Regulatory Impact Analysis

Conservation of Fuel and Energy in New Dwellings

Proposed amendments to Building Regulations Part L and Technical Guidance Document L

26 July 2010
1. General Introduction

This Regulatory Impact Assessment (RIA) is concerned with proposals to amend the requirements of Part L (Conservation of Fuel and Energy) of the Second Schedule to the Building Regulations applicable to dwellings.

The Second Schedule of the Building Regulations 1997-2009 sets out the statutory minimum building standards and performance requirements that must be achieved by a new building when it is constructed. The Schedule is comprised of twelve distinct parts, classified A to M, which are primarily designed to ensure the safety and wellbeing of people in and around buildings. A Technical Guidance Document is published to accompany each of the various parts and it sets out how the legal requirements of each individual part can be achieved in practice.

The requirements of Parts A to M, and the associated technical guidance documents, are reviewed periodically by the Building Standards Section of the Department in light of evolving issues relating to the built environment and in response to developments and trends within the construction industry. The aim of Building Standards Section is to develop and promote a strong and evolving building code in support of quality construction and sustainable development.

The purpose of this RIA is to consider in detail the impacts, costs and benefits of the proposed changes to Part L (Conservation of Fuel and Energy) for dwellings. This RIA, together with draft copies of the proposed Part L amendment regulations and accompanying Technical Guidance Document L, will form the basis for a comprehensive three month public consultation process. It is intended that this process, taking due account of
submissions received, will enable the Department in conjunction with the Building Regulations Advisory Body, to recommend a final set of amended regulations to the Minister for the Environment, Heritage and Local Government for signature into law later this year.

2. Part L – Dwellings: Current Context

2.1 Current programme of change
Part L (Conservation of Fuel and Energy) of the Building Regulations sets out the statutory minimum standards of energy efficiency and carbon dioxide emissions that apply to a newly constructed building, a new extension to an existing building or an existing building undergoing a material alteration or a material change of use. Technical Guidance Document (TGD L) sets out how owners, builders, developers and designers can achieve compliance with Part L requirements in practice. Since 2008 separate volumes of TGD L have been published in respect of Dwellings and Buildings Other than Dwellings.

In 2007 the Government committed itself to a well publicised policy of upgrading the energy efficiency and carbon dioxide emissions requirements for newly built dwellings. This policy commitment, as introduced in the current Government’s first Programme for Government (June 2007) and further developed in subsequent policy decisions, involves three broad step changes as follows: -

(a) revision of the Building Regulations Part L (Conservation of fuel and energy) for dwellings to achieve a 40% improvement in requirements prescribed in 2005 in relation to energy efficiency and carbon dioxide emissions by 2007;
(b) a further revision of Part L requirements for dwellings to achieve a 60% improvement in the requirements for energy efficiency and carbon dioxide emissions (again relative to 2005 requirements) by 2010; and
(c) the ultimate aim of achieving a carbon neutral standard for dwellings by 2013.

The first step change has been fully achieved in practice in the form of the Building Regulations (Amendment) Regulations 2007 of 22 December 2007. These Regulations were later incorporated into the consolidated Building Regulations (Part L Amendment) Regulations 2008. The associated TGD L – Dwellings – 2008 also refers.

This Regulatory Impact Analysis is now concerned with proposals to achieve the second policy commitment referred to at (b) above. This will involve an amendment to the Building Regulations Part L / TGD L to provide for further improved minimum energy efficiency requirements and stricter limitations on carbon dioxide emissions for dwellings than is currently required under the Building Regulations 1997–2009.

A consultative document in relation to the final policy commitment on carbon neutrality for dwellings as referred to at (c) above will be published separately in the near future.

2.2 EU and International Commitments
Ireland has responded positively to the global challenges of climate change and energy sustainability. The National Climate Change Strategy 2007 - 2012 sets out the joint efforts required across all sectors of the economy to reduce Ireland’s greenhouse gas emissions in the Kyoto period 2008 to 2012, while also identifying additional measures likely to be significant to the achievement of further emissions reductions in the period to
2020. Overall, Ireland is committed to cutting its emissions by 13% on 1990 levels by 2020. This target will increase further if and when a proposed new global agreement on climate change is reached.

Complementary to this, the white paper on energy *Delivering a Sustainable Energy Future for Ireland* (2007) is focused on the twin strategies of accelerating the use of energy from renewable sources and maximising energy efficiency.
Table 1: Projected Residential Sector Energy Savings in 2020 as outlined in National Energy Efficiency Action Plan 2009 - 2013

<table>
<thead>
<tr>
<th>Description</th>
<th>GWh PEE¹</th>
<th>ktCO₂²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Regulations 2002 – Improved energy performance of residential buildings</td>
<td>1,015</td>
<td>266</td>
</tr>
<tr>
<td>Building Regulations 2008 – 40% Improvement on energy performance of residential buildings relative to 2002 building regulations</td>
<td>2,490</td>
<td>615</td>
</tr>
<tr>
<td>Building Regulations 2010 – 60% Improvement of residential buildings relative to 2002 regulations</td>
<td>1,100</td>
<td>272</td>
</tr>
<tr>
<td>Low Carbon Homes 2013 – 70% Improvement of residential buildings relative to 2002 building regulations</td>
<td>395</td>
<td>98</td>
</tr>
<tr>
<td>House of Tomorrow Programme – developer support for buildings exceeding existing building regulations</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Warmer Homes Scheme</td>
<td>170</td>
<td>42</td>
</tr>
<tr>
<td>Home Energy Saving Scheme – Improving current residential stock in Ireland</td>
<td>600</td>
<td>157</td>
</tr>
<tr>
<td>Smart Meter Installation – estimated efficiency gains among domestic users</td>
<td>690</td>
<td>120</td>
</tr>
</tbody>
</table>

¹ Giga-watt hours (GWh) of energy based on Primary Energy Equivalent (PEE).
² Kilo tonnes (kt) of Carbon dioxide (CO₂)
³ Part L – Conservation of Fuel and Energy - of the Building Regulations were amended in 2005 to provide for the Dwellings Energy Assessment Procedure (DEAP) calculation methodology. Throughout this document Part L 2005 is regarded as the benchmark year against which incremental improvements in energy performance requirements for dwellings are judged. However the actual energy performance requirements in 2005 remained the same as those specified in 2002 which explains the reference to 2002 in this table.
The white paper was followed by Ireland’s first National Energy Efficiency Action Plan 2009 – 2013 (May, 2009), which outlines specific measures to be pursued in the key sectors of the economy, including the transport, commercial, public, residential and energy services sectors. The measures proposed in relation to the residential sector are summarised in Table 1 above. Table 1 demonstrates the intended effect of the current proposals (highlighted in the table) in the context of the overall projected energy and CO₂ savings within the residential sector.

