

## European Retrofit Network

# Retrofitting Social Housing Methodology Report

Presentation: 'Training for Retrofit', Brussels 10 October 2011 Colin Patrick Gleeson School of Architecture & the Built Environment University of Westminster



## **ERN Initial outcomes**

- Green Deal 'One building per minute to 2050'
- Retrofitting interventions what can be done
- Skills requirements
- Costs
- 'Value Carbon' € / kgCO<sub>2</sub>
- Shallow, mid-level (C60), deep retrofit (C80)
- 'Tipping point'
- Decanting occupants?
- Disruption to occupants!

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> EU dwellings built before 1945 generally "Hard to Heat"







Not responding : Hungary Portugal Romania

Source: GEODE 2005, http://www.ceps.lu/pdf/6/art1143.pdf

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## Average costs for mid/deep emissions reduction

Source	Туроlоду	Low cost	Med cost	High cost	LZC cost	£Total	%CO2 reduction
Housing							
Forum	HR Flat	150	2500	7500	2000	12150	84
HF	Terrace	1350	3000	10450	19000	33800	81
HF	LR Flat	800	3000	7500	2000	13300	94
HF	Semi	1450	4200	8750	19000	33400	78
Existing Homes Alliance	Semi cavity wall					22300	68
EHA	Semi solid wall					29500	71
EHA	Semi off gas					27400	78
United House Construction	Precast semi					22000	70
DGHP (Hous Assoc)	Terrace					25000	80
Radian (Hous Assoc)	House					36000	85
MEAN						£25,485	<b>79%</b>

### **Tipping Point: semi-detached & mid-floor flat**

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source: The Housing Forum, http://housingforum.org.uk/sites/default/files/sustainable-refurbishment-010409.pdf



FOR THE SAME COST: ONE HOUSE AT 70-80% OR THREE HOUSES AT 50% PLUS "ENABLING WORKS"

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10 days in house				
	CO2 (kg/yr)			
HIGH DISRUPTION	REDUCTION	SAVED	CuSum	Individual
Original Solid Wall Detached	9717	0	0%	0%
CF lighting	9564	153	2%	2%
Draught proof Q15 to Q10	9190	374	5%	4%
300mm loft insulation	7778	1412	20%	17%
2kWp Photovoltaics	6934	844	29%	10%
New condensing boiler & controls	5371	1563	45%	18%
New dual coil cylinder & insulated primaries	5240	131	46%	2%
3m2 solar thermal with PV pump	5039	201	48%	2%
Double glaze all windows u=2.0	4525	514	53%	6%
100mm EPS external wall insulation (EWI)	1718	2807	82%	33%
Thermal bridges y=0.04	1373	345	86%	4%
Appliances	1173	200	88%	2%
		8544		100%
Disruption to heating and hot water				
Internal disrution from window replacement				
External facades require preparation				
EWI: re-routing of services & RWPs, SVP & drains?				
EWI: Roof soffits may need extending?				
OPTION FOR Q5 + fans or Q3 + MVHR				

#### **D) DSWHD**



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Q10 down to Q3	1554	164	84%	2%
MVHR Paul Thermos	1388	166	86%	2%
Thermal bridges y=0.04	1030	358	89%	4%
Appliances	830	200	91%	2%
		8887		100%
AIR TIGHTNESS CHAMPION				
MVHR designer				
MVHR installer and commissioner				

