

April 22

Building Regulations Review: Changes to Part L (conservation of fuel and power); Part F (ventilation); and Part O (Mitigation of Overheating) of the Building Regulations for Residential Buildings: Final Impact Assessment

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1. Summary

Policy changes considered in this impact assessment

- 1.1 This assessment considers the impact on dwellings in Wales of changes to Part L and Part F of, and the introduction of Part O to, the building regulations. The costs and benefits of the proposed changes have been assessed over a 70-year appraisal period. The costs and benefits are net of those that would be incurred under the current regulations.
- 1.2 The proposed changes are expected to result in a net present value benefit of £102.4m and a reduction in Greenhouse gas emissions of 1.6 million tonnes of CO₂ equivalent.

Table 1.1: Summary - Present Value costs and benefits (£m)				
	Familiarisation Costs	New Dwellings	Existing Dwellings	Total
Costs (£m)	0.7	371.3	98.3	470.3
Benefits (£m)		412.6	160.1	572.7
Net Benefit (£m)	-0.7	41.3	61.8	102.4
Greenhouse Gas Emissions (MtCO₂e)		-0.98	-0.62	-1.60

New Dwellings – policy changes

Part L standards for New Dwellings

- 1.3 The policy changes to the notional specification to set the target to achieve improvement in energy efficiency standards in new dwellings include:
- Improved Fabric;
 - PV;
 - Wastewater Heat Recovery;
- 1.4 In addition, three other specific changes to Part L are assessed:
- Requiring all new homes to have air tightness tests;
 - Removing the fuel factors – removing the relief for high-carbon heating systems (such as oil and LPG);
 - Requiring all new homes to have self-regulating devices.

Part F standards for New Dwellings

- 1.5 Two specific changes to Part F are assessed:
- Naturally Ventilated Systems – the proposed policy change is to simplify the guidance for naturally ventilated systems;

- Mechanical Extract Ventilation (MEV) Systems – the proposed policy change is for the size of background ventilators to be increased from 2500mm² to 5000mm² equivalent area in habitable rooms for mechanical extract ventilation (MEV) systems.

Part O standards for New Residential buildings¹

1.6 Part O will introduce a new standard and will comprise the following requirement to mitigate overheating risk in new dwellings:

- Dwellings shall be designed and constructed in such a way as to provide reasonable mitigation from the risk of summertime overheating; and
- Any mitigation measures shall be safe, secure and reasonably practical for occupants.

New Dwellings - Impacts

Part L- Improved Energy Efficiency standards are estimated to result in:

- Additional capital, replacement, and maintenance costs of £358.7m present value (net of the counterfactual);
- Reduced energy costs of £213.4m present value;
- Increased social benefits (derived from reduced carbon and improved air quality) of £172.1m present value over the appraisal period;
- **Resulting in a net present value policy benefit of £26.9m.**

Part L - Air Tightness Test requirements are estimated to result in:

- An additional capital cost of £0.6m;
- Energy savings of £0.1m;
- Social benefits of £0.2m;
- **Resulting in a net present value policy cost of £0.3m.**

Part F – Improved Natural and Mechanical Ventilation standards are estimated to result in:

- For Naturally Ventilated Systems – the benefits of this policy change are simplification and improved compliance. As previous Part F revisions assumed 100% compliance, no additional benefit has been accounted for here;
- For Mechanical Extract Ventilation (MEV) systems – the analysis suggests an additional cost of £0.250m (£0.026m EANC). The benefit of this policy change is improved air distribution in the home, leading to improved ventilation and indoor air quality, with associated health benefits. These have not been monetised in this analysis however, due to difficulties and uncertainty in the quantification of these benefits;

¹ The policy applies to new residential buildings. This includes new dwellings as well as other residential-type buildings where people sleep on the premises e.g. student halls of residence and care homes. The analysis has been done for new dwellings only as these make up the majority of all new residential-type buildings

- **Resulting in a net present value policy cost of £0.250m (but noting that the benefits have not been included in the analysis)**

Part O - Mitigating Overheating in new residential buildings is estimated to result in:

- Additional capital costs - the analysis suggests the policy could result in additional capital costs of £11.74m;
- Reduced energy costs - these measures are estimated to result in a reduced energy costs of £2.64m;
- Social benefits - the improvements should also result in social benefits (improved health and reduced carbon) equalling £23.63m;
- **Resulting in a net present value policy benefit of £14.94m.**

Table 1.2: Present Value costs and benefits of proposed changes for all residential new builds (£m)				
	Part L	Air tightness	Part F	Part O Overheating
Capital	£ 240.90	£ 0.59	£ 0.25	£ 11.74
renewals	£ 69.69			
maintenance	£ 48.12			
energy	£ 213.44	£ 0.08		£ 2.64
Carbon Price	£ 143.70	£ 0.24		£ 0.41
Air quality price	£ 28.43	£ 0.01		
Health impacts				£ 23.63
Net Cost	£ 26.87	£ 0.26	£ 0.25	£ 14.94
Greenhouse Gas Emissions (MtCO₂e)	- 0.970	- 0.002		- 0.004

Removing the Fuel Factors - impacts

- 1.7 Analysis undertaken for the England Part L² changes suggests that in practice there may not be any material cost difference between retaining or removing the fuel factor if complying with the Part L target. This has been assumed to apply to this analysis.

² England Part L Domestic IA - Para 4.16-4.19 and Para 9.17-9.24

Self-Regulating Devices - impacts

- 1.8 It is assumed that in practice all new homes currently install SRDs. Therefore, requiring this within the guidance, will not result in significant additional costs or benefits.

Existing Buildings – Policy Changes

Part L standards for Existing Dwellings

- 1.9 Improvements are considered with regard to the following elements:
- = Extensions;
 - = Windows;
 - = Doors;
 - = Conservatories;
 - = Conversions;
 - = Boiler Plus;
 - = SRDs.

Part F standards for Existing Dwellings

- 1.10 Background Ventilation - where energy efficiency measures are likely to significantly reduce the air permeability of the dwelling, the policy recommends ventilation as for new homes.