Finally, in terms of EU and international commitments, it is important to note that EU member states have recently adopted a recast version of the Energy Performance of Buildings Directive which entered into force with effect from 8 July 2010. The Directive, among other things, formally requires Member States to set minimum energy performance requirements for buildings and building elements. Minimum energy performance requirements should be set at cost-optimal levels in line with a framework methodology to be developed by the EU Commission and should be reviewed and updated to reflect technical progress at intervals not exceeding 5 years. Moreover, the Directive requires that all new buildings will be nearly zero energy buildings (i.e. buildings with a high energy performance where the very low amount of energy required should to a very significant extent be met from renewable sources including onsite or nearby sources) by 31 December 2020.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Number</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greener Homes Scheme</td>
<td>265</td>
<td>64</td>
</tr>
<tr>
<td>Eco-design for Energy-Using Appliances (Lighting)</td>
<td>1,200</td>
<td>210</td>
</tr>
<tr>
<td>Efficient Boiler standard</td>
<td>2,400</td>
<td>585</td>
</tr>
<tr>
<td>Sector Total</td>
<td>10,355</td>
<td>2,436</td>
</tr>
</tbody>
</table>
2.3 Residential Emissions in Ireland – Current Position

The primary source of information on national residential energy use is the Sustainable Energy Authority of Ireland’s (SEAI) report on *Energy in the Residential Sector* (2008). The following information is particularly relevant:

- In 2006 the total amount of primary energy\textsuperscript{4} used by the residential sector was 3,965 ktoe\textsuperscript{5}, an increase of 32% (1.8% per annum on average) on 1990.
- The residential sector’s share of total energy usage fell from 32% in 1990 to 25% in 2006 and was second only to the transport sector.
- In final energy terms, the residential sector’s total energy use was 2,990 ktoe equivalent to 23% of Ireland’s Total Final Consumption.
- With regard to CO\textsubscript{2} emissions the residential sector’s share of total emissions decreased from 35% in 1990 to 25% in 2006, despite actual CO\textsubscript{2} increasing by 9.8% to reach 11,896 KtCO\textsubscript{2}.

The residential sector continues to be a major source of energy consumption and, as a result, a significant source of CO\textsubscript{2} emissions. New housing represents an addition to the existing housing stock (1.9M units) and, over time, dwellings built now and in the coming years will represent an increasing proportion of the overall stock.

In a report commissioned by the Department, DKM Economic Consultants forecast that housing completions are expected to be

\textsuperscript{4} SEAI’s use of the term primary energy includes energy used to convert primary sources of energy into forms that are useful for the final consumer, for example electricity generation and oil refining. Final energy consumption refers only to the energy consumed directly by the end user.

\textsuperscript{5} Kilo tonnes of oil equivalent.
of the order of 10,000 per annum in 2010 and 2011.\textsuperscript{6} DKM expects housebuilding activity to increase significantly beyond this level as the economy recovers. Based on the DKM estimates for 2010 and 2011, the average level of housing completions over the five year period from 2007-2011 would be 33,350 per annum. This is considerably less than the record housing output levels seen at the height of the economic boom but is in line with the forecast of 36,400 units per annum suggested by the ESRI in its report \textit{Recovery Scenarios for Ireland} (May 2009).

Energy use and CO\textsubscript{2} emissions associated with the residential sector continue to be significant and measures to reduce their impact in both new and existing housing stock will continue to be an important component of Government energy and climate change policies.

3. Purpose and Objectives

The aim of the proposal to upgrade Part L of the Building Regulations is to raise energy performance standards in order to reduce both residential energy demand and CO\textsubscript{2} emissions.

The 2007 Programme for Government specifically provides for the introduction of “\textit{new national building standards in 2007 to ensure that new housing has 40\% lower heat energy demand than existing building standards and revise them again in 2010 to achieve a 60\% target in further years}”.

Energy and CO\textsubscript{2} emissions savings likely to accrue as a consequence of the proposals have already been factored into plans prepared to meet national targets set out in the \textit{National

4. **Options**

Three options have been identified: -

- **Option 1** - Do nothing

- **Option 2** – Provide information and education on a voluntary basis

- **Option 3** – Adopt mandatory measures

(A) **Option 1 – Do nothing**

Whilst there would be no additional costs associated with this option, there would be no benefits either. In addition, failing to address the impacts of the built environment on national climate change obligations would significantly undermine Government targets aimed at increasing energy efficiency and reducing CO₂ emissions. This would have adverse implications for sustainable development and would inevitably lead to necessary consideration by Government of alternative interventions to make up the resultant shortfall against existing commitments.

Moreover, the recast EU Energy Performance of Buildings Directive (2010/30/EU) which will enter into force later in 2010 specifically commits member states to continuously improving their building codes to ensure that energy efficiency requirements in buildings and building elements are pitched at cost-optimal levels and to work toward achieving low energy / low carbon standards for buildings by 2020. Thus failure to make reasonable progress at this point would simply be delaying the inevitable and adding to the store of commitments which must be achieved at a later date.
This is not considered a viable option.

(B) Option 2 - Provide information and education on improving energy efficiency

Raising stakeholder awareness levels through advice, promotion and education is a critical component in fostering best practice in environmental matters. In terms of energy efficiency and carbon emissions reduction methods the Government has been proactive across a broad range of policy measures in informing people about the importance of understanding and improving the energy efficiency performance of residential dwellings. Among the many initiatives currently in place are the following:

- The Building Energy Rating (BER) certification scheme was introduced for new dwellings in 2007 and for existing dwellings in 2009. Under this scheme the energy certification of a dwelling is mandatory whenever a dwelling is commissioned or offered for sale or rent. The purpose of the BER certificate is to enable prospective buyers or tenants to take the energy performance of a dwelling into account when deciding whether to avail of a particular property. The BER Certificate is accompanied by an Advisory Report, with recommendations for cost effective improvements to energy performance, allowing householders to plan for further improving the energy performance of the dwelling and saving money on their energy bills. Currently some 125,000 BER certificates for dwellings are in place (representing 6.6% of the total housing stock of 1.9m) and BER certificates are currently being issued at the rate of over 6,000 per month.

