrical engineers, plumbers and electricians were likely to be sufficient to cope. Workmanship in terms of air tightness during construction would need to be addressed throughout by craftsmen and supervisors.

Costs of the changes

12.12 Respondents stated that it was very difficult to get cost data as the proposals were not yet finalised, and there would also be an element of "wait and see".

12.13 It was thought that the SAP calculations might be more complex but were probably outsourced and that the software providers were likely to provide updates to deal with the new standards. The cost of this was unclear, as is whether suppliers would absorb the costs or pass them on to firms.

12.14 Small firms would need to familiarise themselves with the revised policy, alter design specifications, inform their workers and supervisors, and might have to undertake additional training.

12.15 Another issue that is cost related is that of innovation. While the exact specifications of the regulations, and the size and durability of the market remain unclear, product manufacturers of all sizes, but particularly small ones are very reluctant to invest. If for example, a product innovation was going to be useful for the 2010 regulations, but made obsolete in the 2013 ones, firms would be reluctant to produce. Bad investment decisions (such as product development/R&D gone wrong) are likely to have a much greater impact on small product manufacturers than larger ones. Small firms therefore are likely to be more severely affected by the uncertainty associated with the new regulations.

12.16 There would also be procurement implications in terms of needing to research solutions to the new specification. This might require alterations to firms' supply chains.

12.17 The costs of complying would vary depending on what point in the supply chain the firm was involved – one respondent stated that he did not think there would be higher training costs as a result of the changes because his firm worked to specifications.

12.18 It was thought that insurance might also become a significant factor as insurers appeared reluctant to provide cover for many of the new technologies which would increasingly be required on the road to zero carbon.

12.19 There was also a fear expressed that increasing standards of airtightness would reduce indoor air quality which could in turn lead to or aggravate a range of health conditions. Concerns were raised as to who would be held accountable if increasing standards of air tightness led to a wave of litigation as a result of health problems.

Potential benefits from the changes for small firms

12.20 It was thought that some small firms might gain additional work from the provision of the necessarily more specialised services required to meet the changes. However, in general respondents thought it unlikely that there would be any particular benefits to small firms from the policy changes.

12.21 Whether there was likely to be a greater impact on small firms compared to larger firms

12.22 One respondent did not think there would be a disproportionate effect on small firms, he felt that there would be additional expenditure on components but that this would affect all firms, not just small. However, the more general view was that there would be a disproportionate effect on small firms due to resource issues.

Overall small firm impact

12.23 There did not appear to be much awareness/understanding of the proposed changes to the regulations, with most small firm representatives we contacted describing them as “very complex” and “difficult to understand”. As a result of this it was difficult to find representatives with sufficient understanding of the changes as to be able to share their views.

12.24 Of the small firm representatives whose views we did receive, the overall view was that the proposals would lead to increased costs for small firms although the extent of the increase was largely unclear due to uncertainty about what the final changes would be as well as how much of the costs would be absorbed by others (e.g. software providers). Areas where costs were likely to disproportionately affect small firms included familiarisation of staff with the policy, altering design specifications, and training staff in new techniques. Small firms may also be discouraged from innovating due to the uncertainty associated with the new regulations.

12.25 There were also concerns expressed that the changes to the policy might lead to increased insurance costs and the potential for litigation costs if airtightness standards aggravated health conditions. However, it is unclear whether such costs if realised would have a disproportionate effect on small firms.

Section 13

Legal aid

The proposals would have no impact on Legal Aid.

Section 14

Carbon assessment

14.1 The reductions in CO2 emissions from this policy have been taken into account in the main cost benefit analysis.

14.2 Emissions in the electricity sector are fixed by the EU ETS and reduction in electricity consumption as a result of this policy does not affect the EU ETS levels. The CO2 reductions in this sector produce a financial benefit which has been quantified in terms of the EU ETS allowances saved. These have been valued using DECC guidance.

