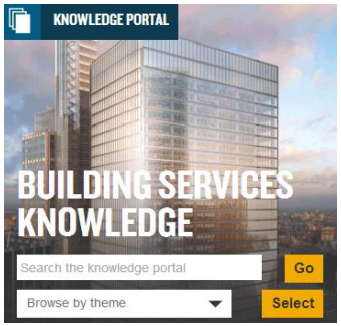
CIBSE REPUBLIC OF IRELAND

CIBSE
Engineering a sustainable built environment

Why join CIBSE

CIBSE Journal + App & Electronic Newsletter



CIBSE Societies

ILEVE – Improving workplace air quality

The Society of Light and Lighting

Society of Façade Engineering

The Society of Public Health Engineers

Networking Opportunities

FORUM

Special Interest Groups

WiBSE

YEN

BIM

CPDs all around Ireland

Social events:

- Golf Luttrellstown Castle September 7
- CIBSE Ireland Dinner & Awards 30th November Burlington hotel
- CIBSE Ireland YEN 5-A-Side- May 31, 2018

CIBSE IRELAND

Student awards DIT & WIT

SDAR Journal

Standards Development: NSAI

Regulations Development


CIBSE
IRELAND
50
YEARS
1968-2018

CIBSE Ireland awards (part of CIBSE Dinner) Sponsored by

These awards are open to the design consultant and mechanical or electrical contractor
Submissions must be a joint entry by both the consultant and contractor.
There are three categories for the CIBSE Ireland Awards,
These are:—
Up to €2 million
Between €2 million and €5 million
Over €5 million
The categories are based on services cost e.g. mechanical or electrical

Completed submissions must be received by no later than **12pm on Friday, 27th July 2018**. You will receive an acknowledgement of receipt by return.

Pre-submission enquires must be received by 13th July 2018 and no later than 2pm.

The awards will be presented as part of the CIBSE Ireland 50th dinner celebrations in the Clayton Burlington Hotel, Burlington Road, Dublin 4 on Friday, 30 November 2018.

Project Summary:

Provide a synopsis of the project, You can include details of the client brief, design and installation details (500 words maximum).

Overall design approach and solutions:

Detail how the design team approached the project and decided on the solutions to the building services installation.

You may include interactions with other members of the design team to fulfil the correct interpretation of the client brief, e.g. interaction with the architectural team (500 words maximum).

Specific elements of excellence in design implementation:

Detail how design was brought to life by the mechanical and/or electrical contractors in terms of taking the design, adapting it (where applicable), how the challenges of certain aspects of the design/installation were overcome by the design and contracting team (500 words maximum).

Project delivery:

Provide details such as project timelines, budget plan throughout and the challenges related to this. You should also submit evidence of how the design and contracting team worked together to implement project delivery on time and within budget. (500 words maximum).

Highlight the project's key performance indicators:

Detail how the tendered design was brought to reality and where applicable, altered to improve the key performance indicators. This section can compare design stage, as-built energy performance targets, commissioning results etc. (500 words maximum).

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CIBSE
IRELAND
50
YEARS
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Nearly Zero Energy Buildings

and the revised Irish Part L of the Building Regulations

Eoin Doohan BE CEng MCIBSE
Principal Mechanical Engineer, AECOM Dublin

May 29th, 2018

Agenda

- Background to NZEB in Ireland
- Non domestic buildings
- Domestic buildings
- Schools
- Summary
- Questions, Answers and Discussion

AECOM In Ireland

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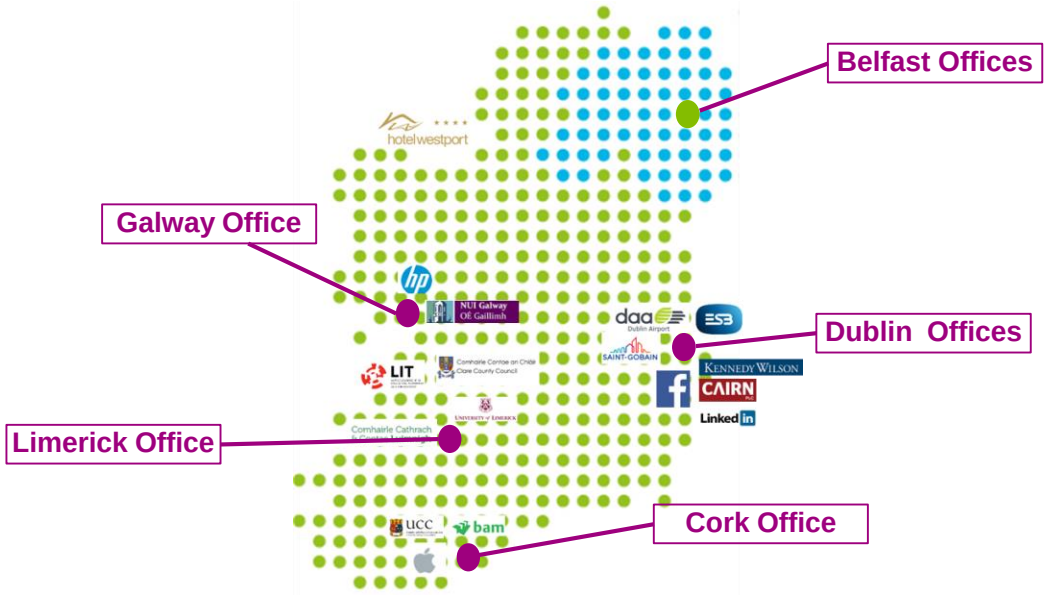


1

2

4

3

Business Lines

1. Buildings & Places
2. Resources & Industry
3. Environment
4. Civil Infrastructure

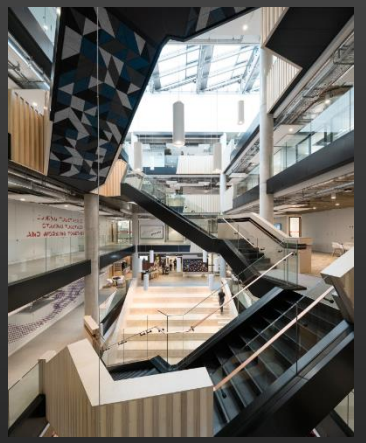
92,000
Staff Globally

500+
Staff in Ireland

5 Offices
In Ireland

Curragh Racecourse Redevelopment

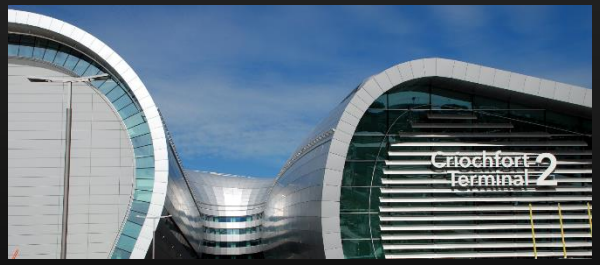
Dublin Landings



LinkedIn EMEA HQ

AECOM Imagine it. Delivered.

Project Opera, Limerick



Dublin Airport Capacity Development

Central Bank of Ireland

Background to NZEB in Ireland

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What is NZEB?

– Nearly Zero Energy Buildings
  - ‘Nearly zero-energy building’ means a building that has a very high energy performance…The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby’

    - From article 2.2 of the Energy Performance of Buildings Directive (EPBD)

Energy Performance of Building Directive (EPBD)

- Main European legislative instrument to improve energy performance of buildings
  - Original released in 2002 (Directive 2002/91/EC)

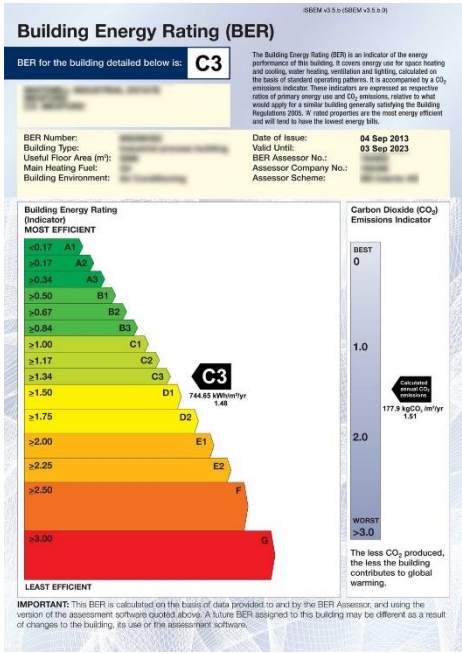
- Directive 2010/31/EU (recast)

- Article 4: Member States must set minimum energy performance requirements for new buildings, for the major renovation of buildings, and for the replacement or retrofit of building elements

- Article 9.1: 'Member States shall ensure that by 31st December 2020, all new buildings are nearly zero-energy buildings and after 31st December 2018, new buildings occupied and owned by public authorities are nearly zero energy buildings'

Energy Performance of Building Directive (EPBD)

- Establishment of a calculation methodology for energy performance
- Minimum energy performance requirements
- Established energy performance certificates for buildings
  - Mandatory display for buildings offered for sale or rent
- Establish inspection schemes for heating and air conditioning systems
- Draw up lists of financial measures to improved energy efficiency of buildings

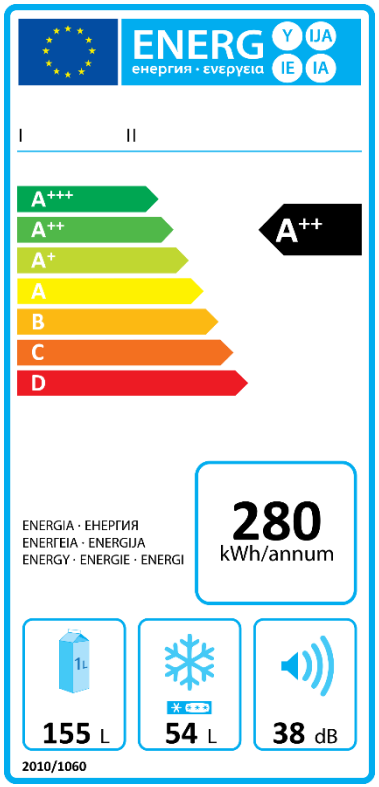


Other Legislation

– Energy Efficiency Directive (2012/27/EU)
  - Establish long-term national building renovation strategies
  - Make energy efficient renovations to at least 3% of buildings owned and occupied by central government
  - Governments should only purchase buildings which are highly energy efficient
  - Retail energy sales companies to achieve energy savings of 1.5%

– Ecodesign Directive (2009/125/EC)
  - Minimum mandatory requirements for energy efficiency of products
  - Expanded in 2009 to include all energy related products (ErP)

– Energy Labelling Directive (2010/30/EU)
  - Framework for labelling regarding energy consumption

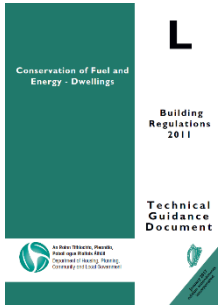


Ireland Implementation Timeline

- January 2017: Interim NZEB Specification for Public Sector buildings
  - New buildings owned and occupied by Public Authorities after 31st December 2018 must be NZEB

- December 2017: Part L of the Building Regulations 2017 for buildings other than dwellings
  - Work, material alteration or the change of use commences or takes place on or before 31st December 2018
  - Where planning approval or permission for buildings has been applied for on or before 31st December 2018, and substantial work has been completed by 1st January 2020

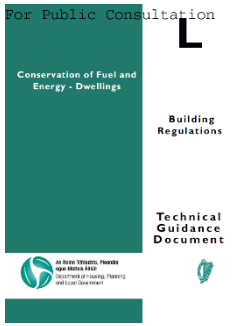
- February 2018: TGD-033 “School Building Projects and Compliance with Part L of the Building Regulations 2017”

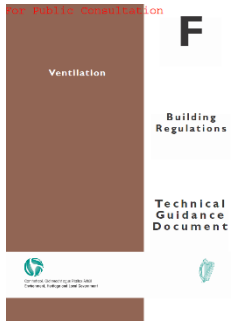


Ireland Implementation Timeline

- January 2017: Part-L 2011 for Dwellings (amended)
  - For information only

- April 2018: Part L of the Building Regulations 2018 for Dwellings issued for public consultation
  - Work, material alteration or the change of use commences or takes place on or before 31st March 2019
  - Where planning approval or permission for buildings has been applied for on or before 31st March 2019, and substantial work has been completed by 31st March 2021
  - Part F (Ventilation) also revised
  - Public consultation closes Friday 8th June 2018





How are the Regulations Derived?