- Grant assistance under schemes funded by the Department of Communications, Energy and Natural Resources and administered by the Sustainable Energy Authority of Ireland
(SEAI) such as the Home Energy Savings Scheme for private homeowners and the Warmer Homes Scheme for lower income families. In addition, in 2009, the Department of Environment, Heritage and Local Government introduced a scheme to improve the energy efficiency of the stock of social houses owned by local authorities through the investment of €20 million to upgrade vacant houses, and apartment complexes, to achieve a minimum BER of C1, as well as a €5 million investment in a number of demonstration projects which will inform future energy efficiency improvement works.

- The ongoing *Power of One* Campaign has brought the message of the importance of energy efficiency to all consumers and has provided practical steps to help the public improve their own personal energy efficiency through small changes in behaviour and choices.

- Planning exemptions for renewable technologies in domestic dwellings (which enable the installation of certain exempted technologies, such as micro wind turbines, solar panels, heat pumps and biomass boilers to be installed on or within the curtilage of a dwelling, subject to certain conditions relating to siting, scale and operation) have been in place since 2007.

- Under the *Towards Carbon Neutral* programme, the Department of the Environment, Heritage and Local Government is sponsoring several Local Authorities and voluntary / co-operative housing associations to deliver as demonstration projects a number of sustainable energy-efficient housing developments in which homes will reach a minimum A2 Building Energy Rating; €10m has been allocated to support these demonstration projects on which
construction will commence within 2010. The projects will significantly advance the knowledge and experience base in the design, construction and use of high performing energy efficient housing, and promote wider awareness of the technologies involved.

- The Department of the Environment, Heritage and Local Government will continue to promote higher standards of energy efficiency in social housing. Best Practice Guidelines – “Quality Housing for Sustainable Communities 2007” – focus on promoting high standards in design, construction, environmental performance and durability. The Guidelines advocate that climate-sensitive design should take account of orientation, topography and existing site features, so as to control wind effects, while optimising natural light and solar gain. The Guidelines help optimise energy performance.

The above programmes have been very successful in setting the context for change in public perceptions of energy efficiency in buildings and in encouraging those stakeholders who are already committed to best practice and energy efficiency. However, in terms of newly built dwellings, there is no evidence to suggest that they have resulted in the mainstream adoption of building approaches which significantly exceed the current Part L requirements. While examples of low energy and low carbon dwellings in Ireland do occur the overall number is low in proportion to overall housing output. Thus, in isolation from other actions, information and education are not sufficient to achieve a reduction in domestic energy demand and reduced CO₂ emissions to the extent to which is required to meet Ireland’s national commitments for energy efficiency and carbon emissions reduction. For this reason, Option 2 must be considered as being
complementary to, rather than a substitute for, mandatory measures.

(C) Option 3 – Adopt appropriate mandatory measures

Given that Options 1 and 2 point to a clear need for further action across a wide range of fronts, the Building Regulations are considered the most appropriate vehicle for such action in relation to the built environment. Thus, this is the preferred option as it is the most effective method of delivering on the stated aims to reduce domestic primary energy consumption and CO₂ emissions as set out in Section 2.
The amended Building Regulations – Part L and associated TGD L – will stipulate that new dwellings can achieve the new standards by making provision for: -

- A 60% improvement in energy efficiency for new dwellings (relative to 2005 base year standards).
- A 60% reduction in CO₂ emissions (again relative to the 2005 base year standards).
- Effecting significant improvements in wall, roof and floor insulation levels backstop U values.
- Achieving higher performance levels in windows and doors backstop U values.
- Reducing air permeability backstop value.
- Providing clarification on the requirement for single unit development air pressure testing.
- Providing for more accurate thermal bridging heat loss calculation and specification.
- Deploying higher efficiency oil and gas boilers.
- Providing for minimum performance levels for the efficiency of biomass boilers.
- Providing for independent time control of space heating zones.
- Improvement of maximum elemental U values to apply to building fabric elements where an existing dwelling undergoes a material alteration or where an existing building undergoes a change of use to function as a dwelling.
5. Public Consultation

The proposed upgraded Part L requirements have been preceded by a comprehensive cross-departmental and inter agency consultation process involving close contact between this Department, the Department of Communications, Energy and Natural Resources, the Sustainable Energy Authority of Ireland (SEAI), the National Standards Authority of Ireland (NSAI), FÁS and local building control authorities.

The proposals have also been considered and reviewed at several meetings of the Building Regulations Advisory Body (BRAB), a statutory consultative body comprised of both private and public sector representatives who advise the Minister in relation to proposed changes to the building regulations.

Cognisance has been taken of feedback received from industry and the general public under an open public consultation process undertaken when Part L requirements were last upgraded in 2007. Part L 2010 revises and enhances the performance requirements set down in Part L 2007 without extending the overall range of requirements in place. As a result any supports already in place to facilitate compliance with TGD L 2007 will continue, subject to appropriate modification, to be useful supports for ensuring compliance with the proposed TGD L 2010. A list of the supports which have been put in place as result of consultation in relation to TGD L 2007 and the development of the proposed TGD L 2010 are as follows: -

- DEHLG/SEAI/Homebond’s “Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details”

- DEHLG/SEAI’s “Heating and Domestic Hot Water Systems for dwellings – Achieving compliance with Part L”
• NSAI’s Air tightness Testers Scheme

• NSAI’s Windows Energy Performance Scheme

• Technical Guidance Document F 2010 - Ventilation

• DEHLG/SEAI’s Installation and Commissioning of Ventilation Systems for Dwellings-Achieving Compliance with Part F (to be published)

• NSAI’s draft SR 50-2:2010 Code of practice for building services - Part 1: Domestic plumbing and heating (currently available for public consultation)

• NSAI’s draft SR 50-2:2010 Code of practice for building services - Part 2: Solar panels (currently available for public consultation)

The above suite of guidance materials and schemes was designed specifically in response to industry feedback which emphasised the importance of:

• Ensuring that the completed dwelling achieved the statutory performance requirements.
• Promoting adequate installation skills, product quality and standards, site supervision, effective building control and inspection systems, including air pressure testing of dwellings.
• Ensuring that upgraded air infiltration and ventilation requirements do not compromise health and safety and are properly linked with Part F and J of the Building Regulations.
• Complementary and integrated development of Part L requirements and the BER scheme.