14.3 Other savings, principally from reduced gas consumption have been valued using the Shadow Price of Carbon in DECC guidance.

Section 15

Equalities assessments

15.1 There is a statutory duty to consider the impact of a policy on race, disabilities and gender equality. The assessment involves a screening process followed by a thorough assessment if impacts are identified which have or might have a negative impact on certain target equality groups and is of high or medium impact; is not intentional; or is illegal or possibly illegal.

15.2 The policy would affect all parties the same regardless of race, gender and disability. We consider whether there might be indirect impacts on BME groups due to the distribution in the housing mix as discussed below.

Housing mix

15.3 The proposals may have differing effects on certain groups due to the housing mix, i.e. the concentrations of people in different types of housing. There is the possibility that the occupiers of dwellings which are currently overcrowded would be disproportionately affected by proposals relating to the building of new extensions.

15.4 Levels of overcrowding are measured using the "bedroom standard" which calculates a standard number of required bedrooms for each household in accordance with its age/sex/marital status composition and the relationship of the members to one another.[34] On this measure in the period 1995-2007 fewer than 3 per cent of households in England were overcrowded, with the average number of households in England which were overcrowded in the three years to 2006/07 approximately 554,000 (about 2.7 per cent of all households).

15.5 Overcrowding is highest in the social rented sector at 5.8 per cent over the whole of England, slightly lower in the private rented sector at 5.0 per cent and much lower in the owner occupied sector at only 1.4 per cent.[35] It is unclear how many extensions are carried out in dwellings that are overcrowded.

[34] See Survey of English Housing Preliminary results: 2006/07 for method of calculation.

[35] CLG, Survey of English Housing preliminary results: 2006/07.

15.6 The proposals for energy efficiency for extensions are less demanding than those for new build. When extensions are built to the new standards there will be benefits to the owners/occupiers as any increased cost of construction will be offset by the reduction in total energy bills due to the increased energy efficiency.

15.7 Overall therefore there should not be a negative effect on the owners or occupiers of dwellings which are currently overcrowded if they choose to build extensions which have to conform to the revised standards.

Overall equality impacts

15.8 The proposed policy will not have a negative impact on any racial or gender groups.

15.9 The proposed policy would have the same effect on all parties regardless of disabilities.

15.10 There would not be any impact on human rights.

Section 16

Rural proofing

16.1 Rural proofing involves a commitment by the Government to ensure its domestic policies take account of specific rural circumstances and needs (Rural White Paper 2000). As a result policy makers should:

- consider whether their policy is likely to have a different impact in rural areas from elsewhere, because of the particular characteristics of rural areas
- make a proper assessment of these impacts if they are likely to be significant
- adjust the policy, where appropriate, with solutions to meet rural needs and circumstances.[36]

16.2 The policy would not apply differently to rural and urban areas. However, it may impact differently on the two groups due to the higher proportion of rural households that are not connected to the gas network and therefore do not have access to gas as a less carbon intensive and cheaper source of fuel.

Impact of non connection to the gas grid

16.3 According to the Select Committee on Business and Enterprise Eleventh Report[37], around 5 million households in the UK are not connected to the gas network and so are principally dependent for heating on electricity, domestic heating oil or liquefied petroleum gas (LPG). National Energy Action figures show that households off the gas network typically have energy bills in the region of £1,700 per annum, compared to £1,000 for those with gas mains connections.

16.4 Analysis undertaken by Transco's Affordable Warmth Programme (AWP) for DTI's Design & Demonstration Unit's first annual report covering the period October 2003 to March 2005 found that there were nearly 9,000 community clusters of 50 homes or more that did not have access to a gas supply. Of these clusters over 4,600, representing around 525,000 households were within 2kms of an existing gas main. This breakdown is shown in the following table:

[36] DEFRA rural proofing – policy makers' checklist.

[37] House of Commons Business & Enterprise eleventh report, session 2007-08.