- EPBD Annex I: Principle of Cost Optimality
  - AECOM 2013 reports on behalf of the SEAI for domestic and non domestic installations
  - Approx. 60% reduction in primary energy

- EU Commission 2016 Guidelines Oceanic Region
  - Offices: 40-55 kWh/(m^2.y) of net primary energy with, typically, 85-100 kWh/(m^2.y) of primary energy use covered by 45 kWh/(m^2.y) of on-site renewable sources
  - New single family house: 15-30 kWh/(m^2.y) of net primary energy with, typically, 50-65 kWh/(m^2.y) of primary energy use covered by 35 kWh/(m^2.y) of on-site renewable sources

Cost Optimality

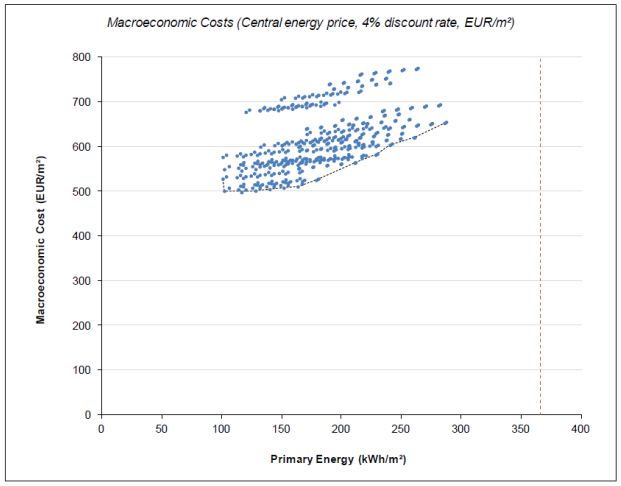


Figure 6.1c: Results of the cost-optimal analysis (Office (AC), Macroeconomic costs, 4% discount rate)

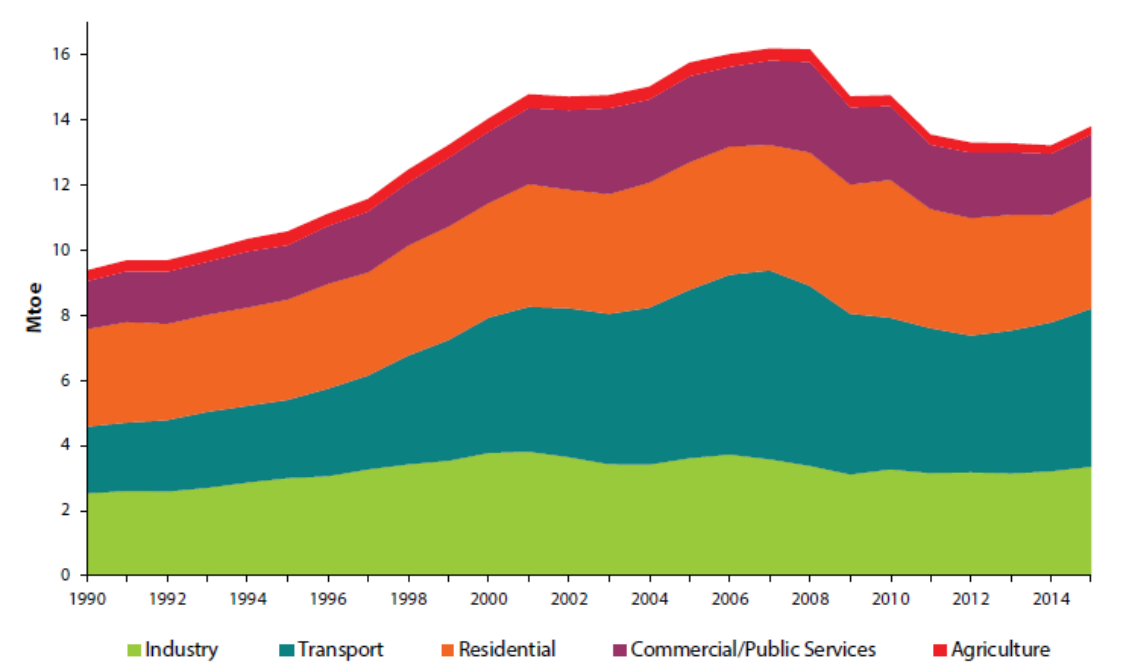
Table 6.1: Economic Optimal Energy Performance Level in Primary Energy

Reference building	*Primary Energy (kWh/m²/yr)*	*Sensitivity Range(kWh/m²/yr)*
Retail (Air Conditioned)	239	227-338
Office (Natural Ventilation)	52	35-103
Office (Air Conditioned)	102	101-179
School (Primary – Natural Ventilation)	55	8-80
Hotel (Air Conditioned)	284	243-330

Table 7.1: Comparison Table

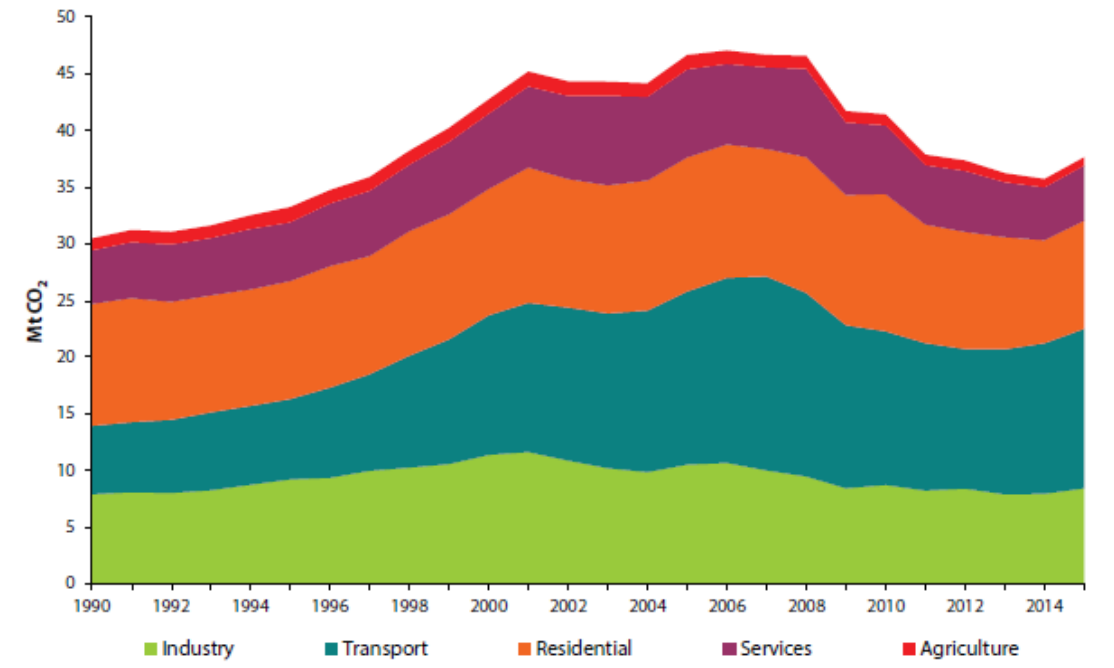
Reference building	*Cost Optimal Level (kWh/m²/yr)*	*Current Requirements(kWh/m²/yr)*	*Ratio of current requirements and cost optimal level*
Retail (Air Conditioned)	239	726	The current requirements are more than 15% greater than cost optimal
Office (Natural Ventilation)	52	247	
Office (Air Conditioned)	102	366	
School (Primary – Natural Ventilation)	55	111	
Hotel (Air Conditioned)	284	507	
Average	146	391	

Building Energy Consumption in Ireland



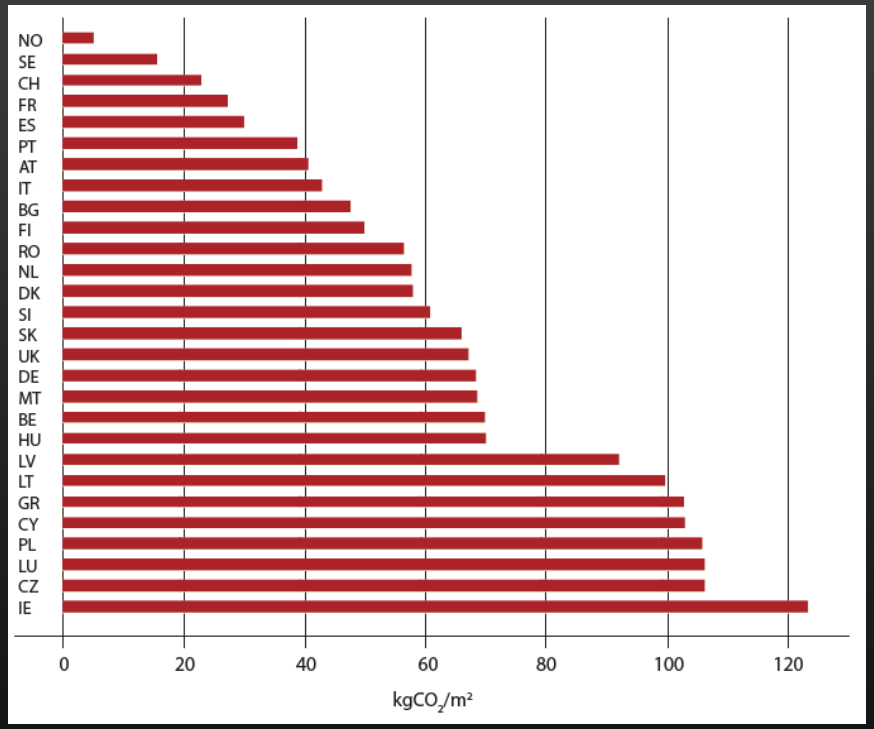
Primary energy demand by sector in Ireland
Source: SEAI

Building Energy Consumption in Ireland



Energy related CO2 by sector in Ireland
Source: SEAI

Building Energy Consumption in Ireland



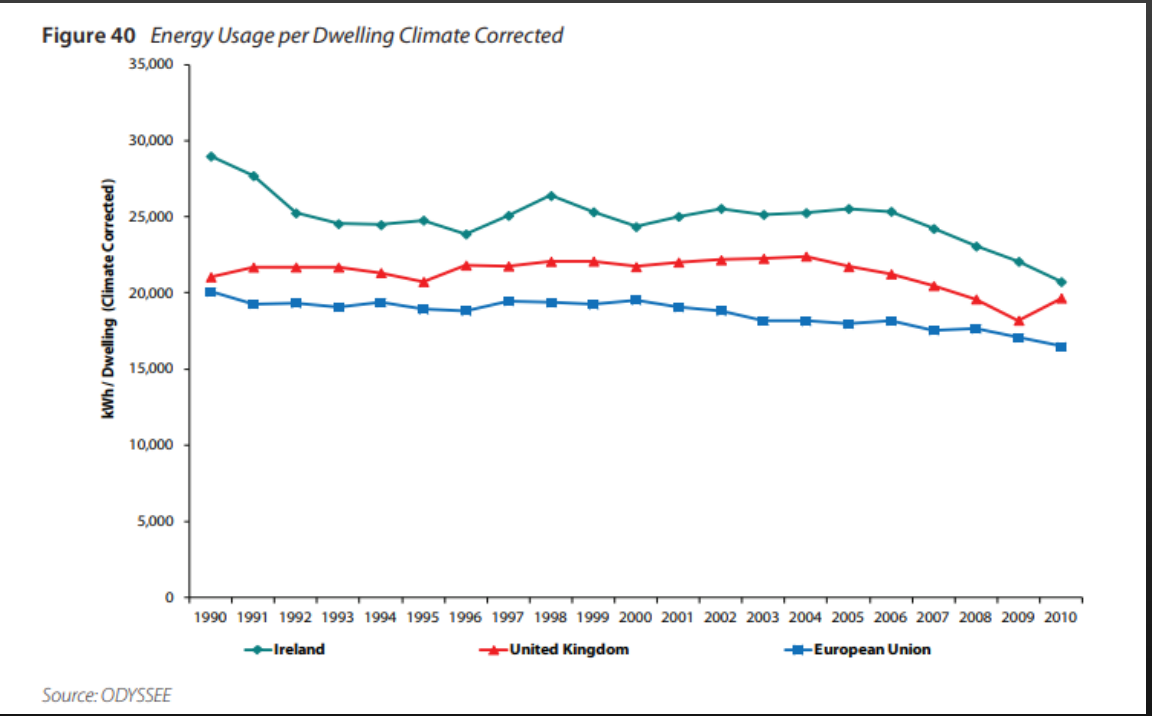
CO2 emissions per useful floor area

Source: BPIE survey, Eurostat database 2011

Building Energy Consumption in Ireland

Half of Irish dwellings are less than 30 years old, which makes it the youngest dwelling stock in Europe.

In dwelling energy usage in 2010, Ireland was 5% above the UK and 26% above the EU-27 average (compared to 36% above in 2006) (SEAI 2013)



Energy Usage per Dwelling Climate Corrected
Source: ODYSSEE

NZEB & Non Domestic Buildings

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Building Fabric / U Values / Part L 2008 Recap

- Elemental Method
  - Max average elemental U Values as per table 2
  - Max Area of openings as per table 3

- Overall Heat Loss Method
  - Max Average U Value based on building Area:Volume ratio as per table 1
  - Subject to different max elemental U values

Table 2 **ELEMENTAL HEAT LOSS METHOD: Maximum average elemental U-value (W/m^2K)**

Fabric Elements	New Buildings & Extensions to Existing Buildings	Material Alterations to, or Material Changes of Use of, Existing Buildings
Pitched roof, insulation horizontal at ceiling level	0.16	0.35
Pitched roof, insulation on slope	0.20	0.35
Flat roof	0.22	0.35
Walls	0.27	0.60
Ground Floors	0.25	-
Other Exposed Floors	0.25	0.60
External personnel doors, windows and rooflights	2.20[1]	2.20
Vehicle access and similar large doors	1.5	-

NOTE 1: Permitted average U-value of external personnel doors, windows and rooflights in buildings other than dwellings may vary as described in Paragraph 1.2.3.2.

Table 3 **ELEMENTAL HEAT LOSS METHOD Maximum area of openings for average U-value of 2. (W/m^2K)**

Building type	Windows and doors as % of the area of exposed wall	Rooflights as % of area of roof
Residential buildings (where people temporarily or permanently reside)	30	20
Places of assembly, offices and shops	40	20
Industrial and storage buildings	15	20

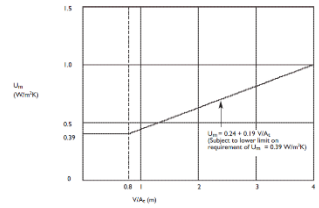
NOTES:
1 For the purposes of this calculation, dormer windows in a roof may be included in the rooflight area.
2 Opening area excludes area of openings for vehicle access doors and display windows and similar glazing.

Table 1 **Maximum average U-value (U_m) as a function of building volume (V) and fabric heat-loss area (A_t)**

Area of Heat Loss Elements/ Building Volume (A_t/V) (m^{-1})	Maximum Average U-Value (U_m) (W/m^2K)
1.3	0.39
1.2	0.40
1.1	0.41
1.0	0.43
0.9	0.45
0.8	0.48
0.7	0.51
0.6	0.56
0.5	0.62
0.4	0.72
0.3	0.87

NOTE 1: The expression $U_m = 0.24 + 0.19\ V/A_t$ can be used to establish U_m for intermediate values of A_t/V and for values below 0.3 m^{-1}.