The quarterly forum meeting convened by the NSAI and attended by officials from the DoEHLG, SEAI and FAS has greatly
improved public sector coordination and integration of the work jointly undertaken in support of quality construction.

A workshop on Delivering the Performance Requirements of Part L took place in Dublin Castle on 4 November 2008. The event, which was organised by the Sustainable Communities and Housing Committee, a joint venture between the DEHLG and the Royal Institute of the Architects of Ireland, invited regulators, professionals and industry representatives to work together to support implementation of the Part L 2008 requirements for dwellings at each stage from design through to construction and then certification of the completed dwelling.

A workshop for Building Control Officers on Improving Compliance with Part L and BER was run on 30 June 2010.

A review of Part F took place with a supporting TGD F document published in 2010 to ensure adequate indoor air quality and a supporting installation guide (to be published).

6. **Who will be affected by the proposed upgraded Part L requirements?**

The following stakeholders will be directly affected by the proposed Part L requirements: -

- Dwelling owners and tenants
- Building Professionals
- Developers and Builders
- Construction product/systems manufacturers
- Industry Suppliers
- Renewable energy system producers
- Building Control Authorities
While the proposed Part L requirements substantially improve the energy performance requirements for a new dwelling, designers, developers, builders and consumers have been left considerable discretion in choosing their own individual approach to achieving the overall standard required for compliance. In this way, no individual technology or system should or will be either favoured or disadvantaged. This will incentivise suppliers of building elements and components which have a significant impact on energy performance to innovative and adapt their existing products or develop new ones as the amended Part L /TGD L requirements should fully recognise the contribution of such products to reducing energy demand and CO₂ emissions.

Consumers should have the benefit of reduced energy bills and improved health and comfort.

The amended Part L /TGD L requirements should also contribute to achieving national CO₂ emissions reduction targets and thus help address Ireland’s international CO₂ commitments and renewable energy objectives under EU Directive 2006/32/EC on energy end-use efficiency and energy services.

7. Achieving Compliance in Practice

Nine typical dwelling types have been chosen as representative of the range of residential dwellings in use in Ireland. These have been modeled in DEAP and are summarized in Table 2. The Maximum Permitted Energy Performance coefficient and Maximum Permitted Carbon Performance Coefficient (MPEPC and MPCPC) to be achieved are 0.40 and 0.46 respectively.
For any given floor area, detached dwellings are less energy efficient, due to the extra exposed area (typically 4 walls, floor and roof), and apartments are more energy efficient with smaller exposed areas (typically 2 walls) than semi-detached dwellings. Semi-detached dwellings, therefore, with exposed surface areas comprising typically of 3 walls, floor and roof, usually represent the average in terms of energy use.

The performance levels specified for parameters specified in TGD L 2010 are in the nature of backstop minimum performance levels so as to ensure reasonable levels of performance for all factors affecting energy use, irrespective of the measures incorporated to achieve compliance. In the examples given in Table 2 it is necessary to exceed the backstop values given in TGD L 2010 in order to achieve compliance in DEAP.

The models given are modelled with 5m$^3$/hr/m$^2$ air permeability and natural ventilation. It is also possible to model these dwellings with other ventilation systems such as Mechanical Ventilation with Heat Recovery (MVHR) and lower levels of air permeability.

The renewable energy technology provision is met with the use of solar thermal collectors for domestic hot water and in one case solar thermal collectors and a biomass stove. This provision can also be met through using other renewable technologies e.g. solar photo-voltaic systems, biomass systems, systems using biofuels, heat pumps, aerogenerators and other small scale renewable systems.

U values used in opaque building elements are lower than the backstop values specified in TGD L 2010 e.g. 0.14 W/m$^2$K in
model vs. 0.21 W/m²K backstop for walls. These can be achieved through the use of internal insulation and/or external insulation. Guidance on methods of construction for achieving these U values can be found in Appendix B of TGD L 2010 or in the Agrément Certificates or equivalent for building products and systems.

U values used for windows are for high performance double glazed units or triple glazed units. These U values range from 1.3 W/m²K to 0.9 W/m²K. The backstop U value for opes at 25% of floor area is 1.6 W/m²K. Certified U values for windows can be found from the NSAI Window Energy Performance Scheme (WEPS) website or equivalent.

U values used for doors are at 1.5 W/m²K. Increased availability of doors with certified U values on the market will facilitate the achievement of improved energy performance coefficients.

The thermal bridging parameter used varies from 0.05 to 0.08. This can be achieved by calculating the actual thermal bridging loss for the specific dwelling. Psi values for specific junctions based on traditional constructions with internal insulation and external insulation are published in Appendix D of TGD L 2010 for a range of U values. It is intended that these psi values be used for calculating actual thermal bridging loss for specific dwellings for the range of U values given. Psi values can also be obtained from Agrément certificates or equivalent for building products or from certified values from a proposed Thermal Modellers scheme.

Energy efficient circulation pumps are specified for heating water circulation. There is currently a default of 130kWh/yr in DEAP. It is assumed that this can be improved to 90kWh/yr by
using a user defined value as certified by the Europumps Energy Plus\textsuperscript{7} pumps project.

While the greater exposed surface area in detached houses may make reducing heat loss more expensive than for a semi-detached or an apartment, where perhaps only 2 exposed walls exist, it is unlikely that the overall costs of compliance will be significantly different. In general, detached dwellings are afforded greater design flexibility to improve energy efficiency and reduce CO$_2$ emissions. They can utilise the low cost measures such as orientation, glazing areas and locations and also capitalise on passive solar gain.