Existing Dwellings - Impacts

Part L - improved Energy Efficiency standards are estimated to result in:

- Additional capital and replacement costs of £97.5m present value (net of the counterfactual);
- Reduced energy costs of £44.5m present value;
- Increased social benefits (reduced carbon and improved air quality) of £115.9m present value, over the appraisal period;
- **Resulting in a net present value policy benefit of £62.7m.**

Part F - improved Ventilation standards are estimated to result in:

- An additional capital cost of £0.9m present value;
- The benefit of this policy change is improved air distribution in the home, leading to improved ventilation and indoor air quality, with associated health benefits. These have not been monetised in this analysis however, due to difficulties and uncertainty in the quantification of these benefits;
- **Resulting in a net present value policy cost of £0.9m (noting that the benefits have not be included in the analysis).**

Table 1.3: Present Value costs and benefits of proposed changes for all existing dwellings (£m)

	Part L	Part F
Capital	£ 95.30	£ 0.87
renewals	£ 2.15	
Maintenance		
Energy	-£ 44.25	
Carbon Price	-£ 111.15	
Air quality price	-£ 4.70	
Health impacts		
Net Cost	-£ 62.65	£ 0.87
Greenhouse Gas Emissions (MtCO_{2e})	-0.625	-

Familiarisation Costs

1.11 Businesses will incur transition costs as a result of employees spending time to familiarise themselves with the new technical requirements.

1.12 Familiarisation costs are estimated at **£0.7m present value**

Figure 1.4: Present Value familiarisation costs for new and existing dwellings (£m)

	Familiarisation Costs (£m)
Part L	0.258
Part F	0.017
Performance Gap	0.142
Overheating	0.095
SAP	0.174
Airtightness	0.015
Total familiarisation costs for domestic buildings	0.700

2. Policy Context

Net Zero & Climate Emergency

- 2.1 In March 2021 under the provisions of the Environment (Wales) Act 2016 Wales, set a Net Zero target by the year 2050, with a system of interim emissions targets and carbon budgets. Furthermore, the Senedd also declared a climate emergency in April 2019.
- 2.2 Delivery of these targets will be achieved through actions set out in Net Zero Wales and subsequent strategies, delivering:
- 123 policies and proposals are identified to meet the carbon emissions targets;
 - Coupled with the subsequent plan which sets out measures to meet carbon budget for 2021-25.

Setting energy performance related targets in building regulations is an important means of reducing the carbon emissions of buildings

- 2.3 Homes, both new and existing, account for 20% of greenhouse gas emissions.
- 2.4 **Policy 45** of Net Zero Wales commits Wales to set higher energy efficiency standards for new builds through reviewing Building Regulations Part L (Conservation of Fuel and Power).
- 2.5 The performance-based targets set through the Building Regulations are an important means of ensuring reduced carbon emissions of new buildings. Segments of the development industry are implementing reduced carbon emission measures of their own accord, but not all segments of the industry are likely to achieve the required standards without introduction of performance-based target regulation. Causes of market failures include the cost of climate change not being fully reflected in energy prices, lack of information about energy efficiency opportunities and limited incentives to make improvements.

Policy objectives

- 2.6 The policy objectives considered in this assessment are to reduce carbon emissions of dwellings through changes to Part L of the Building Regulations, and to instigate the changes in specifications, skills and supply chains needed to stimulate innovation and learning in the sector, as the basis for introducing a world-leading performance standard incorporating low-carbon heat in new homes by 2025.
- 2.7 Policy objectives also include ensuring provision of adequate ventilation through changes to Part F of the Building Regulations to align with more airtight construction encouraged by Part L.

3. Policy options assessed

- 3.1 This assessment considers the impact of proposed changes to Part L and to Part F of the building regulations. The Options consider include
- Option 1 - counterfactual – continue to use BR2014 requirements
 - Option 2 – preferred option – adopt the changes to the standards to improve energy efficiency, ventilation and mitigate overheating in dwellings set out below

New Dwellings – policy changes

Part L standards for New Dwellings

- 3.2 The policy changes to the notional specification to set the target to achieve improvement in energy efficiency standards in new dwellings include:
- Improved Fabric;
 - PV;
 - Wastewater Heat Recovery;
- 3.3 In addition, three other specific changes to Part L are assessed:
- Requiring all new homes to have air tightness tests;
 - Removing the fuel factors – removing the relief for high-carbon heating systems (such as oil and LPG);
 - Requiring all new homes to have self-regulating devices.

Part F standards for New Dwellings

- 3.4 Two specific changes to Part F are assessed:
- Naturally Ventilated Systems – the proposed policy change is to simplify the guidance for naturally ventilated systems;
 - Mechanical Extract Ventilation (MEV) Systems – the proposed policy change is for the size of background ventilators to be increased from 2500mm² to 5000mm² equivalent area in habitable rooms for mechanical extract ventilation (MEV) systems.

Part O standards for New Residential buildings³

- 3.5 Part O will introduce a new standard and will comprise the following requirement to mitigate overheating risk in new dwellings:
- Dwellings shall be designed and constructed in such a way as to provide reasonable mitigation from the risk of summertime overheating; and
 - Any mitigation measures shall be safe, secure and reasonably practical for occupants.

³ The policy applies to new residential buildings. This includes new dwellings as well as other residential-type buildings where people sleep on the premises e.g. student halls of residence and care homes. The analysis has been done for new dwellings only as these make up the majority of all new residential-type buildings

Existing Dwellings – policy changes

Part L standards for Existing Dwellings

3.6 Improvements are considered with regard to the following elements:

- = Extensions;
- = Windows;
- = Doors;
- = Conservatories;
- = Conversions;
- = Boiler Plus;
- = SRDs.

Part F standards for Existing Dwellings

3.7 Background Ventilation - where energy efficiency measures are likely to significantly reduce the air permeability of the dwelling, the policy recommends ventilation as for new homes.

4. Analytical Approach

- 4.1 This section sets out the principal steps and key considerations used to estimate the impact of both policy options.
- 4.2 The assessment only applies to dwellings. It also does not consider non-domestic buildings. This will be assessed separately.
- 4.3 The methodology is similar to that recently used to assess the impact of similar policy changes to Part L and F of the building regulations in England
- 4.4 In summary, the assessment:
- Estimates the additional costs to house builders/ occupiers of both policy options, over and above the current situation (as defined by BR2014), termed the counterfactual;
 - Then estimates the additional benefits likely to derive from each policy option, over and above the current situation;
 - And then deducts the additional costs from the additional benefits to arrive at the net policy cost.