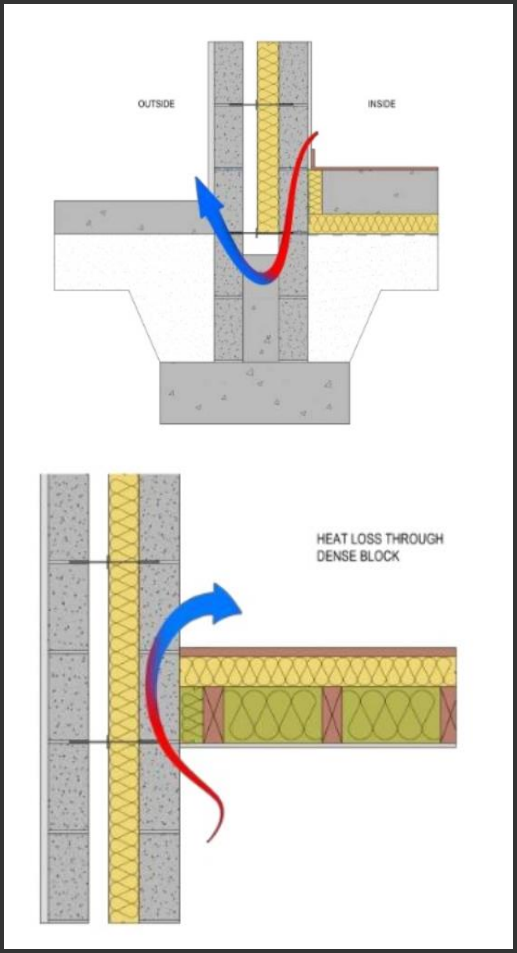
Diagram 1 *Para 1.2.2.1*
Maximum average U-value (U_m) in relation to building volume (V) and total area of heat loss elements (A_t)



Building Fabric / U Values

	Part L 2017		Part L 2008	
Building Element	Area Weighted Elemental U Value W/m^2.K	Max Average Elemental U Value W/m^2.K	Maximum Average Elemental U Value W/m^2.K (Elemental Method)	Max Average Elemental U Value W/m^2.K (Overall Heat Loss Method)
Pitched Roof	0.16	0.3	0.16	0.25
Flat Roof	0.2	0.3	0.2	0.37
Wall	0.21	0.6	0.27	0.37
Ground Floor	0.21	0.6	0.25	0.37
Other Exposed Floor	0.21	0.6	0.25	0.37
Door, Window, Rooflight	1.6	3.0	2.2	NA
Curtain Walling	2.8	3.0	NA	NA
Swimming Pool Basin	0.25	0.6	NA	NA

– Principle of ‘Reasonable Provision’ provides flexibility
  - Roof, wall and floor element heat loss same as if area weighted figures used



Thermal Bridging

- Thermal Bridging Transmission Heat Loss Coefficient (H_{TB}) generally needs to be calculated

- 3 options
  - Use DHPLG Acceptable Construction Details
  - Use certified details e.g. NSAI / Agrément approved or BRE database
  - Use alternative details and default NEAP figures
    - Generally less beneficial in overall calculations

Air Tightness

- Air tightness testing mandatory
  - Min. value of 5m^3/m^2/hr @ 50Pa
- More emphasis on design and construction stage
  - Identify appropriate air barrier elements
  - Develop appropriate details
  - Establish responsibility for construction of details
  - Establish on site inspection regime / quality control procedures

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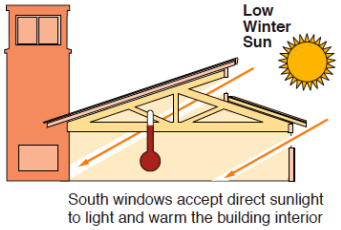
Solar Overheating

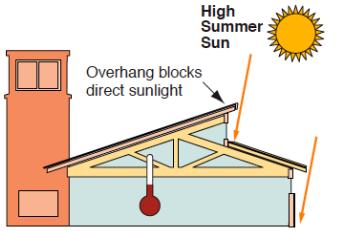
– Restrictive 25W/m^2 no longer applies

– Reference glazing systems provided
  - East facing
  - Full width glazing to a height of 1m
  - g value of 0.68
  - Frame factor of 10%

– Calculated from April to September

– CIBSE TM 52 overheating assessment ‘recommended’





Building Services

- More stringent heat generator efficiencies
  - 93% for boilers >70kW
  - 86% for boilers <70kW
- Heat pumps must meet EcoDesign directive efficiencies
- Defined minimum controls / BMS for various heating systems
- Maximum specific fan power (SFP) reduced for various systems
  - 1.6W/l/s for centralised heating and cooling systems (excl. heat recovery etc.)
- All motors > 1.1kW should have variable speed drives

Building Services

– Air handling unit leakage classification of minimum L2

– Cooling system efficiencies as per EcoDesign directive

– Minimum control requirements for ventilation systems
  • BMS required for all systems > 70kW effective rated output

Lighting

– Minimum controls as per Part L 2008
  - Manual switches (>6m to switch)
  - Daylight sensing switching / dimming
  - PIR's
  - Time controls

– Minimum standards for efficacy
  - Lower efficacies acceptable with better controls

Table 8 Lighting Efficacy with controls in new buildings		
General lighting in office, industrial and storage spaces		Initial luminaire lumens/circuit watt
		60
Controls Column 1	Control Factor Column 2	Reduced luminaire lumens/circuit-watt[1] Column 3
(a) daylight[2] space with photo-switching with or without override	0.90	54
(b) daylit[2] space with photo-switching and dimming with or without override	0.85	51
(c) unoccupied space with auto on and off	0.90	54
(d) unoccupied space with manual on and auto off	0.85	51
(e) space not daylit dimmed for constant illuminance	0.90	54
a + c	0.80	48
a + d	0.75	45
b + c	0.75	45
b + d	0.70	42
e + c	0.8	48
e + d	0.75	45
General lighting in other types of space		The average initial efficacy should be not less than 60 lamp lumens/circuit watt
Display lighting		The average initial efficacy should be not less than 22 lamp lumens/circuit watt

[1]In calculating the reduced luminaire lumens/circuit-watt for each luminaire the Initial luminaire lumens/circuit watt is multiplied by the appropriate control factor.

[2]The zones for which daylighting controls can be applied are described in NEAP zoning rules

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Non Domestic Energy Assessment Procedure (NEAP)

- EPBD 2002/91/EC Article 3 mandated methodology to calculate energy performance in Buildings
- NEAP Introduced in Part L 2008
  - Heavily based on UK National Calculation Methodology
  - Uses ‘Simplified Building Energy Model’ as developed by BRE
- NEAP calculates Primary Energy Performance Coefficient (PEPC) and Carbon Performance Coefficient (CPC)
- ‘Reference Building’ with defined fabric details, efficiencies etc.
  - EPC & CPC = 1.0
- Part L defines maximum figures for EPC and CPC for ‘actual’ building

Non Domestic Energy Assessment Procedure (NEAP)

Parameter	Reference Values TGD L 2017	Reference Values TGD L 2008
Total Floor Area and Building Volume	Same as actual building	Same as actual building
Opening Areas	Side lit :Exposed facades will have windows with area that is the lesser of either: 1.5m high × full facade width OR 40% of exposed facade area Top Lit:12% of exposed roof area will be made up of roof-lights	Offices and Shops –windows and pedestrian doors are 40% of the total area of exposed walls
Walls	U=0.18 W/m^{2}K	U=0.27 W/m^{2}K
Roofs	U=0.15 W/m^{2}K	U=0.16 W/m^{2}K
Floor	U=0.15 W/m^{2}K	U=0.25 W/m^{2}K
Thermal bridging	Actual Length of Key Junctions x Advanced Ψ value	Add 16% to fabric heat loss
Window U Value	Side lit: 1.4 W/(m^{2}K) Top lit: 1.6 W/(m^{2}K)	2.2 W/(m^{2}K)
Solar energy and Light transmittance	Side lit: 0.40 Top lit: 0.71	0.72
Air Permeability	5m^3/(hr.m^2) Floor area <250m^2 3m^3/(hr.m^2) Floor area >250m^2	10m^3/(hr.m^2)

Non Domestic Energy Assessment Procedure (NEAP)

Parameter	Reference values TGD L 2017	Reference values TGD L 2008
Heating efficiency (heating and hot water)%	91% Gas Boiler	0.73 CoP
Cooling Seasonal Energy Efficiency Air conditioned building Ratio (SEER / SSEER)	4.5 / 3.6	SEER=1.67
Cooling where applicable (mixed mode) (SSEER)	2.7	-
Lighting	65 lm/circuit watt	divide the illuminance by 100, then multiply by 3.75 W/m^2 per 100 lux
Occupancy Control	Yes (Manual-On-Auto-Off)	Local Manual Switching
Daylight Control	Yes (photo-electric dimming without back sensor control)	Local Manual Switching
Central Ventilation SFP	1.8 W/(l/s)	2 W/(l/s)
Variable speed control of fans	Yes	No
Renewable Energy Ratio	20% using photovoltaics	None

Renewable Energy Ratio (RER)

- Primary Energy from Renewable Sources : Total Primary Energy
  - Determined by NEAP
- Renewable Sources = Solar Thermal / Solar Photovoltaic / Biomass Systems / Biofuel Systems / Heat Pumps / Combined Heat and Power / Aerothermal / Geothermal / Hydrothermal / Wind / Biomass / Biogases
- Minimum RER of 20% with Maximum Permitted EPC of 1.0 and CPC of 1.15
- Minimum RER of 10% with Maximum Permitted EPC of 0.9 and CPC of 1.04
- CHP systems sized in accordance with CIBSE AM 12 – Combined Heat and Power in Buildings

Commissioning and Construction Quality

- On site quality control of insulation installation, air barriers and thermal bridges
- Air tightness testing mandatory
- Ductwork leakage testing mandatory on high pressure ductwork
- Systems should be adequately commissioned to meet design requirements
- Commissioning plan required at design stage
- Adequate Operation and Maintenance manuals now a Building Regulation requirement

Solutions / Challenges

- How Renewable Energy Ratio will be met
  - Achieving RER with PV difficult on larger / high rise buildings
- CHW and LPHW options to meet high spec office requirements
- Revised NEAP not yet issued – currently using interim measures
- Reduce primary energy – less primary energy, less renewables
  - Mixed mode and natural ventilation

Existing Buildings

– New building U values apply to extensions

– Material alterations have revised U values (applies to new works only)

Building Element	Area Weighted Elemental U Value W/m^2.K	Max Average Elemental U Value W/m^2.K
Pitched Roof	0.16	0.35
Flat Roof	0.25	0.35
Cavity Wall	0.55	0.6
Other Wall	0.35	0.6
Curtain Wall	1.8	1.8
Door, Window, Rooflight	1.6	3.0
Ground Floor	0.25	0.6

Existing Buildings

– Material change of use requires minimum U values for all building elements if they exceed threshold

Building Element	Area Weighted Threshold U Value W/m².K	Area Weighted Elemental U Value W/m².K	Max Average Elemental U Value W/m².K
Pitched Roof	0.16	0.16	0.35
Flat Roof	0.35	0.25	0.35
Cavity Wall	0.55	0.55	0.6
Other Wall	0.55	0.35	0.6
Curtain Wall	3.6	1.8	1.8
Door, Window, Rooflight	3.6	1.6	3.0
Ground Floor	0.45	0.45	0.6
Other Exposed Floor	0.6	0.25	0.6

Existing Buildings

- Use ‘Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details’ among other requirements

- Boiler efficiencies for extended systems must meet new system efficiencies

- Controls must be upgraded to minimum standards

- Minimum specific fan powers for new and extended systems
  - e.g. 2.2W/l/s for ventilation systems with heating and cooling

- Lighting as per new building requirements

Major Renovations

– >25% of the surface area of building envelope undergoes renovation
  - Cladding external surface
  - Dry lining internal surface
  - Replacing windows
  - Excludes painting / replastering

– Performance of entire building improved to ‘Cost Optimal’ levels
  - Upgrading oil / gas heating systems >15 years old
  - Upgrading direct electric heating controls
  - Upgrading cooling systems >15 years old
  - Upgrading lighting systems >15 years old OR systems with efficacy < 50lms/W

Major Renovations

– Alternatively meet Primary Energy Performance as per Table 13
  - Calculated using NEAP
  - Min Part L 2008 Office: 360 kWh/m^2/yr
  - Min Part L 2008 School: 110 kWh/m^2/yr

Table 13 Whole Building Cost Optimal Level	
Building Type	**Major Renovation - Cost Optimal Performance kWh/m^2/yr** primary energy
Retail Air Conditioned	338
Office Natural Ventilated offices and other Buildings	124
Office Air Conditioned	180
Hotel Air Conditioned	342
Schools	60
Other Air Conditioned Buildings	338
Other Naturally Ventilated Buildings	124

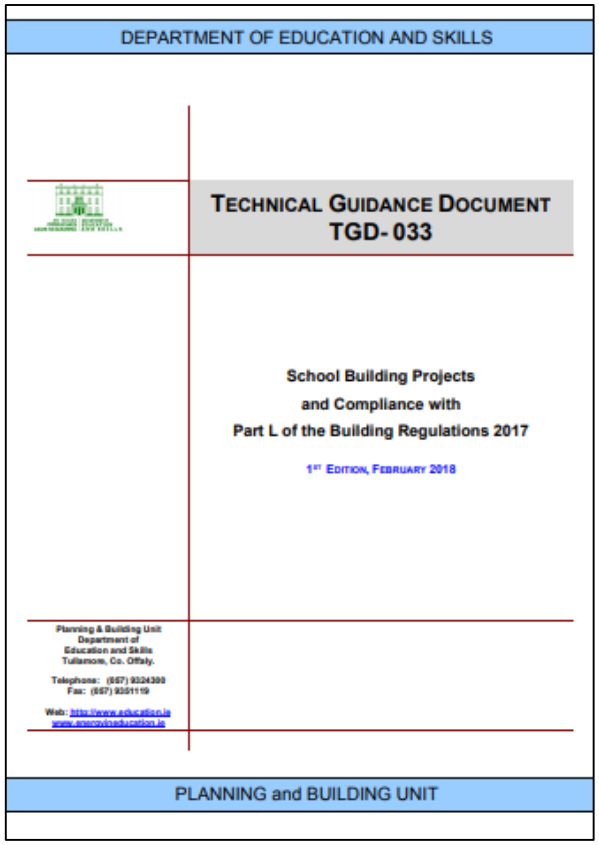
NZEB & Schools

AECOM

Technical Guidance Document TGD-033 for Schools

– First edition released February 2018

– Covers new buildings and buildings with planning permission already granted / projects in architectural design