Table 32: Households without access to a gas supply

	No. of Non Gas Household Clusters (>50)	Total No. of Non Gas Households
England	7,120	876,510
Scotland	1,246	208,938
Wales	630	81,186
Total	**8,996**	**1,166,634**

Source: DDU First annual report Implications of electricity use instead of gas

Impact of the proposal

16.5 The costs of building homes in rural areas will not increase relative to urban homes as a result of the proposals. The finished homes will require less energy which will result in a saving in fuel bills for occupiers.

16.6 New rural dwellings which do not have access to piped gas will still have access to the same energy efficiency technology solutions as homes connected to the gas grid, with boilers powered by LPG or oil. These would have a higher operating cost than mains gas solutions but the cost would not be as high as electric solutions. At the same time the value of any energy saved will be higher in rural areas reflecting the price differential between mains gas and other fuels. As a result of the reduced energy use associated with the higher energy efficient homes, there should be an overall cost saving for dwellings not on the gas grid built under the new proposals when compared to those built previously which were less energy efficient.

16.7 Developments in rural areas may have better access to LZC options as a way of meeting the building compliance target than urban areas. This might come in the form of better access to biomass materials, better wind resource and fewer planning constraints on LZC development

16.8 Overall the policy should not have an adverse effect on rural areas relative to other parts of England and Wales.

Section 17

Administrative Burdens

17.1 For measuring the impact on the admin burdens baseline, three steps should be carried out[38]:

- calculate new admin burdens and/or admin burden reductions as explained in the "UK Standard Cost Model Manual"
- adjust these figures to 2005 prices by using an appropriate deflator
- use the deflated figures to calculate the impact of the new proposal on the 2005 admin burdens baseline.

17.2 Government guidelines require additional admin burdens on companies to be identified separately. Admin burdens are identified as the costs to businesses of legal requirements to provide information. In this review we have separately identified the cost of preparing the information that has to be provided and the administrative cost of providing that information to building control.

Part L

17.3 The policy proposals include a number of measures aimed at improving compliance with Part L of the Building Regulations and closing the performance gap between theoretical and realised energy performance, as discussed earlier. Of these, the following may lead to additional administrative burdens:

- The improved procedure for allowing BCBs to check that the energy performance of new buildings. This would involve developers providing BCBs with a design-stage submission containing not just the SAP/SBEM calculation but also the component specifications which the developer is going to use to deliver this result. The submission would also place greater emphasis on a list of key features generated by SAP/SBEM showing the aspects of the building design which are most important in delivering the TER, thus assisting BCBs in prioritising what to check when onsite. This design-stage submission would be in addition to the existing SAP/SBEM submission required later in the process.

[38] BERR Website, admin burdens and impact assessment: http://www.berr.gov.uk/whatwedo/bre/policy/scrutinising-new-regulations/preparing-impact-assessments/toolkit/page44262.html

- An increase in the size of the sample of buildings on which developers must undertake air pressure testing.

17.4 No changes are planned alongside this regulatory amendment to the existing sanctions provided for in the Building Act in the event that non-compliance is identified. CLG is considering the potential introduction of new and extended enforcement powers in the context of the Future of Building Control Implementation Plan.[39]

Impact of above measures

17.5 The above items would lead to a number of additional costs. The following cost assumptions have been used:

- The additional design-stage submission for dwellings would cost £100 per new building. A reasonable cost estimate for a full SAP calculation is £100 to £150. In this instance, however, there would be additional costs to companies associated with providing details of the component specifications for the building. On the other hand, this would be offset by savings in producing the later SAP submission, since in many cases this would largely become a repeat of the design-stage submission, albeit with a few alterations where aspects of the building design had been changed.
- Air pressure testing would cost an average of £150 per additional building included in the test sample.
- The typical costs of SBEM calculations for non-domestic buildings for Part L compliance purposes are currently in the region of £3,000 – £4,000. For more complex buildings, it can rise to £10,000 or more. If the same model can be used both for design and on-completion (e.g. same contractor involved and/or client has a copy of the model), the additional costs for the two stages of calculations will be a about one third of the initial cost, in the range £1,000 – £1,500.
- For each of these items it has been assumed that there would be an administrative cost of £5 per item for to submitting the test results to BCBs.