Types of costs considered in the assessment

- 4.5 This analysis assesses the following costs of the proposed options for a 'typical dwelling' compared to the counterfactual (BR2014):
- Capital costs;
 - Maintenance costs;
 - Replacement costs.
- 4.6 The costs are derived as follows:
- Costs include capital, maintenance and replacement costs;
 - All costs are in current prices;
 - Costs are estimated for the life of the building;
 - Cost estimates are provided by AECOM;
 - Changes in costs over time, due to anticipated future learning, are taken into account. The analysis uses the same learning rate assumptions as used for the England Part L analysis.⁴

Types of benefits considered in the assessment

- 4.7 Three types of benefit are assessed in the analysis:
- Energy Usage - reduced energy usage as a result of improved energy efficiency;
 - Two environmental benefits - reduced carbon emissions and air quality improvements;

⁴ England Part L Domestic IA – Para 7.17

- Health impacts - improved health of occupants of dwellings as a result of improved ventilation and reduced overheating.

4.8 The benefits are calculated as follows:

- Energy usage – estimated by AECOM for gas, grid electricity and electricity generated by dwelling / exported to grid;
- Energy, Greenhouse gas emissions and air quality costs – valued using the HMT Greenbook Supplementary Guidance: Valuation of energy use and greenhouse gas emissions for appraisal (updated October 2021);
- Improved Health – additional life years valued at £70,000 per quality adjusted life year, as per Green Book Guidance (updated March 2022).

Types of residential dwelling considered in the assessment

4.9 The assessment has been undertaken using four standard dwelling types:

- Detached House (117m² total floor area (TFA));
- Semi Detached House (84m² TFA);
- Terraced House (84m² TFA);
- Block of Flats (assuming 32 flats per block) (50m² TFA 1 bed single aspect apartment and 70m² TFA 2 bed corner apartment).

Appraisal period

4.10 Costs and benefits are assessed over a 70-year period (2022-2091) as follows:

- A 10-year policy period (2022-31);
- The impact of which is assessed over the assumed 60-year lifespan of each building built in the 10-year policy period.

Sequence of calculations

- Costs and benefits are first assessed for each of the four new build dwelling types;
- The costs and benefits of each policy option across Wales are then calculated by multiplying each building type's costs and benefits by the estimated number of new build completions over a 10-year period for each of the dwelling types (see Annex A for new build completion figures used).

Discount rates used

4.11 The results are presented in present value terms using the HM Treasury's standard discount rates:

- Non-Health impacts – 3.5% for the first 30 years and 3.0% for the subsequent years;
- Health impacts – 1.5% for the first 30 years and 1.0% for the subsequent years.

Additional calculations undertaken

4.12 In addition to the above, this assessment on new homes also considers:

- Part F – increased background ventilator sizing – this is costed by estimating the average cost per dwelling of increased background ventilators multiplied by the number of homes estimated to require the increase;
- Air tightness tests – requiring all new homes to have air tightness tests. The cost has been calculated by estimating the average cost of an airtightness test and the number of additional tests required. Benefits have been estimated based on the improved energy savings of buildings that have improved air tightness multiplied by the number of dwellings estimated to currently be untested and having an air tightness of less than the design target of 5 m³/m²h.

5. New Dwellings

Policy standards for new dwellings

Part L Standards for New Dwellings

5.1 The policy changes to achieve improvement in energy efficiency standards in new dwellings include:

- Improved Fabric;
- PV;
- Wastewater Heat Recovery;

5.2 In addition, three other specific changes to Part L are assessed:

- Requiring all new homes to have air tightness tests;
- Removing the fuel factors – removing the relief for high-carbon heating systems (such as oil and LPG);
- Requiring all new homes to have self-regulating devices.

Part F Standards for New Dwellings

5.3 Two specific changes to Part F are assessed:

- Naturally Ventilated Systems – the proposed policy change is to simplify the guidance for naturally ventilated systems;
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Part O Standards for New Residential Buildings

5.4 Part O will introduce a new standard and will comprise of the following requirement to mitigate overheating risk in new residential buildings:

- Dwellings shall be designed and constructed in such a way as to provide reasonable mitigation from the risk of summertime overheating; and
- Any mitigation measures shall be safe, secure and reasonably practical for occupants.

Impacts – New Dwellings

Part L- improved energy efficiency standards are estimated to result in:

- Additional capital, replacement, and maintenance costs of £358.7m present value (net of the counterfactual);
- Reduced energy costs of £213.4m present value
- Increased social benefits (derived from reduced carbon and improved air quality) of £172.1m present value over the appraisal period;
- **Resulting in a net present value policy benefit of £26.9m.**

Part L - Air Tightness Test requirements will result in:

- An additional capital cost of £0.6m;
- energy savings of £0.1m, and
- Social benefits of £0.2m
- **Resulting in a net present value policy cost of £0.3m.**

Part F – improved natural and mechanical ventilation standards are estimated to result in:

- For Naturally Ventilated Systems – the benefit of this policy change is simplification and improved compliance. As previous Part F revisions assumed 100% compliance, no additional benefit has been accounted for here;
- For Mechanical Extract Ventilation (MEV) systems – the analysis suggests an additional cost of £0.250m (£0.026m EANC). The benefit of this policy change is improved air distribution in the home, leading to improved ventilation and indoor air quality, with associated health benefits. These have not been monetised in this analysis however, due to difficulties and uncertainty in the quantification of these benefits
- **Resulting in a net present value policy cost of £0.250m (but noting that the benefits have not been included in the analysis)**

Part O - Mitigating overheating in new residential buildings⁵ are likely to result in:

- Additional capital costs - the analysis suggests the policy could result in additional capital cost of £11.74m:
- Reduced energy costs - these measures will result in a reduced energy cost of £2.64m;
- Social benefits - the improvements should also result in social benefits (improved health and reduced carbon) equalling £23.63m;
- **The resulting in a net present value policy benefit of £14.94m.**

⁵ The policy applies to new residential buildings. This includes new dwellings as well as other residential-type buildings where people sleep on the premises e.g. student halls of residence and care homes. The analysis has been done for new dwellings only as these make up the majority of all new residential-type buildings