Technical Guidance Document TGD-033 – New Schools

- MPEPC < 0.9
- 10% on site renewables from photovoltaics
- Potential for biomass via ESCO
- Infiltration < 3$m^3/m^2/hr$
- Backstop U Values
  - Roof 0.16 W/m^2K
  - Floor 0.21 W/m^2K
  - Glazing 1.4-1.6 W/m^2K
  - Wall 0.21 W/m^2K
- SBEM being revised based on Irish school data

Technical Guidance Document TGD-033

- Planning permission already granted / projects in architectural design
  - Fabric and infiltration backstops to be used
  - LED lighting

- Major Refurbishments: Cost Optimal
  - Boilers and Controls >15 yrs old
  - General Ventilation Systems > 15 yrs old
  - Lighting Systems > 15 yrs old
  - PV to be ‘considered’

Technical Guidance Document TGD-033

– Traffic Light System for Ventilation

Carbon Dioxide (CO_2) Traffic Light Display Indicator Ranges Optimum Range <1500ppm		
Green	Amber	Red
<1500ppm	1500 to 2000ppm	>2000ppm

NZEB & Residential

AECOM

NZEB for Dwellings

– Part L 2017 (Amended) for Dwellings issued January 2017 (for information)

	TGD L Dwellings 2017 (Amended)	TGD L Dwellings 2011
Maximum Permitted Energy Performance Coefficient (MPEPC)	0.30	0.40
Maximum Permitted Carbon Performance Coefficient (MPCPC)	0.45	0.35
Renewables	10kWh/m^2/a	10kWh/m^2/a

– Dwelling Energy Assessment Procedure (DEAP) v3.2
  • Published by Sustainable Energy Authority of Ireland (SEAI)

NZEB for Dwellings

– Part L 2018 issued for public consultation

– Elemental U value method only
  • U values reduced for certain elements

	Part L 2017	Part L 2008
Building Element	Max Elemental U Value $W/m^2.K$	Max Elemental U Value $W/m^2.K$
Walls	0.18	0.21
Floor	0.18	0.21
Windows & Doors	1.4	1.6
Pitched / Flat Roof	0.16	0.16

– Renewable energy ratio of 20% instead of fixed renewables in $kWh/m^2/yr$
  • CHP as alternative to RER

NZEB for Dwellings

- Max airtightness of 5m^3/m^2/hr & mandatory air tightness testing
- Recognition of overheating risk
  - Mitigation measures, e.g. blinds, may be required
- Minimum controls and efficiencies for heat pumps
- Higher efficiencies for ventilation systems
- Major renovation = >25% of building envelope undergoes renovation
  - Cost optimal levels
  - 125kWh/m^2/yr in DEAP
  - Upgrade boilers & electric heating >15yrs old
  - Upgrade insulation at ceiling level

NZEB for Dwellings – Sample Options in Draft Part L

Type	Heating	Ventilation	Renewables*
Semi Detached House	Gas Boiler	Continuous Mechanical Extract	5 no. PV
Semi Detached House	Gas Boiler	Natural Ventilation	5 no. PV
Semi Detached House	Gas Boiler	MVHR**	4 no. PV
Semi Detached House	Heat Pump	Continuous Mechanical Extract	Heat Pump
Mid Floor Apartment	Gas Boiler	MVHR**	3 no. PV
Mid Floor Apartment	Heat Pump	Continuous Mechanical Extract	Heat Pump

*All PV's based on 275W PV panels, E/W facing

MVHR = Mechanical Ventilation with Heat Recovery

– Common items
  - Medium thermal mass
  - Thermal bridge factor of 0.05
  - U Values: Walls = 0.13W/m^2.K / Floor = 0.14W/m^2.K / Ceiling 0.11W/m^2.K / Glazing 0.9W/m^2.K (triple glazed)

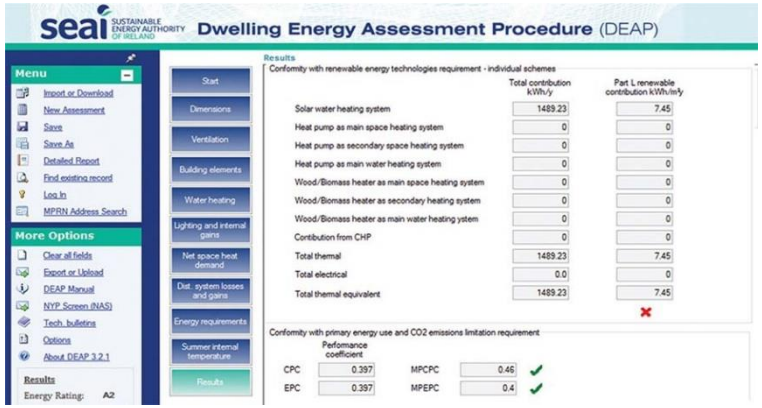
DEAP Methodology

– DEAP v3.2 to be replaced by web based DEAP4

– Hot water use now considered
  - Accounts for type of fitting
  - Accounts for electric showers
  - Low water use designs improve overall BER

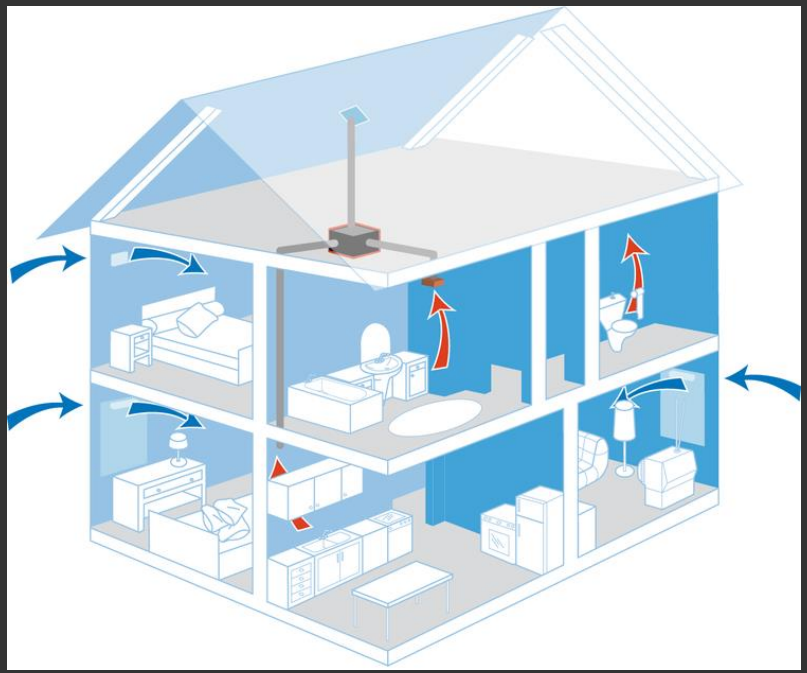
– More detail on lighting
  - Greater benefit for using low energy fittings
  - Prevents overdesigning

– Other items
  - Changes in how renewables are calculated
  - Primary energy factors based on 5 year average
  - Waste water heat recovery can be used



Part F (Ventilation)

- Now includes ‘Central Continuous Mechanical Extract Ventilation’
- Natural ventilation only acceptable for airtightness of <3 / >5 $m^3/m^2/hr$
- Competent designers & competent installers
- ‘Installation and Commissioning of Ventilation Systems for Dwellings - Achieving Compliance with Part F 2018’
  - Checklists for installation and commissioning
  - Operation and Maintenance manuals required



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Cost of NZEB

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Estimated % Additional Cost to Comply with Part L 2017

Building Type	Additional Cost Range
Office	1.9% - 2.4%
Primary School	6.2% - 7.7%
Post Primary School	8.1% - 9.5%
Hotel	4.6% - 5.3%
Retail	2.4% - 3.0%
Mixed-use	1.3% - 1.5%
Residential - Housing	0.9% - 4.2%
Residential - Apartments	0.7% - 2.9%

Estimated Cost Uplift - School

Construction Costs (Excl VAT)	€/m²	Uplift
Basic Building Cost + Fitted Furniture	1,220.00	
Additional Costs to Comply with Part L 2017		
Increased width of cavity wall & insulation	21.46	1.76%
Increased thickness of floor insulation	38.06	3.12%
Increased thickness of roof insulation	13.77	1.13%
Triple glazed windows in lieu of double glazed	14.57	1.19%
Introduction of PV panels	31.98	2.62%
LED Light Fittings throughout	3.24	0.27%
Total - Additional Costs to Comply with Part L 2017	123.08	10.09%
Total Building Cost (Excl VAT)	1,343.08	
Basic Building Cost + Fitted Furniture	1,220.00	

Summary

How Does NZEB Impact Us?

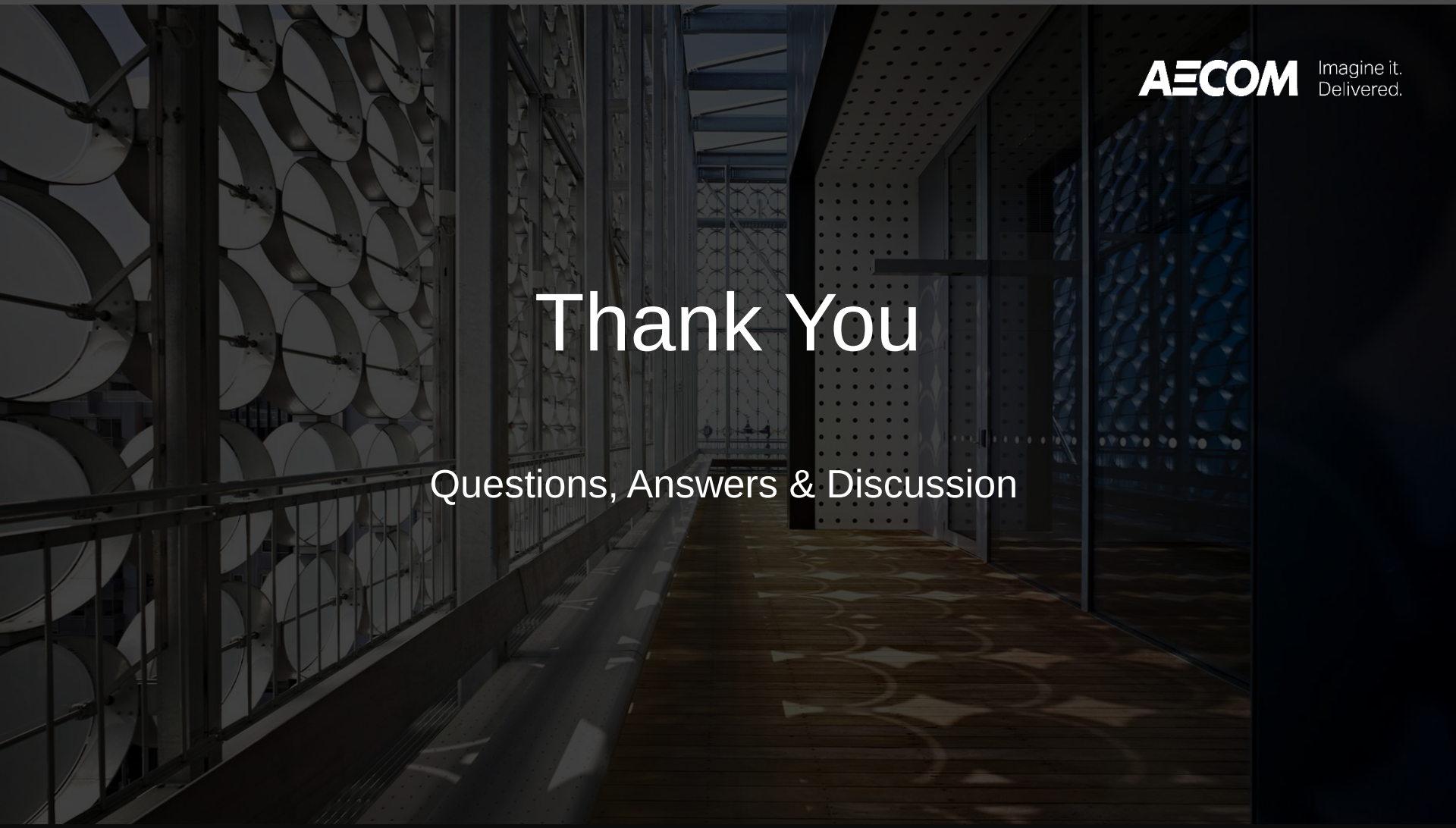
<table>
<tr><th>M&E Engineer</th><th>Architect</th><th>Contractor</th><th>Client</th></tr>
<tr><td>More stringent specifications for HVAC systems</td><td rowspan="2">Increased requirements for building fabric and air tightness</td><td>Construction quality around insulation air tightness</td><td>Increased cost</td></tr>
<tr><td rowspan="2">More in depth building calculations (incl</td><td rowspan="2">Quality control for thermal bridging</td><td rowspan="2">Higher specification building services & controls systems</td></tr>
<tr><td>Mandatory calculations for</td></tr>
<tr><td colspan="2">More collaboration from project outset (pre planning) and throughout the project life cycle</td><td>Mandatory air tightness testing</td><td>Reduced running costs</td></tr>
<tr><td colspan="2">Increased focus on site inspections & construction quality</td><td>More emphasis during commissioning</td><td>More certainty on quality of building product</td></tr>
<tr><td colspan="4">Manufacturers are vital for providing the innovative products that will shape the design solutions</td></tr>
<tr><td colspan="4">CONTRIBUTING TO A BETTER ENVIRONMENT AND A SUSTAINABLE FUTURE!</td></tr>
</table>

It’s not just about Energy!