\textsuperscript{7} See www.europluspumps.eu for further information.
### Table 2 – Table of dwellings achieving compliance with TGD L 2010

<table>
<thead>
<tr>
<th>Dwelling ID</th>
<th>Detached</th>
<th>Semi-Detached</th>
<th>Terrace</th>
<th>Apartments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Note</td>
<td>Bungalow</td>
<td>Det 2st small</td>
<td>Det 2st large</td>
</tr>
<tr>
<td>Terraces</td>
<td>Dwelling ID</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Num stores</td>
<td>Num fans/ventilation</td>
<td>Natural Ventilation with 3 or more fans, No Chimney, No draught Looby included, No sides sheltered</td>
<td>Natural Ventilation with 3 or more fans, No Chimney, Draught Looby included, No sides sheltered</td>
<td>As for Semi-Detached</td>
</tr>
<tr>
<td>Total floor area</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terraces</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Ground floor</td>
<td>Fabric</td>
<td>Door &amp; area</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Wall</td>
<td>Area</td>
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<td></td>
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<tr>
<td>Roof</td>
<td>Area</td>
<td></td>
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<td>Windows</td>
<td>Area</td>
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<td></td>
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<tr>
<td>Compliance when gas fired boiler used</td>
<td></td>
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<td></td>
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<tr>
<td>Compliance when oil fired (91.3% efficient gas boiler replaced with 94% efficient oil boiler)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Table Notes:**
- **Fabric Door:**
  - Area: 1.85, 1.85, 1.85, 1.85, 1.85, 1.85
  - **Thermal bridging parameter:**
    - 0.06, 0.05, 0.05, 0.05, 0.06, 0.05
  - **Area of solar collector, m²:**
    - 4.3m², 320 l cyl, 100mm insul
    - 5.6m², 300 l cyl, 100mm insul
    - 6.5m², 300 l cyl, 100mm insul
    - 6.5m², 320 l cyl, 100mm insul
    - 6.5m², 360 l cyl, 100mm insul
    - 4.3m², 300 l cyl, 100mm insul
    - 5.5m², 320 l cyl, 100mm insul
    - 6.5m², 360 l cyl, 100mm insul
    - 4.3m², 300 l cyl, 100mm insul
    - 3m², 200 l cyl, 100mm insul
    - 4.0m², 300 l cyl, 100mm insul
    - 3m², 200 l cyl, 100mm insul
    - 4.0m², 300 l cyl, 100mm insul

- **Light use:**
  - Living area fraction: 0.25, 0.25, 0.20, 0.31, 0.25, 0.24, 0.29, 0.43, 0.33
  - **Responsiveness category:**
    - 11, 11, 11, 11, 11, 11, 11
  - **Central heating pump efficiency:**
    - 11, 11, 11, 11
  - **Primary circuit loss:**
    - 360, 360, 360, 360
  - **Light energy light proportion %:**
    - 100, 100, 100, 100
  - **Pir area fraction:**
    - 0.25, 0.25, 0.25, 0.31
  - **Efi:**
    - 0.1, 0.1, 0.1, 0.1
  - **Pir control category:**
    - 3, 3, 3, 3
  - **Responsiveness category:**
    - 1, 1, 1, 1
  - **Central heating pump efficiency:**
    - 11, 11, 11, 11
  - **Oil boiler - pump or gas boiler flue fan:**
    - 1, 1, 1, 1
  - **Btf efficiency of main htg system:**
    - 0.9, 0.9, 0.9, 0.9
  - **Efficiency of sec htg system:**
    - 0.9, 0.9, 0.9, 0.9
  - **Main htg fuel:**
    - Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas
  - **Main htg fuel:**
    - Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas
  - **Main htg fuel:**
    - Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas, Gas

- **Compliance when gas fired boiler used:**
  - **CPC:**
    - 0.60, 0.60, 0.60, 0.60, 0.60, 0.60, 0.60, 0.60, 0.60
  - **EPC:**
    - 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57

- **Compliance when oil fired (91.3% efficient gas boiler replaced with 94% efficient oil boiler):**
  - **CPC:**
    - 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57
  - **EPC:**
    - 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57, 0.57
8. Key Costs and Benefits of the Proposed Amended Building Regulations

This Section will identify the costs and benefits of the common methods of complying with the proposed Regulations. In national terms, the proposed regulations will result in a greater reduction in the demand for energy and a reduction in annual CO₂ emissions than would otherwise be the case. The cost of building a house to the new standards will also increase (affecting developers/builders and the state in terms of social housing investment) while savings in energy costs will accrue to the occupants over the lifetime of a dwelling.

The energy performance of a dwelling is dependant on a range of design and construction choices and the performance of each individual element of the dwelling (walls, roofs, floors, windows, heating system, etc). To achieve the overall requirement of a 60% reduction in primary energy use and in CO₂ emissions over Part L 2005 a variety of measures and combinations of these methods may be used. Designers, developers, builders and consumers have the freedom to choose whatever combination of elements they wish to incorporate in a dwelling (as long as the work is carried out in accordance with the legislative codes applying to the construction industry and, most notably, the Building Regulations). As it is impractical to explore the cost of every potential design option and element, we will concentrate in this section on Model 6 in Table 2 above i.e. a 126m² semi-detached house approximating the average energy use and CO₂ emissions of Irish dwellings, to illustrate costs associated with measures required to show compliance with the proposed Regulations.
Table 3 below lists some of the methods that reduce the demand for energy. The additional costs are given for each measure. The elemental costs are based on a costing exercise performed by DEHLG and estimates from industry. Costs can vary considerably on new products, installation etc and are therefore indicative rather than definitive. In the medium term, as measures become more commonly used within the domestic construction sector, market forces are expected to drive down these costs. Costs include material and installation costs. Because we are comparing against the Part L 2005 requirements (on which the Programme for Government commitments are based) it is necessary to discount the costs and benefits associated with the 40% improvement in energy and CO₂ performance already in place since 2007 in order to isolate the true impact of the additional proposals now being considered.