Table 5.1: Present Value costs and benefits of proposed changes for all residential new builds (£m)

	Part L	Air tightness	Part F	Part O Overheating
Capital	£ 240.90	£ 0.59	£ 0.25	£ 11.74
renewals	£ 69.69			
maintenance	£ 48.12			
energy	-£ 213.44	-£ 0.08		-£ 2.64
Carbon Price	-£ 143.70	-£ 0.24		-£ 0.41
Air quality price	-£ 28.43	-£ 0.01		
Health impacts				-£ 23.63
Net Cost	-£ 26.87	£ 0.26	£ 0.25	-£ 14.94
Greenhouse Gas Emissions (MtCO_{2e})	- 0.970	- 0.002		- 0.004

Removing the fuel factors - impacts

- 5.5 Analysis undertaken for the England Part L changes suggests that in practice there may not be any substantive cost difference between retaining or removing the fuel factor if complying with the Part L target.⁶

Self-Regulating Devices - impacts

- 5.6 It is assumed that in practice all new homes currently install SRDs. Therefore, requiring this within the guidance, will not result in significant additional costs or benefits.

Unit costs used in the calculations

- 5.7 Table 5.2 shows the summary costs and energy use assumptions per building used in the calculations for the counterfactual and policy options to uplift Part L standards.

⁶ England Part L Domestic IA - Para 4.16-4.19 and Para 9.17-9.24

Table 5.2: Unit costs for New Build Part L						
Reference		Building Cost / Unit	Annual Maintenance Costs per Unit	Energy Demands by Fuel Type (kWh/yr/unit)		
Building Reference	Building Type			Gas	Grid Elec	Gen Elec
BR2014 case	Detached House	171,444	100	8,151	324	-
Policy Option	Detached House	179,850	148	6,700	(743)	1,825
BR2014 case	Semi-detached House	123,470	100	6,219	284	-
Policy Option	Semi-detached House	129,589	148	5,165	(536)	1,268
BR2014 case	Mid-terrace House	113,300	100	5,713	290	-
Policy Option	Mid-terrace House	118,846	148	4,779	(531)	1,268
BR2014 case	Block of Flats	2,796,637	3,200	141,452	7,461	-
Policy Option	Block of Flats	2,885,914	3,547	119,033	(5,113)	11,200

Cost benefit analysis

5.8 Tables 5.3 show the discounted costs and benefits of the counterfactual, of the policy change and the net benefits, for each component.

Table 5.3: Discounted Costs and Benefits (£m)

		Counterfactual	Policy Option	Net Impact
Part L	Capital	£2,431.96	£2,672.86	£240.90
Part L	Energy	£262.28	£48.84	-£213.44
Part L	Renewals	£333.63	£403.32	£69.69
Part L	Maintenance	£146.25	£194.37	£48.12
Part L	<i>Carbon Price</i>	£666.90	£523.20	-£143.70
Part L	Air quality price	£33.60	£5.17	-£28.43
Part F	Capital	-	£0.25	£0.25
Air Tightness	Capital	-	£0.59	£0.59
Air Tightness	Energy	-	-£0.08	-£0.08
Air Tightness	<i>Carbon Price</i>	-	-£0.24	-£0.24
Air Tightness	Air quality price	-	-£0.01	-£0.01
Overheating	Capital and replacement	£9.36	£21.10	£11.74
Overheating	Energy	£2.64	£0.00	-£2.64
Overheating	Carbon Price	£0.41	£0.00	-£0.41
Overheating	Health impacts	£0.00	-£23.63	-£23.63

6. Existing Dwellings

Policy standards for existing dwelling

Part L Standards for existing dwellings

6.1 Improvements are considered with regard to the following elements:

- = Extensions;
- = Windows;
- = Doors;
- = Conservatories;
- = Conversions;
- = Boiler Plus;
- = SRDs.

Part F Standards for Existing Dwellings

6.2 Background Ventilation - where energy efficiency measures are likely to significantly reduce the air permeability of the dwelling, the policy recommends ventilation as for new homes.

Impacts – Existing Dwellings

Part L - improved energy efficiency standards are estimated to result in:

- Additional capital and replacement costs of £97.5m present value (net of the counterfactual);
- Reduced energy costs of £44.5m present value, and
- Increased social benefits (reduced carbon and improved air quality) of £115.9m present value, over the appraisal period;
- **Resulting in a net present value policy benefit of £62.7m.**

Part F - improved ventilation standards are estimated to result in:

- An additional capital cost of £0.9m present value;
- The benefit of this policy change is improved air distribution in the home, leading to improved ventilation and indoor air quality, with associated health benefits. These have not been monetised in this analysis however, due to difficulties and uncertainty in the quantification of these benefits;
- **Resulting in a net present value policy cost of £0.9m (noting that the benefits have not be included in the analysis).**

Table 6.1: Present Value costs and benefits of proposed changes for all existing residential dwellings (£m)

	Part L	Part F
Capital	£ 95.30	£ 0.87
renewals	£ 2.15	
Maintenance		
Energy	-£ 44.25	
Carbon Price	-£ 111.15	
Air quality price	-£ 4.70	
Health impacts		
Net Cost	-£ 62.65	£ 0.87
Greenhouse Gas Emissions (MtCO_{2e})	-0.625	-

Impacts per dwelling

- 6.3 Table 6.2 shows the present value of the net costs and benefits of each element of the policy changes per dwelling to Part L and Part F.