Energy is only one part of building sustainability

Conclusions

- Revised Part L for Non Domestic Buildings is an extensive document that all should read
- Calculation methodology (NEAP) to be confirmed
  - Q2 2018
- Part L for Dwellings in Public Consultation – have your say!
  - DEAP v4 to be issued
- Next steps – EU has committed to cut CO2 emissions by 40% by 2030
  - COM/2016/0765 policy document
  - More emphasis on Smart Technologies



Thank You

Questions, Answers & Discussion

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Zero E rgy

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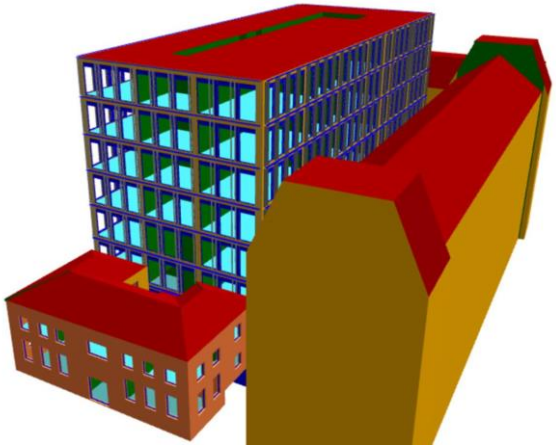
Non Domestic – New Buildings - NZEB

Based on NEAP Methodology

60% Improvement on Previous Regulations

- Improvement in Fabric Performance
- Improvement in Efficiency of Systems
- **10% to 20% Renewable Energy**



OPW – Lesson Lane

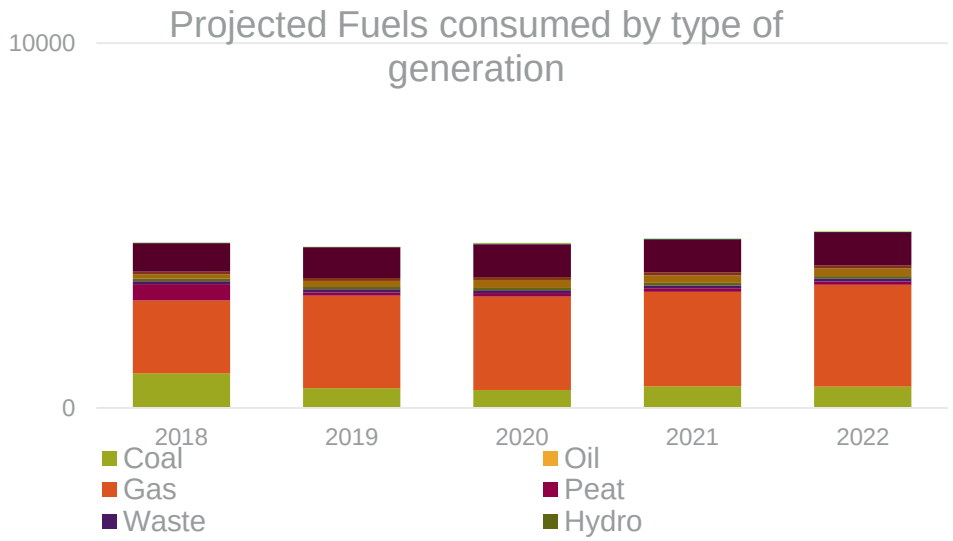
Domestic – New Buildings - NZEB

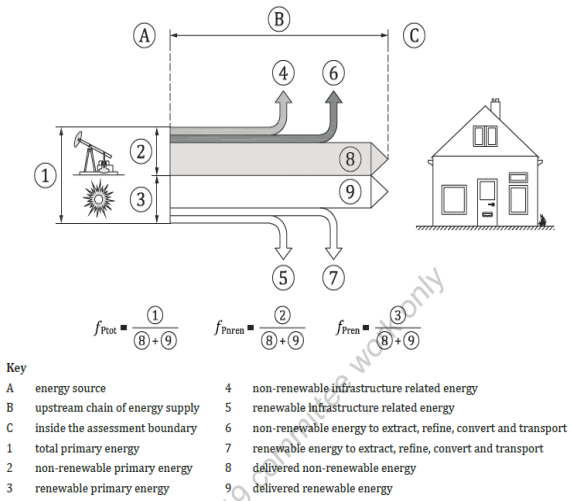
Durkan Homes – Citywest

25% Improvement on Current Regulations
Same Fabric Performance
- Boiler with Increased PV
- Boiler with MVHR and PV
- Heat Pump

Primary Energy Factor

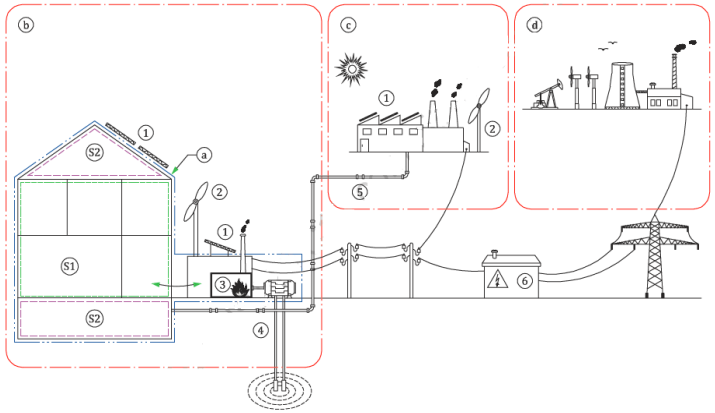
- Methodology outlined in EN ISO 52000 -2017
- Based on Irelands Energy Projections 2017
- https://www.seai.ie/resources/publications/Irelands_Energy_Projections.pdf





Renewable Energy Ratio

- Calculated in line with ISO 52000
- Included:
  - PV
  - Solar
  - Wind
  - Heat Pump
  - Biomass/ Biogas
  - District heating
  - CHP



Key

a	assessment boundary (use energy balance)	1	PV, solar
b	perimeter: on-site	2	wind
c	perimeter: nearby	3	boiler room
d	perimeter: distant	4	heat pump
S1	thermally conditioned space	5	district heating/cooling
S2	space outside thermal envelope	6	substation (low/medium voltage and possible storage)

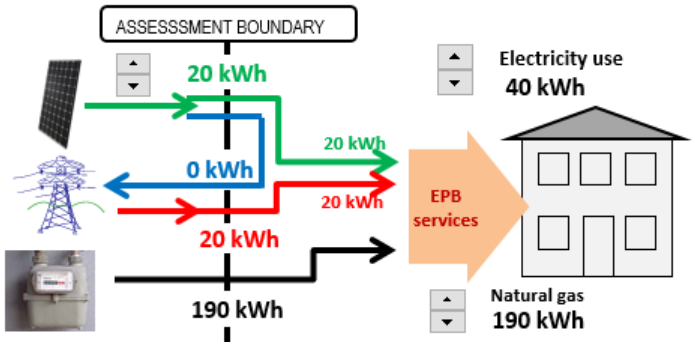
The Renewable Energy Ratio *RER* = $\frac{E_{Pren}\ \text{Primary Energy of the Renewables}}{E_{Ptot}\ \text{Total Primary Energy}}$

Renewable Energy Ratio - General

PV/ Wind/Solar/Biomass/ Biogas/ District Heating

- *Equation 1* $Ep,_{ren} = Generated\ Energy \times Fp,_{ren}$
- Equation 2 $Ep,_{tot} = Generated\ Energy \times Fp,_{ren} + Generated\ Energy \times Fp,_{nren}$

		E	fPnren	fPren on-site	EPnren	Epren on-site	EPtot	RER
		kWh			kWh	kWh	kWh	nrb-os
	PV/Wind	0.0	0	1.94	0.0	0.0	0.0	
+ Delivered energy	Other	0.0	0	1	0.0	0.0	0.0	
+ Delivered energy	Solar	0.0	0	1	0.0	0.0	0.0	
+ Delivered energy	Biomass	0.0	0.1	1	0.0	0.0	0.0	
+ Delivered energy	Biodiesel	0.0	0.3	1	0.0	0.0	0.0	
+ Delivered energy	Bioethanol	0.0	0.34	1	0.0	0.0	0.0	
+ Environmental energy	HP	0.0	0	1	0.0	0.0	0.0	
+ Saved energy	CHP	0.0	0	1	0.0	0.0		
+ Delivered energy	District Heating	0.0	0.6	0.6	0.0	0.0	0.0	
+ Delivered energy	Grid	0.0	1.94	0	0.0	0.0	0.0	
+ Delivered energy	Thermal	0.0	1.1	0	0.0	0.0	0.0	
TOTAL STEP A					0.0	0.0	0.0	

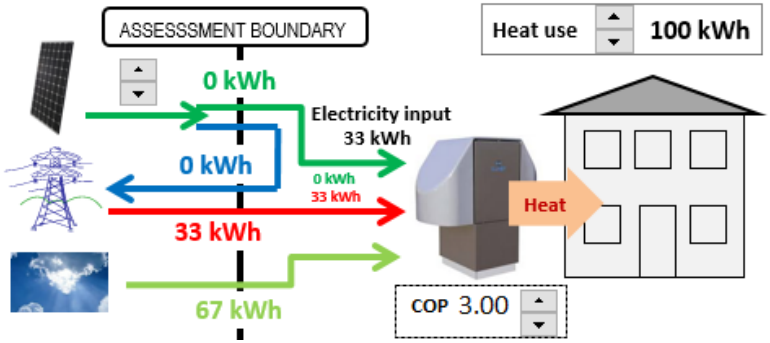


Renewable Energy Ratio – Heat Pump

Heat Pump

- *Environmental Energy = (Htg Demand$_{HP}$ - Consumed Energy$_{HP}$)*

		E	fPnren	fPren on-site	EPnren	Epren on-site	EPtot	RER
		kWh			kWh	kWh	kWh	nrb-os
	PV/Wind	0.0	0	1.94	0.0	0.0	0.0	
+ Delivered energy	Other	0.0	0	1	0.0	0.0	0.0	
+ Delivered energy	Solar	0.0	0	1	0.0	0.0	0.0	
+ Delivered energy	Biomass	0.0	0.1	1	0.0	0.0	0.0	
+ Delivered energy	Biodiesel	0.0	0.3	1	0.0	0.0	0.0	
+ Delivered energy	Bioethanol	0.0	0.34	1	0.0	0.0	0.0	
+ Environmental energy	HP	0.0	0	1	0.0	0.0	0.0	
+ Saved energy	CHP	0.0	0	1	0.0	0.0		
+ Delivered energy	District Heating	0.0	0.6	0.6	0.0	0.0	0.0	
+ Delivered energy	Grid	0.0	1.94	0	0.0	0.0	0.0	
+ Delivered energy	Thermal	0.0	1.1	0	0.0	0.0	0.0	
TOTAL STEP A					**0.0**	**0.0**	**0.0**	

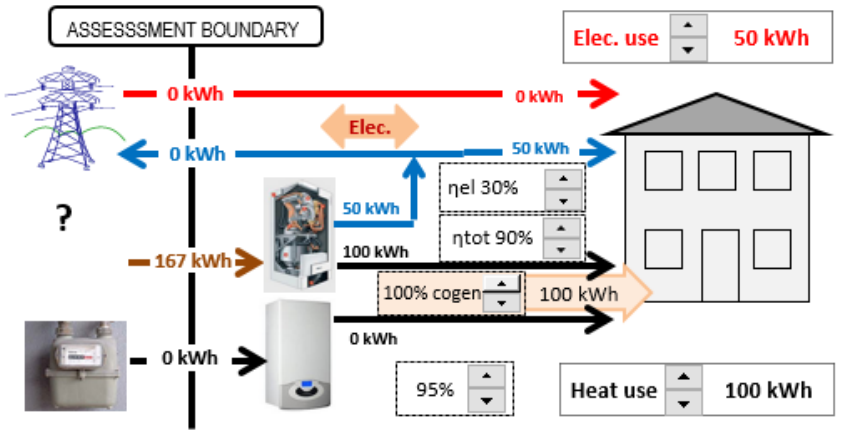


Renewable Energy Ratio – CHP

CHP

- Saved Energy =

$$\text{Heat Demand}_{CHP} \times [(PEF_{gas} / 0.9) + ((CHP_{eff\_elec} \times PEF_{elec}) / CHP_{eff\_heat}) - (PEF_{gas} / CHP_{eff\_heat})]$$