**Table 3 – Additional costs associated with proposed Part L / TGD L 2010 requirements**

<table>
<thead>
<tr>
<th>Element or System</th>
<th>Specification of Dwelling – 60% Improvement over Part L 2005</th>
<th>Extra Cost over Part L 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling Size and Shape</td>
<td>Semi detached 2 storey house. Overall internal dimensions: 7m wide x 9m deep x 5.1m high. Total floor area 126m². Rectangular shape with no irregularities.</td>
<td>2160</td>
</tr>
<tr>
<td>Opening areas (Windows &amp; doors)</td>
<td>25% of total floor area. The above includes one opaque door of area 1.85m², any other doors are fully glazed.</td>
<td>126</td>
</tr>
<tr>
<td>Walls</td>
<td>U = 0.15 W/m²K eg 150mm Cavity wall with 100mm Cavity insulation of conductivity 0.022W/mK &amp; 50mm Insulated Board</td>
<td>358</td>
</tr>
<tr>
<td>Roof</td>
<td>U = 0.14W/m²K eg 340mm insulation of conductivity .04W/mK between &amp; over joists</td>
<td>400</td>
</tr>
<tr>
<td>Floors</td>
<td>U = 0.15 eg slab-on-ground floor with 110mm insulation of conductivity 0.023W/mK</td>
<td>1,000</td>
</tr>
<tr>
<td>Opaque door</td>
<td>U = 1.5W/m²K</td>
<td>Double glazed low E (En= 0.05, soft coat) 20mm gap, argon filled, PVC frames (U = 1.3 W/m²K, solar transmittance = 1,000</td>
</tr>
</tbody>
</table>
Allowance for Thermal Bridging at junctions 0.05x total exposed surface area. (W/m2K) 650
Air permeability Infiltration due to structure 0.25ac/h (5m3/m2/h) 2000
Chimneys None -1,000
Draught Lobby One at Front Door 2,000
Boiler Mains gas condensing boiler, seasonal efficiency 91%, room-sealed, fanned flue 425
Solar Water heating system with flat plate collector of aperture area= 6.0m2, n=0.8, a=5.0W/m2K, facing SE/SW at 30 degrees and unshaded, twin coil cylinder 300 litre with 75 mm insulation.
Remainder of demand met by space heating boiler, separate time control for space and water heating, cylinder temperature controlled by thermostat 6,000
Hot Water System Primary water heating systems Insulated primary pipework between boiler & cylinder 100
Gas fire, closed front, 80% efficiency, fan assisted balanced flue. 200
Low Energy Light Fittings 100%
TOTAL EXTRA COST 14419
Extra Cost to Achieve 40% improvement in TGD L 2007 RIA 10,375
Extra cost to achieve 60% improvement over 2007 4,044
Total Cost (including VAT 21% for materials, 13.5% for services) 4,863

As a result of these measure the average dwelling will save the energy equivalent of 30kWh/m² per annum – see table 4 below. Based on current fuel prices this will result in savings of €134 per dwelling per annum.
Table 4 – Net effect of proposed Part L / TGD L 2010 requirements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Primary Energy Consumption per unit area per dwelling per annum</td>
<td>150kWh/m²</td>
<td>90kWh/m²</td>
<td>60kWh/m²</td>
<td>30 kWh/m²</td>
<td>60%</td>
</tr>
<tr>
<td>Average CO₂ emissions per unit area per dwelling per annum</td>
<td>30kg/m²</td>
<td>18kg/m</td>
<td>12kg/m²</td>
<td>6kg/m²</td>
<td>60%</td>
</tr>
</tbody>
</table>

In CO₂ emissions terms, the annual saving will be 6kg/m². In order to assess the overall effect of this contribution towards our National Climate Change Strategy commitments, we must consider the total number of dwellings being built – see Table 5 below. Based on ESRI projections for housing output up to 2030, Table 5 shows the projected cumulative annual savings in CO₂ emissions that will result from the accumulating level of housing stock that it is anticipated will be built to the new Part L / TGD L requirements. It is assumed that only a small number of publicly funded social houses will be built to the new standards in 2011 and that 50% and 70% of new dwellings will be built to the new requirements in 2012 and 2013 respectively. A further discount equivalent to 8% of annual housing output has been applied to take account of the growing interest in low energy houses (which will occur regardless of regulatory change) and a level of non-compliance with regulatory requirements.
Table 5: Projected Cumulative Annual Savings in CO₂ Emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>Dwellings meeting new Regulations</th>
<th>CO₂ emission reductions (tonnes) Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>200</td>
<td>126</td>
</tr>
<tr>
<td>2012</td>
<td>14,223</td>
<td>8,944</td>
</tr>
<tr>
<td>2013</td>
<td>33,850</td>
<td>21,297</td>
</tr>
<tr>
<td>2014</td>
<td>61,881</td>
<td>38,950</td>
</tr>
<tr>
<td>2015</td>
<td>89,912</td>
<td>55,904</td>
</tr>
<tr>
<td>2016</td>
<td>125,076</td>
<td>87,898</td>
</tr>
<tr>
<td>2017</td>
<td>160,241</td>
<td>100,952</td>
</tr>
<tr>
<td>2018</td>
<td>195,406</td>
<td>123,105</td>
</tr>
<tr>
<td>2019</td>
<td>230,570</td>
<td>159,379</td>
</tr>
<tr>
<td>2020</td>
<td>265,735</td>
<td>145,259</td>
</tr>
<tr>
<td>2021</td>
<td>298,662</td>
<td>167,413</td>
</tr>
<tr>
<td>2022</td>
<td>331,589</td>
<td>188,517</td>
</tr>
<tr>
<td>2023</td>
<td>364,516</td>
<td>208,901</td>
</tr>
<tr>
<td>2024</td>
<td>397,443</td>
<td>229,645</td>
</tr>
<tr>
<td>2025</td>
<td>430,371</td>
<td>250,389</td>
</tr>
<tr>
<td>2026</td>
<td>463,298</td>
<td>271,133</td>
</tr>
<tr>
<td>2027</td>
<td>496,225</td>
<td>291,878</td>
</tr>
<tr>
<td>2028</td>
<td>529,152</td>
<td>333,366</td>
</tr>
<tr>
<td>2029</td>
<td>562,079</td>
<td>354,110</td>
</tr>
<tr>
<td>2030</td>
<td>595,006</td>
<td>374,854</td>
</tr>
</tbody>
</table>

This gives a cumulative reduction by 2020 of some 145,000 tonnes of CO₂ emissions and of some 375,000 tonnes by 2030.