#### D2) DSWHD



Carling of the way   Intervention   Comments   Level of Discription     WESTMINSTER   Intervention   CPL becoming more common. GLS lamps to be phased out in UK by 2011   Low     D   Appliances   Need credible advice   Low     I   Appliances   Need credible advice   Low     I   Intervention   Many RSLs have already installed LL. Potentially disruptive where loft used as storage space.   Low     R   Cavity wall   Many RSLs have already installed CWL QA issues where thermal imaging shows poor application iron entirely missing   Low     Draught   Reduced ventilation can lead to condensation problems especially where envelope u values are low and insulation is internal. Sash windows in particular require skilled labour   Medium     Photovoltaics   Scatfolding, roof work, external and internal electrics, builder's work   Medium     U   Photovoltaics   Scatfolding   Medium     V   Photovoltaics   Scatfolding   Medium     V   Insulated   Potentially difficult to insulate in cylinder, and interventions in internal central heating system   Medium     P   Insulated   Potentially difficult to insulate in cylinder and intervention and bedroom temperatures for low index exprises four anone compant behaviour   Medium <t< th=""><th></th><th></th><th></th><th><b>T</b> 1.0</th></t<>				<b>T</b> 1.0	
LDATION     Distription       WESTMINSTER     Low energy lighting     CFL becoming more common. GLS lamps to be phased out in UK by 2011     Low       D     Appliances     Need credible advice     Low       I     Lot water tank insulation     Uncontrolled heat loss to the house leading to summer overheating. Insulation     Low       I     Critic insulation     Many RSLs have already installed LL. Potentially disruptive where loft used as storage space. Reticence to allow access     Low       S     Proving     Reduced ventilation can lead to condensation problems especially where envelope u values are low and insulation is internal. Sash windows in particular require skilled labour     Low to Medium       Photovoltaics     Scatfolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in Low     Low       R     U     Eos of heating & hot water, disruption to electrics, builder's work     Medium       Photovoltaics     Scatfolding, roof work, external roof work with scaffolding     Medium       P     Insulated     Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through primaries     Medium       P     Reduced     Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively		Intervention	Comments		
Image: Westmainster   Low energy   CPL becoming more common. GLS tamps to be phased out in OK by 2011   Low     Image: Common Stress   Appliances   Need credible advice   Low     Image: Common Stress   Low   Low     Image: Common Stress   Cavity wall   Many RSLs have already installed CWI. QA issues where thermal imaging shows poor application is instalation or entirely missing   Low     Image: Common Stress   Cavity wall   Many RSLs have already installed CWI. QA issues where envelope u values are low to more entirely missing   Low to more entirely missing     Image: Common Stress   Cavity wall   Reduced ventilation can lead to condensation problems especially where envelope u values are low to more entirely missing   Low     Image: Common Stress   Cavity wall   Reduced ventilation can lead to condensation problems especially where		T	CEL hooming more common CLS lamas to be about out in LW he 2011	Disruption	
MESTIMINSTER   Internal   Need credible advice   Low     D   Appliances   Need credible advice   Low     D   Iot insulation   Many RSLs have already installed LI. Potentially disruptive where loft used as storage space. Reficence to allow access   Low     I   Many RSLs have already installed CWI. QA issues where thermal imaging shows poor application insulation   Low     New Joing   Many RSLs have already installed CWI. QA issues where thermal imaging shows poor application insulation or entirely missing   Low     Protovoltaics   Reduced ventilation can lead to condensation problems especially where envelope u values are low and insulation is internal. Sash windows in particular require skilled labour   Low to Medium     Photovoltaics   Scaffolding, roof work, external and internal clectrical wiring. High cost currently offset by Feed in Tariff.   Low     New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Planter   Solar thermal   Generally requires dual coil hot water cylinder, and interventions in internal central heating system plus external roof work with scaffolding   Medium     P   Totovoltaics   Sammes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all temperature   Medium     P <t< th=""><th></th><th>Low energy</th><th>CFL becoming more common. GLS lamps to be phased out in UK by 2011</th><th>LOW</th></t<>		Low energy	CFL becoming more common. GLS lamps to be phased out in UK by 2011	LOW	
Phythatices   Product Charlos advice   D/W     Hot water tank   Uncontrolled heat loss to the house leading to summer overheating.   Low     Loft insulation   Many RSLs have already installed LI. Potentially disruptive where loft used as storage space.   Low     Cavity wall   Many RSLs have already installed CWI. QA issues where thermal imaging shows poor application or entirely missing   Low     Standard   Draught   Reduced ventilation can lead to condensation problems especially where envelope u values are low and insulation is internal. Sash windows in particular require skilled labour   Medium     Photovoltaics   Scaffolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in Tariff.   Low     New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Photovoltaics   Scaffolding, roof work with scaffolding   Medium     Insulated   Potentially difficult to insulate in cylinder, and interventions in internal central heating system plus external roof work with scaffolding   Medium     P   Reduced   Loss of heating & a common temperature. Living room and bedroom temperatures for low walls   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for low windows with ectrocital out reproposed of paspace during retrofit. Loss of space as insulation in a	WESIMINSIEK#	Appliances	Need gradible advice	Low	
D   Flow water tank   Deformation of the flow	_	Appliances	Incertically hast loss to the house leading to summer overheating	Low	
Insulation   Many RSLs have already installed LL. Potentially disruptive where loft used as storage space. Retricence to allow access   Low     Cavity wall   Many RSLs have already installed CWI. QA issues where thermal imaging shows poor application insulation or entirely missing   Low     Draught   Reduced ventilation can lead to condensation problems especially where envelope u values are low and insulation is internal. Sash windows in particular require skilled labour   Low to Medium     Photovoltaics   Scaffolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in Tariff.   Low     New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Solar thermal   Generally requires dual coil hot water cylinder, and interventions in internal central heating system plus external roof work with scaffolding   Medium     P   Insulated   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through walls   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all remperature   Medium     New window   Wide exprince of window replacement market. Potential challenges where new windows interface disruption. Potential for interstitial condensation   Very High     Internal wall   "Dry lining" requires		Hot water talk	Uncontrolled heat loss to the house leading to summer overheating.	LOW	