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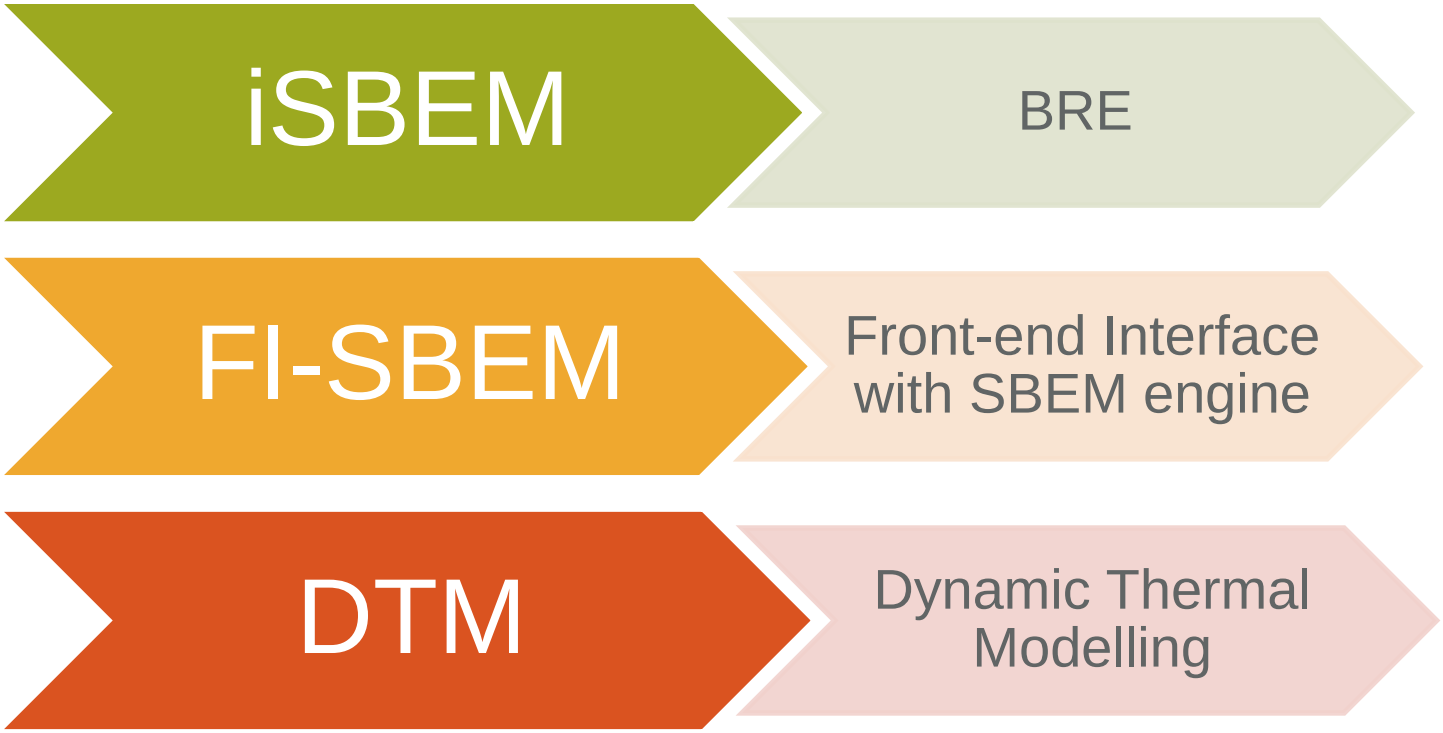
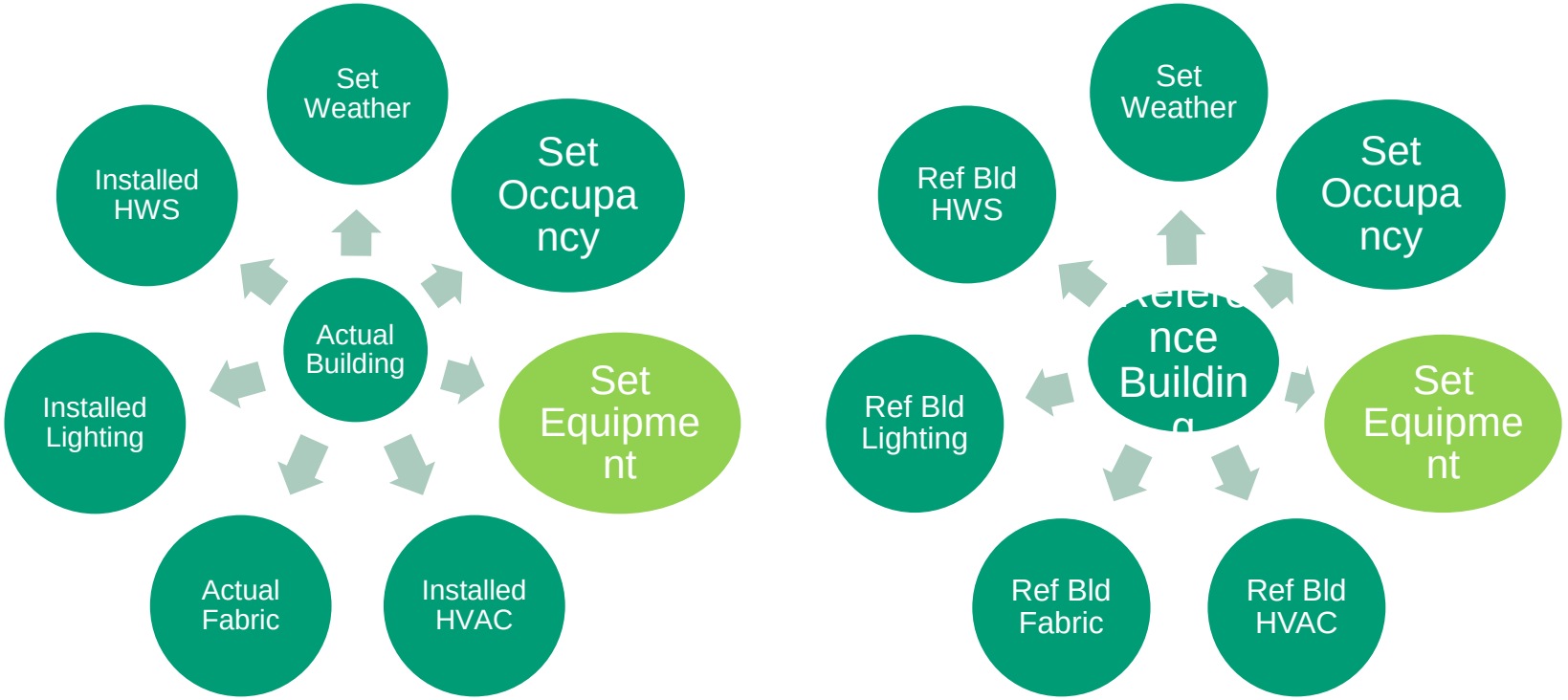
What is the NEAP Methodology

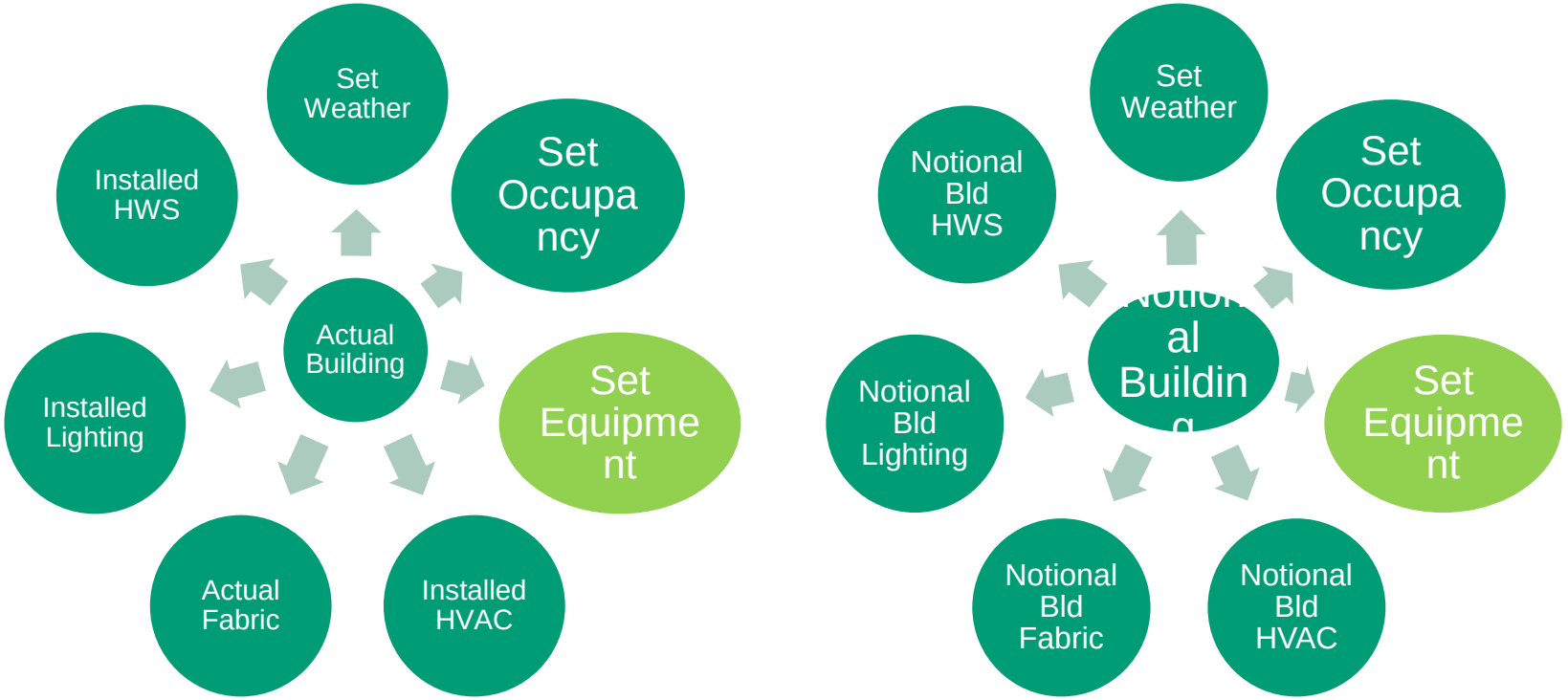


NEAP Methodology – Asset Rating – Part L



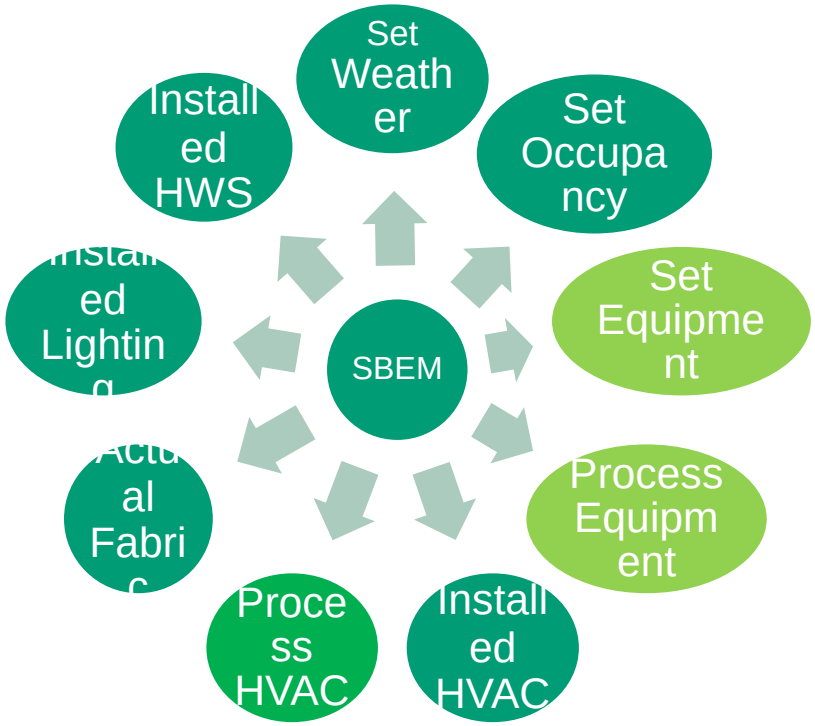
EPC/CPC is ratio of Actual Building to Reference Building
Reference Building is defined in Part L

NEAP Methodology – Asset Rating – BER



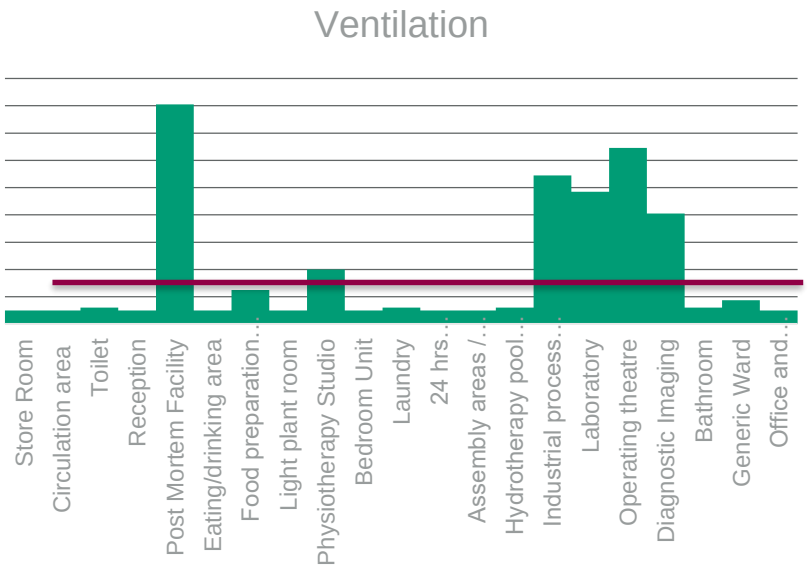
BER is ratio of Actual Building to Notional Building
Notional Building is not changing

NEAP Methodology – Asset Rating – Process Load



For specialist process:

- Setting thresholds removing the Process HVAC demand from the RER calculation
- Adjusting the reference building for activities with specialist processes.



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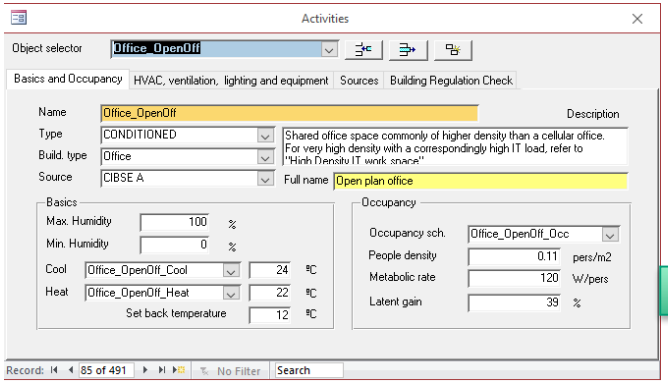
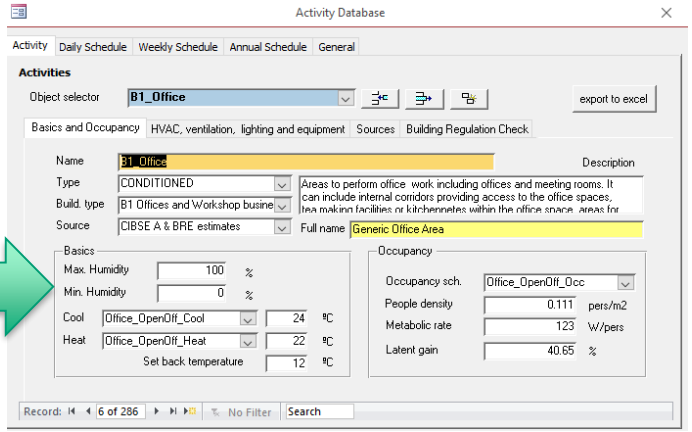
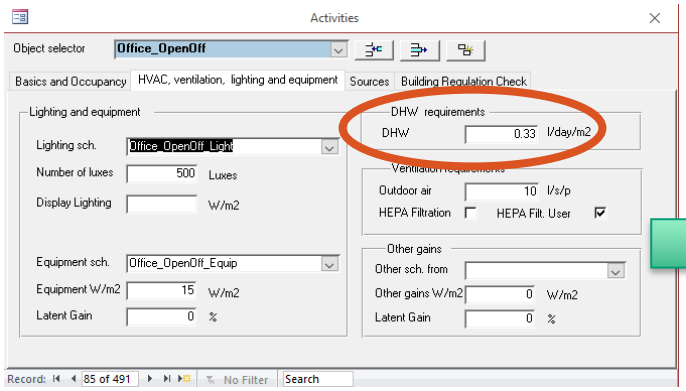
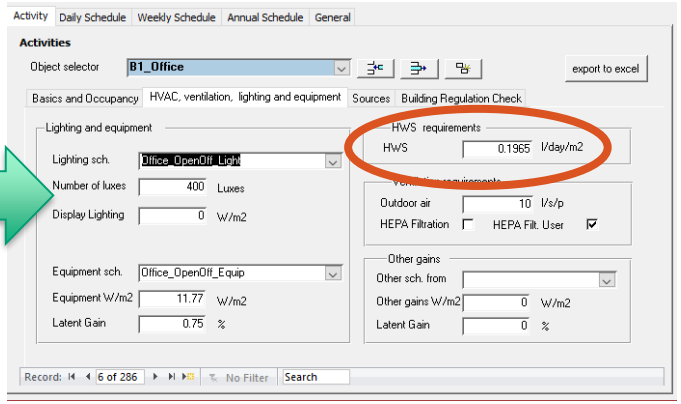
SBEM Development – Activity Database