Table 6.2: Net Benefits (Present Value)									
	Boiler Plus	Conversions	Extensions	Conservatories	Windows and Doors	SRD	Part L	Part F - Ventilation	Total
Capital Costs	£19.82	£10.72	£13.67	£2.78	£40.42	£7.88	£48.31	£0.87	£49.18
Energy Costs	-£5.42	-£4.03	-£2.75	-£0.33	-£26.86	-£4.85	-£31.71	£0.00	-£31.71
Replacement Costs	£1.83	£0.00	£0.00	£0.32	£0.00	£0.00	£0.00	£0.00	£0.00
Maintenance Costs	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Carbon Price	-£16.16	-£10.41	-£8.20	-£1.00	-£63.52	-£11.85	-£75.38	£0.00	-£75.38
Air quality price	-£0.73	-£0.44	-£0.37	-£0.05	-£2.62	-£0.49	-£3.11	£0.00	-£3.11
NPV	-£0.66	-£4.17	£2.34	£1.72	-£52.58	-£9.31	-£61.89	£0.87	-£61.02
MTCO2e	-0.116	-0.060	-0.059	-0.007	-0.319	-0.063	-0.382	0.000	-0.382

6.4 Table 6.3 shows the summary impacts of the proposed changes on costs and energy usage per dwelling.

Table 6.3: Energy Demands by Fuel Type (kWh/yr/unit) and cost

		Energy Usage (Gas) kWhr	Capital Cost
Extension	Extension BR2022 - net change over counterfactual	(151)	£340
Windows	Windows BR 2014	9,767	£3,370
	Windows BR 2022	9,647	£3,516
	Windows - Comfort Taking	18	-
Doors	Doors BR 2014	9,767	£830
	Doors BR 2022	9,728	£850
	Doors - Comfort Taking	6	-
SRD	SRD - Group 1 (assuming some existing SRDs)	(155)	£100
	SRD - Group 2 (assuming no existing SRDs)	(447)	£225
Conversions	conversions - risk assessment - BR2022		£165
	conversions - BR2022	(96)	£159
Conservatories	Conservatories BR2022 - exempt		£53
	Conservatory BR2022 - not exempt	(151)	£340
	Conservatory - not exempt - Comfort Taking	23	-
Boiler plus	Boiler Plus - load compensator	(371)	-
	Boiler Plus - learning thermostat	(68)	-

Cost per dwelling

Extensions

Results

6.5 Table 6.4 sets out the results of the analysis for extensions.

Table 6.4: Results: Extensions	Net Present Value (£m)
Capital Costs	£19.82
Energy Costs	-£5.42
Replacement Costs	£1.83
Maintenance Costs	£0.00
Total financial costs	£16.23
Carbon and air quality costs	-£16.89
Total costs including carbon and air quality improvement	-£0.66
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.116</i>

Cost breakdown per extension

6.6 The analysis assumes that the cost per extension will increase by a total of £340 per extension, comprising:

- £88.65 increase in cost of windows and doors (replaced after 30 years);
- £250.94 increase in the cost of other building fabric (assumed 60-year lifespan, so not replaced).

Benefit breakdown per extension

6.7 The analysis assumes that the benefits for a typical extension will be:

- 151 kWh of gas saving per annum.

Number of extensions per annum

6.8 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- 7,200 extensions are constructed per annum;
- This is based on the assumption that 0.5% of dwellings in Wales build an extension each year;
- This assumption is based on the mid-point of the assumption range (0.1% to 0.8%), referenced in the 2013 Part L Impact Assessment.

Windows and Doors

Results

6.9 Table 6.5 sets out the results of the analysis for windows.

Table 6.5: Results Windows and Doors	Net Present Value (£m)
Capital Costs	£10.72
Energy Costs	-£4.03
Replacement Costs	£0.00
Maintenance Costs	£0.00
Total financial costs	£6.69
Carbon and air quality costs	-£10.86
Total costs including carbon and air quality improvement	-£4.17
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.060</i>

Cost breakdown per dwelling

6.10 The analysis assumes that the cost per dwelling will increase by a total of £167 per dwelling comprising:

- Windows: £147 additional cost per dwelling (£10 additional cost per sqm),
- Doors: £20 additional cost per dwelling

Benefit breakdown per dwelling

6.11 The analysis assumes that the benefits for a typical dwelling will be:

- Windows: 120 kWh of gas saving per annum (or 102kWh of saving when comfort taking⁷ is accounted for).
- Doors: 39kWh of gas savings per annum (or 33kWh of saving when comfort taking is accounted for).

Number of windows and doors replaced per annum

6.12 To estimate the additional impact of the policy for windows across all dwellings in Wales, the analysis assumes:

- That 8 windows (14.65 sqm) are replaced per dwelling;
- That 28,600 dwellings replacing windows per annum (this equates to 2% of total stock);
- The assumption of 2% of stock is in line with the number of notifications reported by the relevant Competent Person Schemes

6.13 To estimate the additional impact of the policy for doors across all dwellings in Wales, the analysis assumes

⁷ Comfort taking refers to the rebound effect of households spending some of the gas bill savings on increasing the room temperature

- That 35,800 dwellings (2.5%⁸) replace doors per year.

Conservatories

Results

6.14 Table 6.6 sets out the results of the analysis for conservatories.

Table 6.6: Results Conservatories	Net Present Value (£m)
Capital Costs	£13.67
Energy Costs	-£2.75
Replacement Costs	£0.00
Maintenance Costs	£0.00
Total financial costs	£10.92
Carbon and air quality costs	-£8.57
Total costs including carbon and air quality improvement	£2.34
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.059</i>

Cost breakdown per dwelling

6.15 The analysis assumes that the cost per dwelling will increase by a total of:

- £53 for a conservatory which is thermally separate from the adjoining house, and is exempt from energy efficiency requirements;
- £340 for a conservatory that is not thermally separate, and therefore not exempt⁹.

Benefit breakdown per dwelling

6.16 The analysis assumes that the benefits for a typical dwelling will be:

- Savings for exempt conservatories have not been quantified;
- 151 kWh of gas saving per annum for non-exempt conservatories (or 129kWh of saving when comfort taking¹⁰ is accounted for).

Number of conservatories installed per annum

6.17 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- 8,600 dwellings (0.6%) add a conservatory per year¹¹;
- The analysis assumes that 50% are thermally separate from building and that 50% are not thermally separate.

⁸ Consultants' working assumption

⁹ For the purpose of this analysis the additional cost and energy savings for a non-exempt conservatory is assumed to be the same as that for an extension since the proposed standards will be the same. However, it is acknowledged that the design and size of a conservatory may differ from an extension.

¹⁰ Comfort taking refers to the rebound effect of households spending some of the gas bill savings on increasing the room temperature

¹¹ Estimated based on the proportion of dwellings with a conservatory (18%) and assuming a 30-year life.