Domestic buildings

17.6 Taking the central assumption of 150,000 new domestic buildings per year used in the modelling, and an assumption of an additional design stage submission costing £100 per building, the policy would result in an additional cost of around £15m per annum in the preparation of submissions and an administrative cost of £0.75m related to submitting the information to BCBs.

[39] http://www.communities.gov.uk/publications/planningandbuilding/buildingcontrolimplementation

17.7 Air pressure testing is carried out at present on a sample of around 2 per cent of new dwellings. This could rise to 4 – 6 per cent. Assuming a cost of £150 per additional building that needed to be air pressure tested, this could result in additional annual costs of £0.45 – £0.9m to carry out the tests with an additional £15,000 – £30,000 related to submitting the information to BCBs.

17.8 Total costs of the additional design stage submission and additional air pressure testing would therefore be around £16m per annum with a further £0.8m attributable to the administrative cost of submitting the information.

Non-domestic buildings

17.9 Using an assumption of 8,500 new buildings per year consistent with the assumptions on floor areas used for modelling and assuming a range of £1,000 to £1,500 as the cost of an additional design stage submission would result in an additional annual cost of between £9m and £13m per annum for non domestic buildings. In addition there would be a cost of about £50,000 attributable to submitting the results to BCBs.

Part F

17.10 A new requirement under Part F 2010 is that air flow rates should be measured for all mechanical ventilation systems in new dwellings and that the measured flow rates be given to the building control body. Based on individual test costs of £125 for MVHR, £90 for MEV and £60 for intermittent extraction it has been estimated that if these tests are carried out on all new dwellings this could have an annual cost of around £10m. There would an additional cost for submitting this information to BCBs of around £0.75m.

Deflated administrative burdens

Table 33: Administrative burdens – £ million

	Part L		Part F	
	Preparing information	**Submitting information**	**Preparing information**	**Submitting information**
Air pressure testing, domestic buildings	0.45 – 0.9	0.015 – 0.03		
Design stage submission – domestic	15	0.75		
Design stage submission – non--domestic	9 – 13	0.05		
Air flow measurement			10	0.75
Total	**24.5 – 29**	**0.8**	**10**	**0.75**

Source: Europe Economics using industry estimates

17.11 The total domestic and non-domestic administrative burdens for preparation and submission of the required information as set out in would be in the region of £35 – 45m per annum in 2009 prices. Out of this total £1.5m is for submitting the information to BCBs. The breakdown between Parts L and F is shown in Table 33.

17.12 Using ONS RPI data[40], deflating this figure to 2005 prices gives a total annual administrative cost figure of £31 – £40m per annum for domestic and non-domestic buildings. £1.4m of this is attributed to the submission of the required information.

[40] Average RPI All Items index figure 2009: 213.7; average 2005 192.0

Appendix 1

Calculation of the Aggregate 25 per cent specifications

Based on the the weighted elemental analysis in the non-domestic case, the optimal specification which yields a 25 per cent reduction in CO_2 emissions was determined by equalising marginal abatement costs across all components for roof-lit and side-lit buildings in the non-domestic sector.

In order to perform this calculation, several relationships between some of the outputs of the elemental analysis were estimated. These are described in more detail below.

Total net cost and total discounted CO_2 savings

A quadratic relationship between the total net cost and the total discounted CO_2 savings for each component in each of the specifications was estimated:

Equation 1 $y_1 = ax^2 + bx + c$

Where "y_1" is the total net cost (in £/unit of component) and "x" is the total discounted CO_2 savings (in tCO_2/unit of component). Differentiating the above equation results in a relationship between the marginal abatement cost and the total discounted CO_2 savings:

Equation 2 $MAC = 2ax + b$

Component specification and total discounted CO_2 savings

A linear relationship between the specification of each component (e.g. different u-values for walls) and the total discounted CO_2 savings for each component was estimated:

Equation 3 $y_2 = dx + e$

Where "y_2" is the specification of the component and "x" is the total discounted CO_2 savings.