- BRE Research
- Irish Specific Requirements

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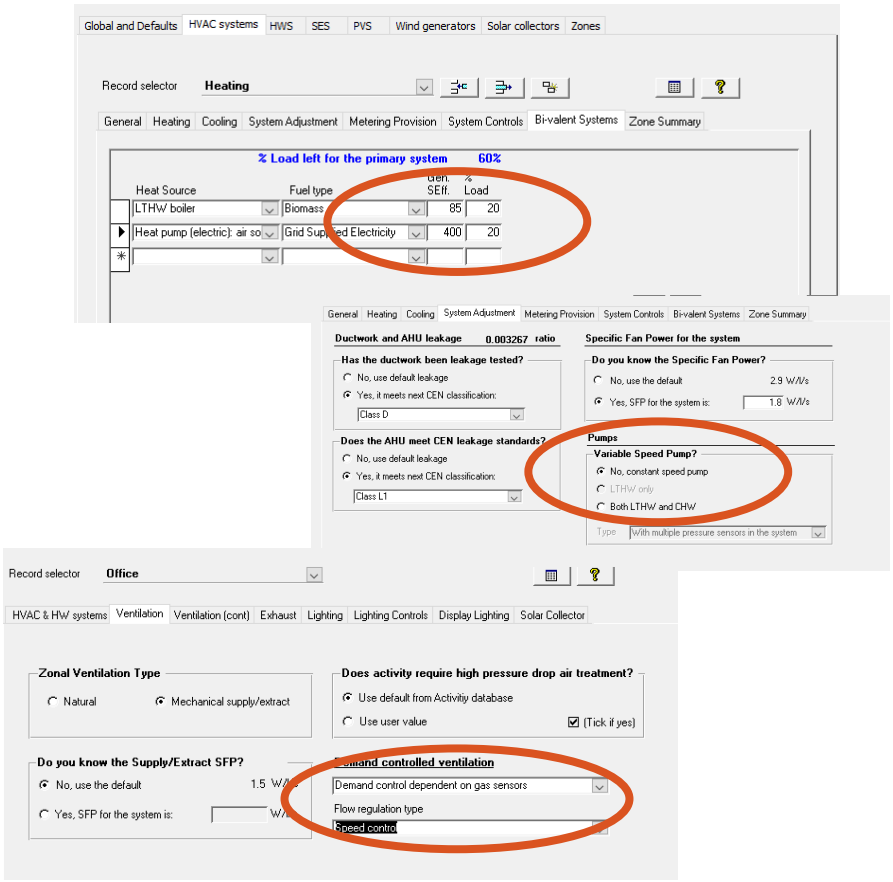
SBEM Development – Tool

Example of some changes

- More than 1 source of Heating
- Variable Speed Pumps
- Demand Control Ventilation
- LED Lighting



NZEB Compliant Office Building – Interim Methodology

Fabric	Performance Specification
Heat Loss Walls	0.2
Roof	0.15
Heat Loss Floor	0.16
Glazing	1.8 – U value; 0.33 – Solar Transmission 0.60 – Light Transmission
Air Permeability	3 m3/hr/m2
Thermal Bridging	Equivalent to ACDs
Services Strategy	Natural Ventilation with Split System in meeting rooms Full M&T on Lighting and HVAC
Heating & DHW Efficiency	92%
Cooling SEER	3.5
Lighting	2.5 W/m2/100lux
Lighting Controls	Full Daylight and Occupancy
Renewable	Photovoltaics - 12% of floor area

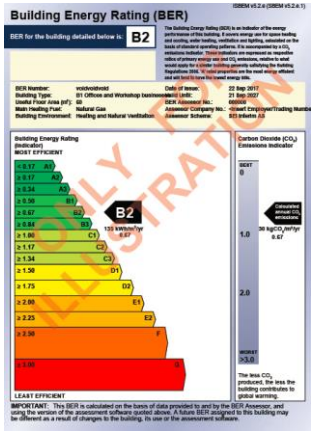
NZEB Compliant Office Building – Interim Methodology

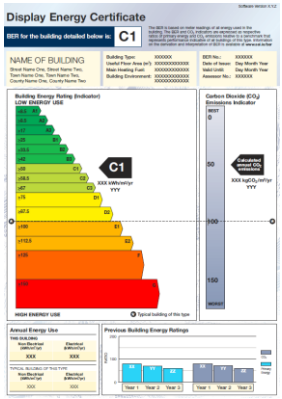
Fabric	Performance Specification
Heat Loss Walls	0.2
Roof	0.15
Heat Loss Floor	0.16
Glazing	1.8 – U value; 0.33 – Solar Transmission 0.60 – Light Transmission
Air Permeability	3 m3/hr/m2
Thermal Bridging	Equivalent to ACDs
Services Strategy	FCU Full M&T on Lighting and HVAC
Heating & DHW Efficiency	92%
Cooling SEER	3.5
Lighting	2.5 W/m2/100lux
Lighting Controls	Full Daylight and Occupancy
Renewable	Photovoltaics - 23% of floor area

NZEB Compliant Laboratory Building – Interim Methodology

Fabric	Performance Specification	
Heat Loss Walls	0.15	
Roof	0.13	
Heat Loss Floor	0.1	
Glazing	1.4 – U value; 0.33 – Solar Transmission 0.60 – Light Transmission	
Air Permeability	3 m3/hr/m2	
Thermal Bridging	Equivalent to ACDs	
Services Strategy	Natural Ventilation in Offices and Support Areas	VAV in Laboratories SFP 1.5 W/l/s HRV 70%
Heating & DHW Efficiency	92%	92%
Cooling SEER		3.71
Lighting	1.5 W/m2/100lux	
Lighting Controls	Full Daylight and Occupancy	
Renewable	CHP providing 60% of DHW and Heating Photovoltaics - 3% of floor area	

Operational Energy Performance





BRIRL Output Document

Compliance Assessment with the Building Regulations (Ireland) Part L 2014

This report demonstrates compliance with specific aspects of Part L of the Building Regulations. Compliance with all aspects of Part L is a legal requirement. Demonstration of how compliance with every aspect is achieved may be sought from the Building Control Authority.

Set Occupancy
Set Weather
Set Temperatures
Set Equipment
Set Usage Profiles
Set Water Demand

Actual Occupancy
More Appropriate Weather
Actual Temperatures
Actual Equipment
Actual Usage Profiles
Actual Water Demand

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Dwellings

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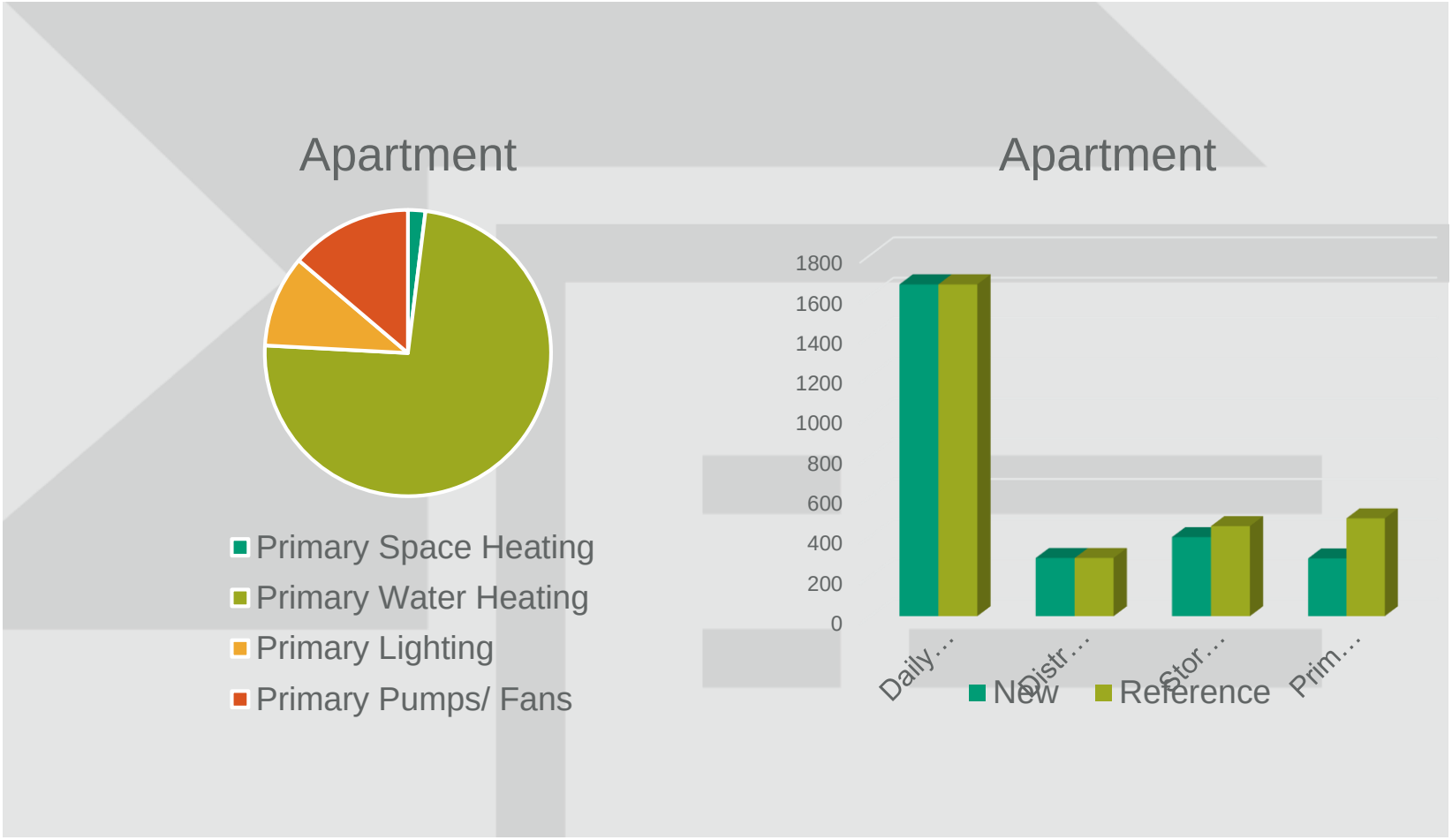
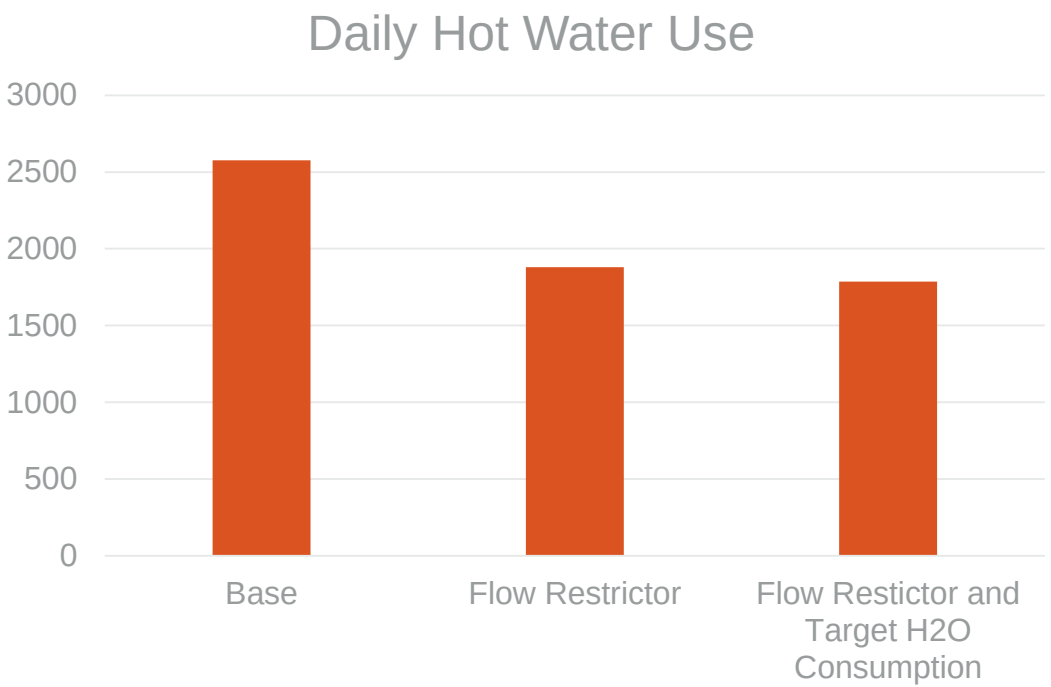
Regulatory Impact Assessment



DHW Energy – Proposed Changes



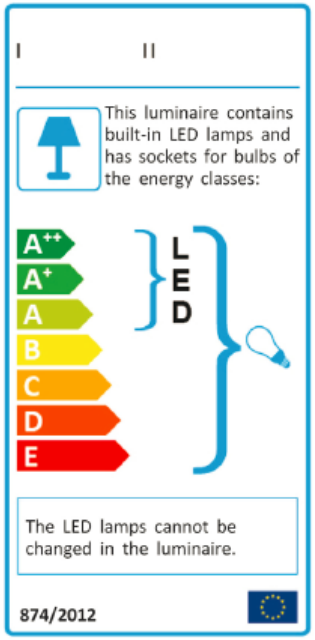
Lighting Energy – Proposed Changes

New buildings:

- Enters details based on design of the installed lighting, including Wattage, Efficiency and/or Lux levels.

Existing buildings:

- Enters default efficiency based on the lamp type/ rating with the lighting level fixed.