Conversions

Results

6.18 Table 6.7 sets out the results of the analysis for conversions.

Table 6.7: Results Conversions	Net Present Value (£m)
Capital Costs	£2.78
Energy Costs	-£0.33
Replacement Costs	£0.00
Maintenance Costs	£0.00
Total financial costs	£2.76
Carbon and air quality costs	-£1.04
Total costs including carbon and air quality improvement	£1.72
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.007</i>

Cost breakdown per dwelling

6.19 The analysis assumes that the cost per dwelling will increase by a total of:

- £165 for an Internal Wall Insulation risk assessment for a typical loft conversion¹²;
- £159 to meet the proposed standards for a conversion.

Benefit breakdown per dwelling

6.20 The analysis assumes that the benefits for a typical dwelling will be:

- Benefits of risk assessment not quantified in this analysis;
- 96 kWh of gas saving per annum for typical loft conversion with insulation at rafter level

Number of conversions installed per annum

6.21 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- 1,400 dwellings (0.1%) undertake a loft conversion per annum¹³;
- 50% of loft conversions with insulation are at rafter level.

¹² Costs derived through discussions with expert practitioners. The costs for a retrofit assessment vary and it is assumed that a whole-house approach is being adopted by those undertaking risk assessments. The Internal Wall Insulation (IWI) risk assessment is suggested as being in the region of 25% to 35% of the whole-house fee. For a one-off house, the fee is likely to be in the region of £550. Therefore, the range for the IWI risk assessment being between £140 and £190. We have used £165 as the mid-point cost per property.

¹³ Calculated based on estimate that 5% of stock have loft conversions; typical house is 50 years old = average rate of 0.1% p.a.

Boiler Plus and Future Proofing

Results

6.22 Table 6.8 sets out the results of the analysis for Boiler Plus

Table 6.8: Results Boiler Plus and Future Proofing	Net Present Value (£m)
Capital Costs	£40.42
Energy Costs	-£26.86
Replacement Costs	-
Maintenance Costs	-
Total financial costs	£13.56
Carbon and air quality costs	-£66.14
Total costs including carbon and air quality improvement	-£52.58
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.319</i>

6.23 The costs/benefits of replacement heating system (relative to the counterfactual) have not been quantified for the consultation stage impact assessment.

Cost breakdown per dwelling¹⁴

6.24 The analysis assumes that the cost per dwelling will increase by a total of:

- £150 to install a load compensator; or
- £30 to install a learning thermostat.

Benefit breakdown per dwelling

6.25 The analysis assumes that the benefits for a typical dwelling will be:

- 371 kWh of gas saving per annum for dwellings that install load compensators; or
- 68 kWh of gas savings per annum for dwellings that install learning thermostats.

Number of additional energy saving devices

6.26 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- 5% of boilers are replaced per annum (72,000 boiler replacements p.a.)¹⁵;
- Of these, it is assumed that 55,400 (77%) of replacement boilers are combi boilers (based on market sales data);
- When installing a combi system, there is also a requirement to install additional energy saving devices, the two most common of which are a load compensator or a learning thermostat. The analysis assumes a 50/50 split between these two, based on the English impact assessment.

¹⁴ The unit costs and benefits for the changes as a result of Boiler Plus are based on the assumptions set out in the England Boiler Plus IA

¹⁵ Estimate of boiler replacement is based on market data for boiler sales

SRD

Results

6.27 Table 6.9 sets out the results of the analysis for SRDs

Table 6.9: Results SRD	Net Present Value (£m)
Capital Costs	£7.88
Energy Costs	-£4.85
Replacement Costs	£0.00
Maintenance Costs	£0.00
Total financial costs	£3.04
Carbon and air quality costs	-£12.35
Total costs including carbon and air quality improvement	-£9.31
<i>Tonnes of carbon saved (tonnes)</i>	<i>-0.063</i>

Cost breakdown per dwelling

6.28 The analysis assumes that the cost per dwelling will increase by a total of:

- £25 per Thermostatic Radiator Valve installed.

Benefit breakdown per dwelling

6.29 The analysis assumes that the benefits for a typical dwelling will be:

- 155 kWh of gas saving per annum for dwellings that already have TRV installed in most used rooms;
- 447 kWh of gas saving per annum for dwellings that have no TRV already installed.

Number of Self-Regulating Devices installed per annum

6.30 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- 5% of boilers are replaced per annum (72,000 boiler replacements p.a.);
- Typical dwelling has 9 radiators that could be fitted with TRV;
- 90% of dwellings either already have TRV installed on all radiators (45%) or would have installed them under the counterfactual (45%);
- 7% of dwellings have TRV already installed on 5 radiators (i.e. in most used rooms);
- 3% of dwellings have no TRV installed.

Part F: Background Ventilators

Results

6.31 Table 6.10 sets out the results of the analysis for ventilation.

Table 6.10: Results Part F	Net Present Value (£m)
Capital Costs	£0.87
Energy Costs	-
Replacement Costs	-
Maintenance Costs	-
Total financial costs	£0.87
Carbon and air quality costs	-
Total costs including carbon and air quality improvement	£0.87
<i>Tonnes of carbon saved (tonnes)</i>	-

Cost breakdown per dwelling

6.32 Two categories of ventilation improvement level are proposed by policy, category A and B, depending on the extent to which air permeability is expected to be reduced.

6.33 The two systems which will deliver the required ventilation improvements are:

- Natural ventilation system comprising 12 x 5000mm² background ventilators (slot-type in head of window), 1 x 15 l/s intermittent fan in bathroom, 1 x 30 l/s intermittent fan in utility room, reconfigure existing canopy in kitchen to duct to outside;
- Continuous mechanical ventilation comprising 7 x 5000mm² background ventilators, 1 x 8 l/s continuous extract in bathroom, 1 x 8 l/s fan in utility room, 1 x 13 l/s extract fan in the kitchen.

6.34 Different combinations of these systems can be used to achieve the categories of required ventilation improvement. The costs of these are as follows:

- Category A: £1,550 for natural ventilation or £1,480 for continuous mechanical ventilation per home.
- Category B: £1,320 for continuous mechanical ventilation per home.

6.35 **Note:** The lower cost for Category B is due to background ventilators being installed during window manufacture.

Benefit breakdown per dwelling

6.36 Increased ventilation leads to improved indoor air quality, which provides benefits in terms of reduced damp and mould, improved health and wellbeing and reduced remedial costs of repairing damp and mould damage. An estimated 3% of dwellings in Wales suffer from serious condensation/mould growth¹⁶. However, the evidence drawing a direct causal link between EEM, ventilation and health impacts because of

¹⁶ Wales Housing Conditions Survey, 2017-18

damp and mould is limited. Therefore, the benefits of improved ventilation (relative to the counterfactual) have not been quantified.