Annual CO_2 savings and component specification

A linear relationship between the annual CO_2 savings and the specification of each component was estimated:

Equation 4 $y_3 = gy_2 + h$

Where "y_3" is the annual CO_2 saving (in tCO_2/unit of component/year) and "y_2" is the specification of the component, for example the u-value of a wall.

The equations above were combined in order to generate the optimal specification for each component in order to yield a 25 per cent reduction in CO_2 emissions overall.

A single marginal abatement cost was calculated such that equation 2 was satisfied for all components (see step 6)

Based on this marginal abatement cost, the total discounted CO_2 saving (per unit of component) was calculated for each component in each building type

Using these total discounted CO_2 saving numbers in equation 3 yielded the optimal specification for each component for each building type

Using these specifications in equation 4 produced numbers for the annual CO_2 saving (per unit of component) for each component in each building type

These annual CO_2 savings were scaled up to the national level based on build rate data for each of the building/dwelling types. This provided the total annual CO_2 savings from tightening energy efficiency standards using this approach

The single marginal abatement cost used in the first step is calculated such that the savings from the derived specifications yield a 25 per cent reduction in emissions compared to a 2006 baseline.

Appendix 2

Elemental cost assumptions

NOTES AND COMMENTARY ON GENERIC NON DOMESTIC AND DOMESTIC CONSTRUCTION COSTS

General exclusions

Costs exclude

- VAT
- Professional Legal Fees etc.
- Land costs, fees etc.
- General assumptions

Costs have been derived from open dialogue with relevant manufacturers utilising their current technical data and costs for branded products as well as recent tender returns and historical elemental cost data bases.

Costs are subject to 20 per cent price variability with the following factors likely to have an impact on real costs:

- current prevalent market conditions
- economies of scale
- individual contractors workload (some may price high if they are busy)
- individual contractors negotiated discounts secured with material suppliers (varies from contractor to contractor)
- commercial views on profitability levels taken by individual contractors
- individual product selection and specification.

Due to the varied nature of non domestic type buildings, costs for the various non domestic buildings are based on generic building types compared where possible to:

- comparable building types and consistency of layout
- comparable floor to wall ratios and glazing to solid external wall ratios
- gross internal floor area; and

- base specification, quality, shape and style, level of fit out etc. provided by Building Sciences for the building fabric and AECOM for the M&E.

Costs are based on:

- current prices, 4th Quarter 2008 with no allowance for future price movements due to inflation or future economic market forces
- competitively tendered works and from direct pricing from Specialist Manufacturers and Suppliers of branded products
- elemental unit quantities and not gross internal floor areas in order to refine accuracy and robustness of cost data; and
- projects generally situated within North Midlands/Yorkshire region.

Total cost data were provided on templates provided by Europe Economics with emphasis placed on incremental elemental costs in lieu of total costs.

Prices obtained from suppliers and contractors were on a commercial and confidential basis.

When obtaining prices for Windows best specification recipe/u value, it was noted that a very limited number of suppliers were able to provide cost data due to the current low demand for this level of specification within the market sector.

The baseline or reference domestic dwellings used in the study were based on typical examples of recent social and private housing developments, subsequently adapted to meet the various specification recipe scenarios provided by AECOM and Building Sciences.