Updating DEAP Guidance based on previous consultation

- Fixed Cooling accounted for in calculation
- Allowance for 2 main heating systems where present
- High Heat Retention Storage Heaters
- Clarification re Curtain Walling and Window Systems
- Efficiency Adjustment to MVHR for uninsulated ductwork
- Waste Water Heat Recovery
- Inclusion of electric showers

Factors to Consider

Renewables

TICK BOX or FIT FOR PURPOSE ?

Renewables - What type is most appropriate

Biomass

- Fuel delivery
- Fuel storage
- Access to fuel

Heat Pump

- Heating Demand
- Location
- Noise

Solar Panels

- Space
- Will it meet requirement

Photovoltaics

- Space
- Overshading
- Demand for Electricity

CHP

- Demand for Heat and Electricity on site

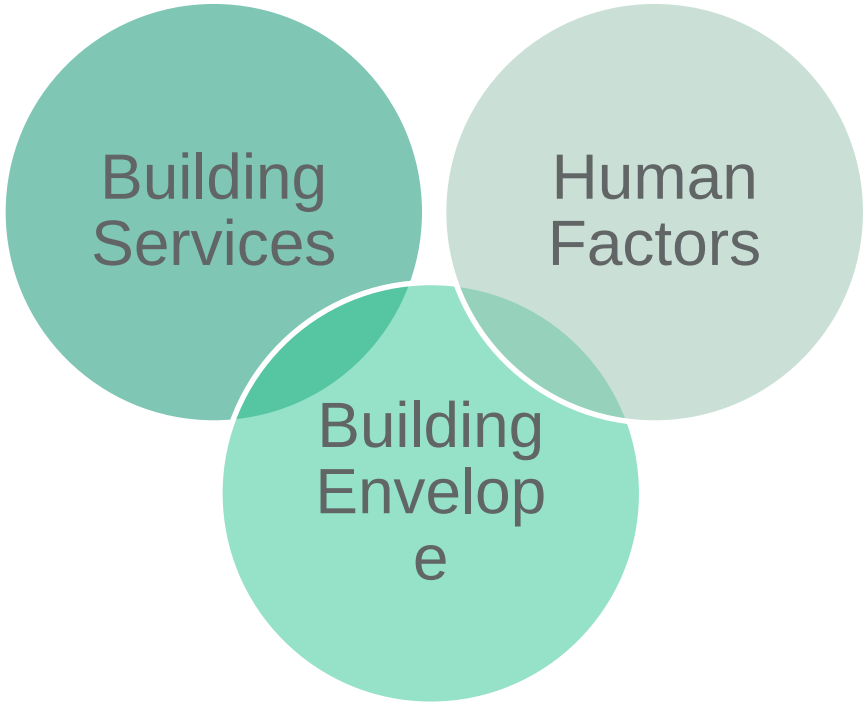
Wind Turbine

- Site Restriction
- Demand for Electricity

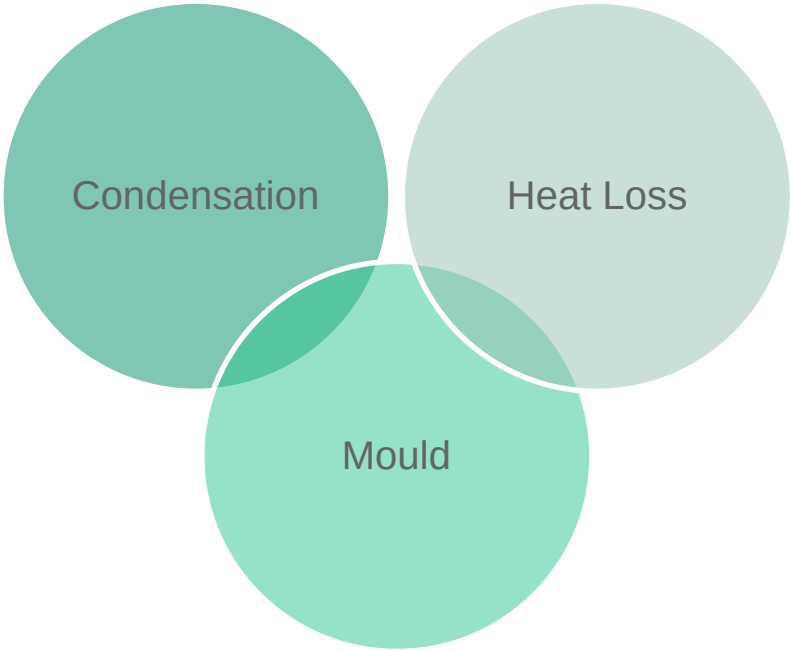
District Heating

- Appropriate for Client
- Site Restrictions

Key Design Considerations



THERMAL BRIDGING



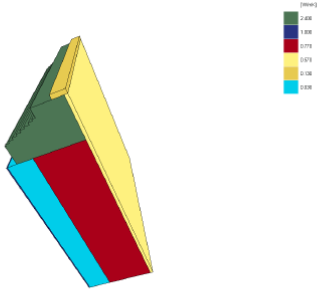


Figure G.13 - Materials modelled in TRISCO showing EWI terminated b low the sill

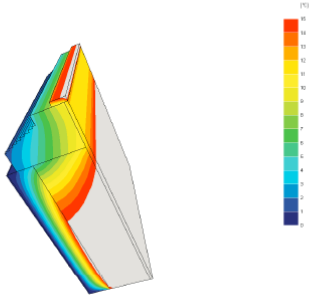


Figure G.14 - Thermal image of TRISCO output showing the internal su face to the rear of the sill is still significantly below 15 °C

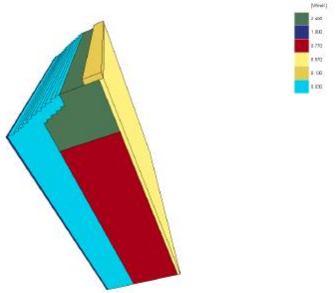


Figure G.15 - Materials modelled in TRISCO showing cut back sill

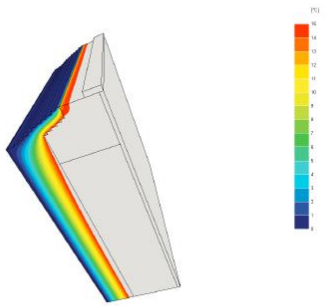
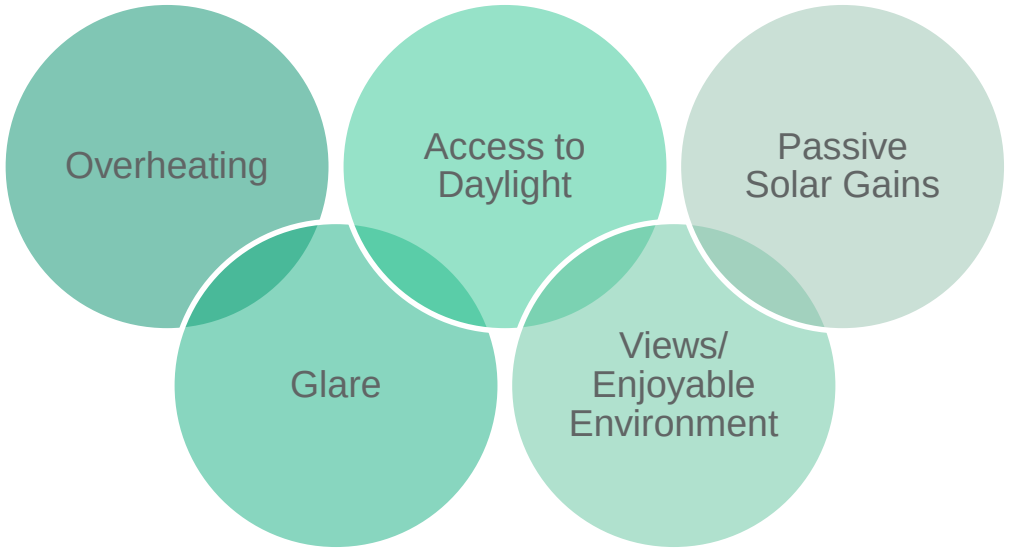
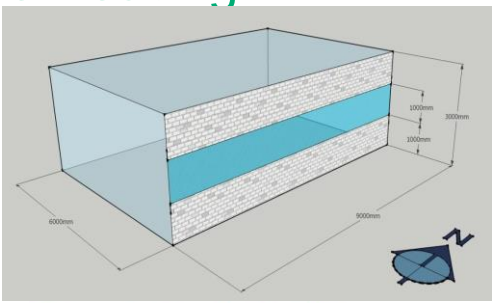


Figure G.16 - Thermal image of TRISCO output showing the internal sur face to the rear of the cut back sill is significantly above 15 °C

Internal Environmental Quality - Overheating





Design methodology for the assessment of overheating risk in homes

CIBSE

The limits of thermal comfort: avoiding overheating in European buildings

CIBSE

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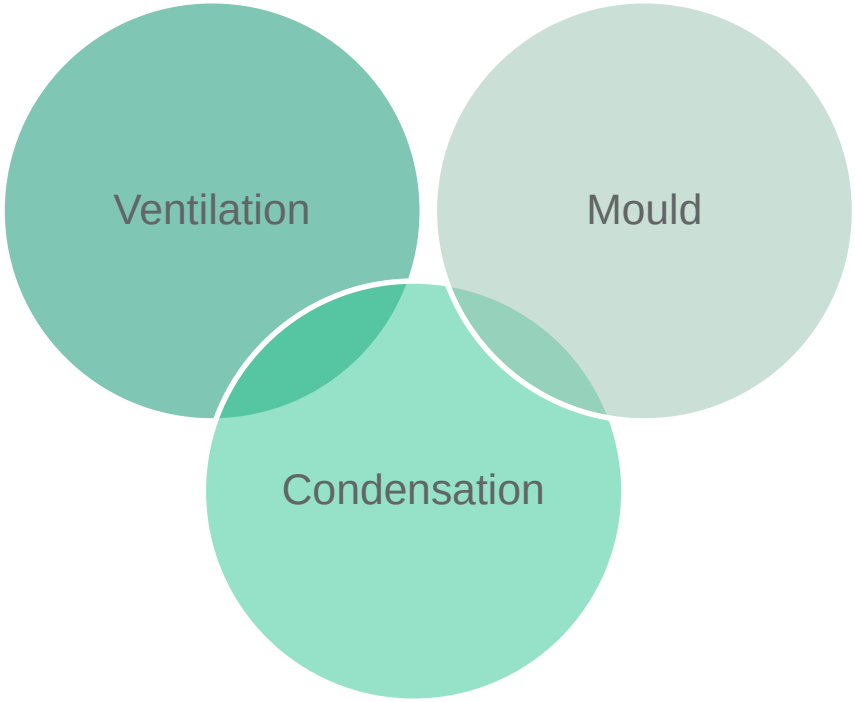
Internal Environmental Quality - Ventilation



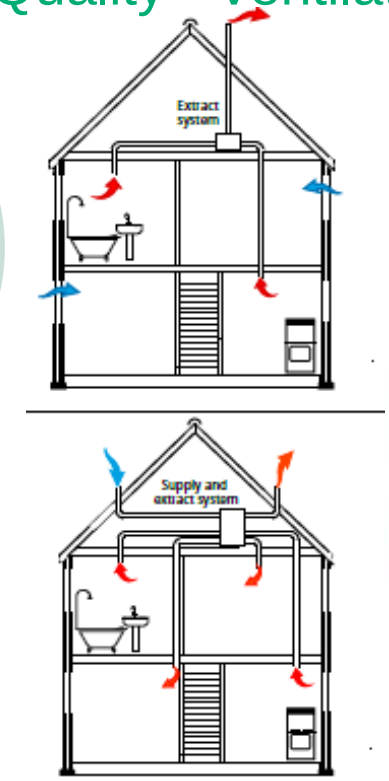


Figure 91 - Mould at external wall and ceiling junction

Engaging the Building User

Building Energy Rating

BER No: XXXXXXXX

Advisory Report

This report provides advice on improving the comfort and condition of your home – reducing energy costs and improving your Building Energy Rating.

Your current Building Energy Rating (BER) **BER D2** 272 kWh/m²/yr

CO_2 produced equivalent to 6.1 tonnes per year. **CO_2 6.1** 55 kgCO_2/m²/yr

The average BER rating for similar homes is E1 and average CO_2 is 75 kgCO_2/m²/yr equivalent to 8.2 tonnes of CO_2 produced per year.

Date of Issue: Day/Month/Year
Valid Until: Day/Month/Year
Address:
Address Line 1
Address Line 2
Address Line 3
Address Line 4
Address Line 5
Eircode
Year of Construction: 1977
Dwelling Type: Detached House
Total Floor Area: 109.8 m²
Deap Version No: 3.2.1

How your home performed – Legend at rear of report

Roof	Windows	Floor	Walls	Heating
Poor	Good	Fair	Very Good	Very Poor

Your annual energy use

	Current Energy Costs*	Potential Costs
Space Heating	€1,284	€807
Hot Water	€453	€260
Lighting	€150	€85
Total Costs	**€1,887**	**€1,152**

You could save €735 per year and improve the warmth and comfort of your home

* Figures show how much a home such as yours, based on standard occupancy, spends for space heating, hot water, ventilation and lighting. Excludes appliances.

Top ways to make your home more energy efficient†

Recommended Measures (Assuming recommendations for improvements are installed in the order they appear in the table below)	Investment Cost (Approx) (Individual)	Payback (Individual)
Draught Stripping, Hot Water, Lighting, Fans/Vents	€252	2 years
New Boiler and Heating Controls	€2,019	4 years
Roof Insulation	€860	5 years
Floor Insulation	€933	6 years
Total for this package	**€4,064**	

Potential rating and savings per year

BER	Rating after improvement kWh/m²/yr	Potential Saving Per Year (Cumulative)
D1	254	€134
C2	193	€549
C2	181	€628
C1	165	€735
Total saving		**€735**

See page 3 for a full list of measures for this property.

† Top Recommendations are based on cost optimal calculations in accordance with the EU Energy Performance of Buildings Directive.

Your potential Building Energy Rating (BER) **BER C1** 165 kWh/m²/yr

CO_2 produced equivalent to 3.8 tonnes per year. **CO_2 3.8** 34 kgCO_2/m²/yr

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Questions

@ seai_ie

Ireland's European Structural and Investment Funds Programmes 2014-2020

Co-funded by the Irish Government and the European Union

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