Number of EEM installed per annum requiring improved ventilation

6.37 To estimate the additional impact of the policy across all dwellings in Wales, the analysis assumes:

- Solid Wall Insulation will be the main energy efficiency measure (EEM) that could result in the need for improved ventilation;
- Data suggests that there were around 300 external wall installation projects in 2017/18 with no internal insulation works.
- The analysis assumes that 25%¹⁷ of these projects will require improved ventilation, split evenly between natural ventilation and mechanical ventilation.

¹⁷ Consultant's working assumption

7. Transition costs

- 7.1 Transition costs are incurred by businesses as a result of the time spent by their employees to familiarise themselves with the new technical requirements.
- 7.2 The familiarisation costs have been calculated using the process developed to estimate the impact of the changes to Part L, F and O in England, which was based on consultations with a small sample of organisations to identify time/cost likely to be incurred. The consultation identified:
- The types of organisations that will be affected by the changes;
 - The types of familiarisation activity (training courses, self-study, CPD);
 - Costs per organisation type;
- 7.3 The analysis then scaled up these costs across industry based on the number of organisations in Wales.
- 7.4 Familiarisation costs of £0.7m present value were calculated. Table 7.1 shows the components of this figure.

Table 7.1: Present Value of familiarisation costs for new and existing dwellings (£m)	
	Familiarisation Costs (£m)
Part L	0.258
Part F	0.017
Performance Gap	0.142
Overheating	0.095
SAP	0.174
Airtightness	0.015
Total familiarisation costs for domestic buildings	0.700

- 7.5 Table 7.2 shows the assumptions used to calculate the number of organisations that will need to become familiar with the changes.

Table 7.2: Familiarisation Assumption – number of organisations

	Energy Consultant	SAP Assessor	Heating/Ventilation installers	Main Contractor/Developer	Architect	Engineer - other	Engineer - energy modeller	Building Control
Numbers of organisations	165	171	1,865	25	400	452	10	26

7.6 Table 7.3 shows the assumptions used to calculate of the time required per organisation to become familiar with the changes.

Table 7.3: Time required per organisation (hrs)

	Energy Consultant	SAP Assessor	Heating/Ventilation installers	Main Contractor/Developer	Architect	Engineer - other	Engineer - energy modeller	Building Control
Part L	22.5	15	0	7.5	2.5	2.5	20	26.25
Part F	2	0	2	3.75	0	0	2	0
Performance Gap	2	0	0	0	2.5	2.5	8	26.25
Part O	7.5	0	0	3.75	3.75	0	8	15
SAP	26.25	7.5	0	0	0	0	2	0
Airtightness	2	0	0	3.75	0	0	12	0

8. Specific Impact Tests

Competition Assessment

New Buildings

- 8.1 The policy will impact on housebuilding sector and the section of the construction industry undertaking works on existing domestic buildings along with the supply chains for construction materials used in those projects.
- 8.2 As a result of higher standards, builders and installers would have to comply with the more stringent targets and as a result would see costs rise. As the increase in costs will affect all builders broadly equally, any competitive effects in the market in Wales are likely to be negligible.
- 8.3 The high standards assume some improvement in fabric and services specifications. If fabric energy efficiency had been improved in isolation, this could have given manufacturers of products which impact on fabric performance (insulation, windows) an advantage over those involved in manufacturing and supplying building services (e.g. boilers, lighting); however, this is not the case. Furthermore, flexibility is provided in a way that developers can meet the higher performance standards, which should ensure that no one product or manufacturer can dominate any part of the market.

Housing Supply

- 8.4 This policy is expected to result in increased build cost, which could deter constructors from building as many houses as it may not be possible to pass this cost onto the price of land. This would then have a negative impact on net additional housing.
- 8.5 We are also aware that the sector will not have had a long lead in time before this change is introduced and so it is unlikely that these costs will be factored into land purchases in the short run (especially where developers have already purchased sites for future pipeline developments).
- 8.6 As such, the short-term impact on housing supply viability may be slightly more volatile, but we also believe that the system as a whole is sufficiently robust to be able to absorb unanticipated costs in other ways. For example, developers have options to renegotiate their Section 106 or make changes to planning permissions to absorb these costs.
- 8.7 In the longer term it is likely that developers will offset higher costs with higher sales prices in areas of high demand

Innovation

- 8.8 Particularly with respect to raising the Part L standards, there should be the potential for new firms to enter the market due to the flexibility for builders and installers to choose building technologies to meet these standards. This should encourage innovation among manufacturers.

Small firms impact test

- 8.9 Most of the impacts of the policy should affect all contractors broadly equally, whether large or small.

- 8.10 Small businesses in the housing sector principally comprise builders, installers, architects, engineers and other technical specialists. The impacts of a change in building standards are likely to be most significant for builders as any change in costs will affect their cost of business. For other parties, impacts are most likely to comprise a short term need to understand and revise practices to reflect the new requirements, however this is unlikely to be above the level that would be typically expected as part of ongoing professional development.

Environmental impact assessment

- 8.11 The main assessment described in this report assess the impact on the environment.

Social impact assessment

- 8.12 Some health benefits are likely to derive from reduced energy use. Health and economic benefits are expected to derive from reduced overheating.
- 8.13 There are improvements in indoor air quality, and consequently occupant's health and well-being, from the proposed changes to Part F. Improved indoor air quality arises as a result of better air distribution between rooms and simplification of the guidance which should deliver greater compliance and reduce the risk of under-ventilation.
- 8.14 There are also potentially beneficial improvements in health and quality of life from the effect of increased energy efficiency on thermal comfort.

Rural impact assessment

- 8.15 Assessing rural impacts means determining whether the impacts on rural areas will be different to those for urban areas, and whether there are specific local or regional effects
- 8.16 The main difference for rural areas will be the removal of the fuel factors. These factors provide some relief to those not connected to the gas grid, mainly in rural areas. The fuel factor means that the carbon emissions target is increased for more carbon intensive fuels for heating fuel making it less demanding. However, this is not consistent with the Welsh Government commitment to address the Climate Emergency.
- 8.17 The result of removing the fuel factor will be an increase in build costs to build to higher fabric and/or service standards. It is likely that the result will be that most new homes off the gas grid will be built using low carbon heating. Industry have indicated that this is already the case for many new homes being constructed off the gas grid, which are using heat pumps rather than LPG or Oil.