Table A2.1: Domestic building costs

	Reference			Level A			Level B			Level C		
Element	**Spec**	**Capital & installation cost**	**Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**
Roofs (£/m² roof)												
Joist level insulation	U = 0.25	9	0	U = 0.18	1	0	U = 0.15	3	0	U = 0.1	8	0
Rafter level insulation		127	0		4	0		7	0		13	0
Walls (£/m² wall)												
Masonry cavity	U = 0.35	115	0	U = 0.25	1	0	U = 0.2	8	0	U = 0.15	11	0
Timber frame		128	0		1	0		9	0		20	0
Party walls (£/m² party wall)	U = 0.3		0	U = 0.0	4	0	–	–	–	–	–	–
Floors (£/m² floor)												
Solid	U = 0.25	107	0	U = 0.2	3	0	U = 0.15	7	0	U = 0.1	16	0
Suspended		86	0		3	0		9	0		18	0
Windows and doors (£/m² window)	U = 2.2	250	0	U = 1.5	10	0	U = 1.1	31	0	U = 0.7	83	0
Lighting (£/bulb)	GLS	0.50	0	–	–	–	–	–	–	CFLs	4.00	0
MEV (£/house)	0.8 SFP	1500	0	0.6 SFP	50	0	0.4 SFP	125	0	0.3 SFP	200	0
MEV (£/flat)	0.8 SFP	1005	0	0.6 SFP	34	0	0.4 SFP	84	0	0.3 SFP	134	0
MVHR (£/flat)	2.0 SFP, 66% HR efficiency	1508	100	1.5 SFP, 75% HR efficiency	168	0	1.0 SFP, 85% HR efficiency	335	50	0.6 SFP, 90% HR efficiency	503	50

Table A2.1: Domestic building costs *(continued)*

	Reference			Level A			Level B			Level C		
Element	**Spec**	**Capital & installation cost**	**Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**
Gas boilers (£/boiler)	86% efficiency	1000	175	90% efficiency	250	0	–	–	–	–	–	–
Electric heat emitter (£/emitter)	100% efficiency	250	0	–	–	–	–	–	–	–	–	–
Air permeability & thermal bridging (£/dwelling)	10.0 $m^3/h.m^{-2}$ y = 0.08	0	0	7.0 $m^3/h.m^{-2}$ y y = 0.08	500	0	4.0 $m^3/h.m^{-2}$ y y = 0.04	850	0	1.0 $m^3/h.m^{-2}$ y y = 0.02	1300	0
Hot water cylinder insulation (£/cylinder)	35mm	50	0	50mm	5	0	75mm	15	0	100mm	20	0

Table A2.1: Domestic building costs *(continued)*

	Reference			Level A			Level B			Level C		
Element	**Spec**	**Capital & installation cost**	**Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**
Internal wall insulation	2.0	0	0	0.25	35.64	0	0.2	48.90	0	0.15	69.23	0
External wall insulation	2.0	0	0	0.25	9.00	0	0.2	12.00	0	0.15	16.00	0
Cavity wall insulation	2.0	0	0	0.25	13.00	0	0.2	16.64	0	0.15	20.88	0
Flat roof – replacement deck & felt	2.1	0	0	0.18	64.00	0	0.15	71.00	0	0.10	100.00	0
Loft insulation (starting point 0mm)	2.5	0	0	0.18	27.00	0	0.15	31.00	0	0.10	43.00	0
Loft insulation (starting point 50mm)	0.73	0	0	0.18	18.00	0	0.15	23.00	0	0.10	34.00	0
Loft insulation (starting point 100mm)	0.43	0	0	0.18	12.00	0	0.15	17.00	0	0.10	28.00	0
Floors – replacement	0.71	0	0	0.2	18.00	0	0.15	20.00	0	0.10	25.00	0
Floors – existing solid	0.71	0	0	0.2	34.71	0	0.15	38.69	0	0.10	48.26	0
Replacement Windows	2.2	0	0	1.5	10.00	0	1.1	31.00	0	0.70	83.00	0