9. Other Impacts

Impact on construction industry skills level

The improvement of energy performance of dwellings will require an improvement in skills levels for both designers and constructors. DEAP assessors will also need to update their knowledge of TGD L 2010. The following section considers the current capacity of the construction and education sector to provide these skills.
**Design professionals**

Third level institutions are currently providing levels 7, 8 and 9 energy and sustainability related courses for construction professionals. Professional Bodies and other Continuing Professional Development organisations are also providing additional training for existing professionals. Over 6,000 persons with construction related qualifications have completed the DEAP training course and some 530 persons with a minimum of level 7 qualification are trained to apply the Non-domestic Energy Assessment Procedure (NEAP) methodology.

**Construction Trades**

There is a requirement for constructors to pay specific attention to the construction of junctions in order to achieve reduced air permeability levels and thermal bridging heat loss. Whilst improvements in these areas do not require additional material costs, an increased level of awareness and attention to detail will be required on site.

The following training and supports are in place to facilitate the development of the required additional skills: -

- FÁS training schemes for air tightness and thermal bridging onsite skills
- Integration of revised Part L guidance into apprenticeship courses in Institutes of Technology
- Upskilling courses for existing trades through FÁS and the Institutes of Technology
- NSAI has recently put in place a certification scheme for air tightness testers and also for certifying the energy performance of windows i.e. Window Energy Performance Scheme (WEPS)
• DEHLG/SEAI/Homebond Acceptable Construction Details are available for use on site

• A Thermal Modellers certification scheme is being put in place by NSAI and DEHLG. This will be referenced in Paragraph 1.3.3.2(iii) of the proposed TGD L 2010. This scheme will provide a mechanism for certifying the use of improved construction details designed to reduce Thermal Bridging, thus achieving better results for Part L purposes and indeed for BER certification purposes

• Key junctions are detailed and psi values are specified on Agrément certificates for building systems certified by NSAI/IAB

• DEHLG are working with industry representative groups to further enhance skills levels in this area

With regards to building services trades the following supports are in place: -

• Upskilling courses for existing trades through FÁS and Institutes of Technology

• Renewables training modules from FÁS

• NSAI’s Plumbing and Heating Code of Practice (currently available for public consultation)

• DEHLG Heating and Domestic Hot Water-A guide to achieving compliance with Part L 2008(to be revised for 2010)

• Technical Guidance Document F 2010

• DEHLG/SEAI’s Installation and Commissioning of Ventilation Systems for Dwellings-Achieving Compliance with Part F (to be published)

Impact on Supply Chain
A good supply of energy efficient construction materials will be required to achieve improved energy performance requirements.
The current slowdown in the construction industry will give suppliers time to adjust to meet changing future demand for materials, components and fabric elements.

The proposed new Part L requirements will bring the statutory minimum energy efficiency performance standards for dwellings to the forefront of mandatory national energy performance standards in Europe. As previously mentioned, the Recast EPBD requires all member states to have nearly zero energy buildings by 2020. By moving early to upgrade its national requirements, the Government recognises the opportunity that exists for manufacturers of construction products to gain a competitive advantage in providing improved energy performance construction materials and products to other countries in Europe.

The minimum performance level for boilers has been increased from 86% to 90% which equates to A-rated boilers as defined on the HARP database.

Article 13 of the EU Renewables Directive (2009/28/EC) requires that residential biomass boilers have a gross efficiency of 85%. When converted to the net efficiency measure used in Ireland this equates to 77% as listed on the HARP8 database.

**Impact on National Competitiveness**
There will be no negative impact on Ireland’s competitiveness. If anything, the amended Building Regulations are likely to encourage Irish business and industry to develop new innovative energy saving products and systems for use in dwellings. This will provide opportunities to reduce the need to import such technologies and may provide export opportunities in future years.

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8 Home-heating Appliance Register of Performance (HARP) maintained by SEAI.
The contribution towards the achievement of national CO₂ emissions reduction targets and the reduced dependence on imported energy will improve the overall efficiency and competitiveness of the Irish economy.

The new energy performance standards will bring Ireland to the forefront of the energy performance standards for dwellings across EU member states. U values for fabric building elements in Ireland will be amongst the most advanced in Europe⁹. Ireland will thus become an early user of innovative high-energy performance construction products and building elements in the mainstream economy. The amended Building Regulations are likely to encourage Irish business and industry to develop new innovative energy-saving products and systems for use in dwellings. This will provide opportunities to reduce the need to import such technologies and may provide export opportunities in future years. The learning and experience associated with the mass market deployment of innovative products will itself have the potential to be a marketable commodity. In this respect the amended Building Regulations complement and support the broader innovation and green economy strategic development policies currently being pursued by Government under the Building Ireland’s Smart Economy policy framework.

**Consumer Impacts**
As discussed above, there will be additional costs of €4,863 incurred in achieving compliance with the amended Building Regulations. However, in return for this upfront investment the consumer will enjoy the benefit of reduced fuel bills and more affordable warmth. Over the lifespan of a dwelling, the savings in

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energy and fuel bills will more than offset the additional costs incurred in achieving compliance.

Consumers are also protected against future possible escalation in energy costs.

The additional attention to detail required in construction of a house to the new performance standards will lead to a general improvement in construction quality.

In addition to direct consumer benefits, indirect non-energy benefits will be obtained e.g. reduced noise levels (due to better insulation and higher performance windows).

**Compliance Burden on Third Parties**

It is not anticipated that there will be any additional compliance burden on third parties other than the additional conformity-checking burden the amended Building Regulations will impose on Building Control Authorities. It is anticipated that any additional costs arising can be met from within existing budgets.

**Impacts on the Rights of Citizens**

There are no impacts on the rights of citizens arising from the amended Building Regulations.

**Impact on the Socially-Excluded or Vulnerable Groups**

The upgraded regulations will have a positive impact on socially excluded or vulnerable members of society. The main benefit will be reduced fuel and energy bills for future occupants of social housing built to the proposed TGD L 2010 performance standards. In this respect it is worth noting from SEAI’s report on *Energy in the Residential Sector* (2008) that lower income groups spent on average 13% of their disposable income on energy in 2004-5 compared to an overall average of 3.6% while
the highest earners spend 1.7%. The new regulations therefore represent a potential saving equivalent to approximately 2.5% of disposable income for lower income groups.