9. Annex A: Scale up metrics

New build

9.1 The following tables set out the new-build scale-up figures used in this assessment:

- New build completion projections¹⁸
- Number of buildings affected by the transition period

Table 9.1: Total Number of New Dwelling Completions

	Per annum
Detached (CF)	2,700
Semi Detached (CF)	1,300
Terraced (CF)	1,000
Flats (Block) (CF)	44
Total Dwellings	6,400

Table 9.2: Transition Assumptions (% of new dwellings meeting standards)

	2022	2023	2024	2030	2031
BR2014	95%	50%	5%		0%	0%
BR2022	5%	50%	95%		100%	100%

Existing Dwellings

9.2 The following tables set out the existing dwellings scale-up figures used in this assessment:

Table 9.3: Total Number of New Projects

	Per annum
Extensions (CF)	7,200
Windows (CF)	7,700
Doors (CF)	9,700
TRV - group 1 (CF)	5,000
TRV - group 2 (CF)	2,100
Loft Conversions	1,400
Loft Conversions - insulation at rafter level	700
Conservatories - exempt	4,300
Conservatories - not exempt	4,300
Boiler Plus - load compensator	27,700
Boiler Plus - learning thermostat	27,700
Total Dwellings	1,431,500

¹⁸ These projections were prepared by Adroit Economics Ltd. They are intended for the purposes of this assessment only and do not represent house building forecasts by the Welsh Government. These projections were prepared on a similar basis to those prepared by Adroit Economics for the England Part L assessment.

9.3 Transition assumptions for existing buildings based on 6 months transition period, so assumes 50% of projects in 2022 will meet the proposed standard and 100% from 2023 onwards.

Table 9.4: Other Assumptions		
	Metric	Proportion of dwellings
Extensions	% of stock p.a	0.50%
Replacement external doors	% of stock p.a	2.50%
Replacement windows	% of stock p.a	2%
Boiler Replacements	% of stock p.a	5%
TRV – baseline % already installed	As % of boiler replacements	45%
TRV – % that will install under counterfactual	As % of boiler replacements	45%
TRV - group 1 - % already have some SRD fitted	As % of boiler replacements	7%
TRV - group 2 - % don't have any RD fitted	As % of boiler replacements	3%
Loft Conversions	% of stock p.a	0.1%
Conservatories	% of stock p.a	0.6%
Proportion of conservatories that are exempt (i.e. have thermal separate doors)	% of new conservatories	50.0%
Proportion of loft conversions with insulation at rafter level / flat roofs	% of loft conversions	50.0%
EWI projects with no internal wall insulation	Number per annum	300
% of EWI projects requiring additional background ventilation	% of EWI projects	25.0%

10. Annex B: Unit Cost Assumptions (New Build)

- 10.1 The costs are developed by AECOM cost consultants who are specialists in their field. The rates are based on their internal cost datasets, recent published cost data and information provided by suppliers.
- 10.2 The cost analysis is intended to reflect typical national costs from Q2 2019 that might be incurred by a medium sized housebuilder using traditional construction methods and with a reasonably efficient supply chain, design development and construction processes. However, costs incurred by individual organisations will vary according to their procurement strategies, the location of their activity and the detail of their housing product. Notwithstanding these variations, the proportional uplifts associated with moving from one specification to another are likely to be similar across different market segments
- 10.3 To provide context to the cost variations assessed in the study an indicative overall build cost (£ per m²) for each building archetype was estimated. However, it should be noted that the build costs should be taken as indicative only as it is sensitive to a wide range of design and specification variables in addition to the economies of scale and regional variations discussed previously.
- 10.4 Base costs for future years are those for the 2019 price year, and subject to adjustments for learning for technologies that have not yet reached a mature market position. It should be noted that construction costs can vary considerably and rapidly with market conditions, particularly where activity levels result in a change in the availability of skills and materials. In these situations, it is not unusual to see quite large (several percentage points) change in overall costs over a period of months.
- 10.5 Table 10.1 below includes details of the cost information used for each specification option, including any variations between building type, costs are only shown for those specifications that vary between the considered specification options.

Table 10.1: Unit Cost data for fabric elements that vary between the selected specifications

Element	Specification	Unit	£ per unit
External Wall, Plasterboard, blockwork, rigid PIR insulation board, cavity and brickwork	0.18 W/m ² .K	m ²	£184
	0.15 W/m ² .K	m ²	£196.50
Air Tightness	5m ³ /h.m ² at 50 Pa	m ² GIFA	-
	3m ³ /h.m ² at 50 Pa	m ² GIFA	£5 ¹⁹
Ground/Exposed Floor	0.13 W/m ² .K	m ²	£138
	0.11 W/m ² .K	m ²	£145
Roof	0.13 W/m ² .K	m ²	£166
	0.11 W/m ² .K	m ²	£170
Windows (Double Glazed)	1.4 W/m ² .K	m ²	£216
	1.3	m ²	£243
Waste-Water Heat Recovery	Vertical pipe system	Nr	£375
	Tray system	Nr	£1,150
Radiators (installed but excluding heating pipework)	Standard	Nr	£90
	Low temperature	Nr	£133
Roof mounted – photovoltaic panels	Fixed costs for systems <4kWp	Per installation	£1,200
	Variable costs for systems <4kWp	Per kWp installed	£800
	Variable costs for systems >4kWp	Per kWp installed	£1,200
Heat Source and storage	Condensing Gas Boiler 18kW	Nr	£2,103
	Condensing Gas Boiler 24kW	Nr	£2,602
	Hot water cylinder (200L)	Nr	£1,200
	ASHP	Nr	£6,000
Ventilation	Intermittent extract fan with trickle vents – houses	Nr	£597
	Intermittent extract fan with trickle vents - Flat	Nr	£448
	MVHR Unit	Nr	£1,712
	MVHR rigid ductwork - houses	m ² GIFA	£10
	MVHR rigid ductwork - Flat	m ² GIFA	£11

¹⁹ Additional cost over current policy