Source: Davis Langdon

Table A2.2: Non-domestic building costs

	Reference			Level A			Level B			Level C		
Element	**Spec**	**Average Cost**	**Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**
Roofs (£/m² roof)												
Composite panel system	U = 0.25	85.00	0.00	U = 0.2	3.00	0.00	U = 0.15	5.00	0.00	U = 0.1	11.00	0.00
Tiled pitched (sarking)		127.00	0.00		4.00	0.00		7.00	0.00		13.00	0.00
Profiled metal		105.00	0.00		8.00	0.00		12.00	0.00		20.00	0.00
Flat		168.00	0.00		6.00	0.00		10.00	0.00		12.00	0.00
Walls (£/m² wall)												
Masonry cavity	U = 0.35	115.00	0.00	U = 0.25	3.00	0.00	U = 0.2	8.00	0.00	U = 0.15	20.00	0.00
Timber frame		128.00	0.00		2.00	0.00		10.00	0.00		21.00	0.00
LMF		349.00	0.00		3.00	0.00		4.00	0.00		7.00	0.00
Composite facade systems		80.00	0.00		3.00	0.00		6.00	0.00		7.00	0.00
Insulating concrete formwork		120.00	0.00		10.00	0.00		23.00	0.00		43.00	0.00
Floors (£/m² floor)												
Solid	U = 0.25	107.00	0.00	U = 0.2	2.00	0.00	U = 0.15	7.00	0.00	U = 0.1	16.00	0.00
Suspended		90.00	0.00		3.00	0.00		8.00	0.00		15.00	0.00
Windows, doors and rooflights (£/m² window)	U = 2.2	250.00	0.00	U = 1.5	10.00	0.00	U = 1.1	31.00	0.00	U = 0.7	83.00	0.00

Table A2.2: Non-domestic building costs *(continued)*

	Reference			Level A			Level B			Level C		
Element	**Spec**	**Average Cost**	**Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**	**Spec**	**Incremental cost**	**Incremental Maintenance Cost**
Lighting (£/fitting)	45 lm/W	105	12	50 lm/W	19	12	75 lm/W	100	15	100 lm/W	n/a	n/a
Multiburner radiant system (£/unit)	82% (thermal)	1,975	100	82% (thermal) 52.5% (radiant)	0	0	86% (thermal) 55% (radiant)	n/a	n/a	86% (thermal) 65% (radiant)	235	100
Central mechanical ventilation, with heating cooling and heat recovery (£/AHU)	2.5	25,000	900	3 (high pressure drop)	n/a	n/a	2.5 (normal pressure drop)	n/a	n/a	1.8 (low pressure drop)	11,125	1,000
Gas boilers (£/boiler)	84% seasonal efficiency	6,950	200	86% seasonal efficiency	625	20	88% seasonal efficiency	1,550	40	91% seasonal efficiency	3,125	75
Chiller – air cooled	2.25 (EER)	43,500	1,000	2.5 (EER)	-1,875	0	2.7 (EER)	n/a	n/a	3.5 (EER)	3,125	0
DX Cooling Units	2.5 (EER)	3,646	100	3 (EER)	325	10	3.5 (EER)	489	20	4 (EER)	n/a	30

Source: Davis Langdon

Appendix 3

Existing building assumptions

Extensions

Extensions to existing dwellings are not required to meet the same specifications as new build dwellings. Indeed, U-values and other elemental standards are more relaxed for extensions. It was assumed that detached, semi-detached and terraced houses may be extended but flats may not. It was further assumed that the floor area of an extension would be $9m^2$ and would not differ between dwelling types. Based on CLG data, it was estimated that approximately 150,000 dwellings will be extended each year.

The same categories of costs and benefits are calculated as for the new-build policy options.