Quality of life improvements will also apply in the form of improved thermal comfort of dwellings and a lessening of the risk of hypothermia in the elderly.

10. Enforcement and Compliance
Under Irish law, the responsibility for compliance with the Building Regulations lies with the owner or developer as appropriate. Enforcement of the Regulations is the responsibility of the 37 local Building Control Authorities under the Building Control Act 1990.

SEAI will upgrade their Dwellings Energy Assessment Procedure (DEAP) software to accommodate the new Part L / TGD L requirements when finalised. They are also considering how the reporting facility in DEAP can be improved to accommodate use by Local Authorities for compliance checking.

The Window Energy Performance rating system recently introduced by NSAI and the HARP database maintained by SEAI will assist compliance with the requirements in relation to windows and boilers respectively.

A Thermal Modellers scheme is currently being considered by the Department in conjunction with NSAI with a view to providing a pool of accredited persons who can calculate psi values thereby encouraging builders to innovate in order to meet and exceed the new energy performance requirements.
Although air permeability tests are currently required, the significance of this test increases as the airtightness requirements increase and the introduction by NSAI of a robust accreditation scheme for Air Tightness Assessors is a welcome development which will greatly assist industry’s ability to demonstrate compliance with the new requirements.

11. Review

A number of houses have already been built in Ireland to specifications which compare favourably with the proposed new requirements.

The Department, in conjunction with building control authorities will work closely with all concerned in order to ensure a smooth transition to the new regulatory requirements.

As previously indicated, the Government is already committed to further upgrading the requirements of Part L for dwellings in the context of achieving a carbon neutral standard for dwellings by 2013. This will provide a suitable opportunity for reviewing the effect of the current proposals in practice prior to considering future approaches to the critically important area of the conservation of fuel and energy in dwellings.
Appendix A: Achieving Compliance with respect to EPC and CPC

The following table gives a set of specifications which are calculated to achieve compliance for a typical 126 m² semi-detached house. Compliance with this requirement could also be achieved by a number of other combinations of measures.

<table>
<thead>
<tr>
<th>Table E1 Example Dwellings</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| **Dwelling size and shape** | Semi-detached house, two-storey  
Overall internal dimensions: 7 m wide x 9 m deep x 5.1 m high  
Total floor area 126 m²  
Rectangular shape with no irregularities |
| **Opening areas (windows and doors)** | 25% of total floor area  
The above includes one opaque door of area 1.85 m², any other doors are fully glazed |
| **Walls** | U =0.14 W/m²K  
e.g. 150mm cavity wall with 100mm cavity insulation of thermal conductivity 0.022 W/mK and 50mm insulated board of conductivity 0.022 W/mK |
| **Roof** | U = 0.12 W/m²K  
e.g. 340 mm insulation of conductivity 0.04 W/m K, between and over ceiling joists |
| **Floor** | U = 0.14 W/m²K  
e.g. Slab-on-ground floor with 110 mm insulation of conductivity 0.023W/m K |
| **Opaque door** | U = 1.5W/m2K |
| **Windows and glazed doors** | Double glazed, low E (En = 0.05, soft coat) 20mm gap, argon filled, PVC frames  
(U = 1.3W/m²K, solar transmittance = 0.63) |
| **Living area fraction** | 25% of total floor area |
| **Shading and orientation** | All glazing oriented E/W; average overshading |
| **Number of sheltered sides** | 2 |
| **Allowance for thermal bridging at element junctions** | 0.05x total exposed surface area (W/m²K) |
| **Internal heat capacity category** | Medium |
| **Ventilation system** | Natural ventilation with intermittent extract fans |
| **Air permeability** | Infiltration due to structure = 0.25 ac/h |
| **Chimneys** | None |
| **Open flues** | None |
| **Extract fans** | 3 |
| **Draught lobby** | One |
| **Primary heating fuel (space and water)** | Mains gas |
| **Heating system** | Boiler and radiators with energy efficient water pump in heated space |
| **Boiler** | Mains gas condensing boiler, seasonal efficiency 91.3%, room-sealed, fanned flue |

<table>
<thead>
<tr>
<th>Table E1 (contd...) Example Dwellings</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heating System Controls</strong></td>
<td>Time and Temperature Zone Control</td>
</tr>
</tbody>
</table>
Hot water system

Solar water heating system with flat plate collector of aperture area = 5.5 m², \( n_0 = 0.6 \), \( a_1 = 3.0 \text{ W/m}^2 \text{ K} \), facing SE/SW at 30 degrees and unshaded, twin coil cylinder 320 litre with 100 mm insulation

Remainder of demand met by space heating boiler, separate time control for space and water heating, cylinder temperature controlled by thermostat

Primary water heating losses

Insulated primary pipework between boiler and cylinder

Secondary space heating

Gas fire, closed front, fan assisted, balanced flue – efficiency 80%

Low energy light fittings

100%

E.2 The standardized primary energy consumption and CO₂ emissions for space heating, water heating, ventilation and lighting for this dwelling, as calculated by DEAP, are given in Table E2, expressed per m² of floor area per annum. The table shows that the calculated EPC complies with the MPEPC requirement of 0.40, and the CPC complies with the MPCPC requirement of 0.46 with a margin to spare.

If the boiler ran on heating oil rather than mains gas, and the secondary heater on bottled LPG, with a boiler efficiency of 94%, the dwelling would still comply. The results for running the boiler on heating oil and the secondary heater on bottled LPG are also shown in the Table E2.

<table>
<thead>
<tr>
<th>Table E2</th>
<th>Example Dwelling - Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dwelling heated by mains gas</td>
</tr>
<tr>
<td>Primary energy [kWh/m² yr]</td>
<td>61</td>
</tr>
<tr>
<td>CO₂ emissions [kg/m² yr]</td>
<td>12</td>
</tr>
<tr>
<td>EPC</td>
<td>0.40</td>
</tr>
<tr>
<td>CPC</td>
<td>0.38</td>
</tr>
</tbody>
</table>
Appendix B – References


Economic and Social Research Institute Recovery Scenarios for Ireland – An Update (Summer 2010). Available from www.esri.ie


SEAI Domestic Fuels Comparison of Costs 1April 2010 www.seai.ie


SEAI Harp Database www.seai.ie