Renovations and replacements

The following renovations have been considered:

- Replacement boilers
- Replacement windows
- External wall insulation – PU or phenolic foam with starting point of zero insulation. We could consider the case in which existing render must be removed and the case where this is unnecessary
- Internal wall insulation (insulated wallboard) – PU or phenolic foam with starting point of zero insulation.
- Cavity wall insulation – Blown mineral fibre
- Loft insulation – Mineral fibre with starting point of 0mm insulation.
- Loft insulation – Mineral fibre with starting point of 50mm insulation.
- Loft insulation – Mineral fibre with starting point of 100mm insulation.
- Floor insulation – Insulation (expanded polystyrene solid floor insulation) provided on existing solid floor.
- Floor insulation – Insulation (expanded polystyrene solid floor insulation) provided when replacing a suspended timber floor with a solid concrete floor – assume a 400mm under-floor space to suspended timber floor.
- Roofs – flat roof replacement deck – add PU foam insulation.

Given the paucity of data concerning renovations, assumptions concerning the number of renovations per year were taken from several sources, although an element of educated guesswork was nonetheless required for some renovations. The area of thermal elements, taken to be the same as for new-build dwellings, differs between dwelling types. This implied a need to split the assumptions regarding number of renovations between dwelling types, which was achieved by employing EHCS stock data.

The same categories of costs and benefits are calculated as for the new-build policy options but only 50 per cent of these are attributed to the policy to allow for the prior impact of EPC and supplier obligations.

It has been assumed that lofts may be converted in detached, semi-detached and terraced houses whilst garages may be converted in detached and semi-detached houses; flats are assumed to have to have neither a loft nor a garage. Assumptions concerning the total annual number of loft and garage conversions were agreed with AECOM, in the absence of any published data.

For loft conversions, area assumptions were identical to those assumed in the new-build analysis and hence differed between dwelling types. To allow an analysis that took differences between dwellings into account, the total number of loft conversions was split between dwelling types on the basis of English House Condition Survey (EHCS) stock data. It was assumed that it would be necessary to insulate the loft at rafter level such that the pitched roof would achieve the same U-value as required under the selected new-build policy option. Per-conversion energy saving and cost data were taken directly from the analysis of renovating a roof and installing insulation from a starting point of 0mm insulation.

Garage conversions were assumed to be a common size with floor area 18m2 and given the wide variety of attached garage styles, it was necessary to make some further simplifying assumptions. In particular, two walls were assumed to be external and two internal, the garage door was assumed to be 4.6m^2 and 80 per cent of existing housing stock was assumed to be of masonry construction. Provided with these basic assumptions, the areas of the other thermal elements, including the additional brickwork and window to replace the garage door, were estimated.

To value costs and benefits for additional brickwork and windows, the cost and energy saving assumptions utilised in the new-build analysis were employed. For existing walls, it was assumed that additional insulation would be provided on the internal area of external walls since this area would require a surface finish upgrade even in the absence of additional insulation. For this, and all other existing thermal elements, energy saving and cost data were taken from the renovations analysis.

The same categories of costs and benefits are calculated as for the new-build policy options.

Assumptions on numbers of existing buildings affected.

	Quantity per annum	Source
Extensions	150,000	CLG planning statistics
Renovations		
Internal wall insulation	7,500	2007 trade estimates in "UK Domestic Solid Wall Insulation, Sector Profile, May 2008
External wall insulation	10,000	2007 trade estimates in "UK Domestic Solid Wall Insulation, Sector Profile, May 2008
Cavity wall insulation	500,000	Based on forecast of required installation rate to meet CERT in "The Insulation Industry", August 2008
Flat roof – replacement deck & felt	5,000	–
Loft insulation (starting point 0mm)	56,700	Based on forecast of required installation rate to meet CERT in "The Insulation Industry", August 2008
Loft insulation (starting point 50mm)	171,500	Based on forecast of required installation rate to meet CERT in "The Insulation Industry", August 2008
Loft insulation (starting point 100mm)	263,200	Based on forecast of required installation rate to meet CERT in "The Insulation Industry", August 2008
Floors – replacement	5,000	–
Floors – existing solid	10,000	–
Replacement Windows	5,794,000	Market research 2007
Replacement Boilers	1,566,084	Sales by SEDBUK band for 12 months to Jan 2009
Loft conversions	30,000	–
Garage conversions	30,000	–

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