Dot   Pairy KSDS have already instance LP. Potentially distingtive where for deed as storage space.   Dow     Reticence to allow access   Cavity wall   Many KSDs have already installed CWL. QA issues where thermal imaging shows poor application or entirely missing   Low     S   Protovoltaics   Scaffolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in Tariff.   Low     New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Solar thermal   Generally requires dual coil hot water cylinder, and interventions in internal central heating system plus external roof work with scaffolding   Medium     Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through medium plus external roof work with scaffolding   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all rooms and on occupant behaviour   Medium     New windows   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     New windows   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     Itemperature   Toroms and or occupant behaviour   Medium   Very High     Cotrols <th></th> <th>L oft insulation</th> <th>Many PSLs have already installed LL. Potentially disruptive where left used as storage space</th> <th>Low</th>		L oft insulation	Many PSLs have already installed LL. Potentially disruptive where left used as storage space	Low	
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Image Carry wait   Image Carry wait   Image Carry wait   Image Carry wait   Dow     Insulation   or entirely missing   Draught   Reduced ventilation can lead to condensation problems especially where envelope u values are low   Low to     Medium   Photovoltaics   Scaffolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in   Low     Tariff.   New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Solar thermal   Generally requires dual coil hot water cylinder, and interventions in internal central heating system   Medium     plus external roof work with scaffolding   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through   Medium     P   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through   Medium     P   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for   Medium     Insulation   Iow income families indicate 19.1 and 17.1°C respectively   Dependent on TRV installation in all   Intermediation with dee pinsulation and effective air tightness sealing.     Internal wall   "Dry lining" r		Cavity wall	Many RSLs have already installed CWL $\Omega A$ issues where thermal imaging shows noor application	Low	
Instant   Definition   Control   Low to medium     S   Draught   Reduced ventilation can lead to condensation problems especially where envelope u values are low medium   Low to Medium     S   Photovoltaics   Scaffolding, roof work, external and internal electrical wiring. High cost currently offset by Feed in Tariff.   Low     New boiler   Loss of heating & hot water, disruption to electrics, builder's work   Medium     Solar thermal   Generally requires dual coil hot water cylinder, and interventions in internal central heating system plus external roof work with scaffolding   Medium     Insulated   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through walls   Medium     P   Insulated   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through walls   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all temperature rooms and on occupant behaviour   Medium     New windows   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     & Doors   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     0 with deep insulation and effe		insulation	or entirely missing	Low	
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S   Protorlig   Internation of internal obtain integents integent and the model in the integent and inte		proofing	and insulation is internal. Sash windows in particular require skilled labour	Medium	
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U   Insulated primaries   Potentially difficult to insulate in cylinder cupboards, behind boilers and where pipes go through welium   Medium     P   Heating controls   User interface leads to difficulty in programming heating and hot water. Default to manual over-ride welium   Medium     P   Reduced upstairs low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all temperature rooms and on occupant behaviour   Medium     New windows   Wide experience of window replacement market. Potential challenges where new windows interface with deep insulation and effective air tightness sealing.   Medium     Internal wall   "Dry lining" requires furniture removal and loss of space during retrofit. Loss of space as insulation effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High cost for single room. New methods proposed for laser measuring and off-site prefabrication to lower disruption. Potential for interstitial condensation   Very High     Ground floor insulation   Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.   Very High     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High	R	Solar thermal	Generally requires dual coil hot water cylinder, and interventions in internal central heating system plus external roof work with scaffolding	Medium	
Primaries walls Heating User interface leads to difficulty in programming heating and hot water. Default to manual over-ride Medium Primaries Walls Heating User interface leads to difficulty in programming heating and hot water. Default to manual over-ride Medium Reduced Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all temperature rooms and on occupant behaviour New windows Wide experience of window replacement market. Potential challenges where new windows interface & Doors With deep insulation and effective air tightness sealing. Internal wall insulation "Dry lining" requires furniture removal and loss of space during retrofit. Loss of space as insulation effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High cost for single room. New methods proposed for laser measuring and off-site prefabrication to lower disruption. Potential for interstitial condensation Ground floor Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc. MVHR Very low air permeability from draught proofing requires whole house mechanical ventilation. Very High		Inculated	Detentially difficult to insulate in cylinder surpleands, behind beilers and where nines, so through	Madium	
Initiality   User   Initiality   Initiality   Initiality   Medium     P   Heating   User interface leads to difficulty in programming heating and hot water. Default to manual over-ride   Medium     P   Reduced   Assumes all house heating at a common temperature. Living room and bedroom temperatures for low income families indicate 19.1 and 17.1°C respectively Dependent on TRV installation in all rooms and on occupant behaviour   Medium     New windows   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     & Doors   Wide experience of window replacement market. Potential challenges where new windows interface   Medium     insulation   "Dry lining" requires furniture removal and loss of space during retrofit. Loss of space as insulation effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High cost for single room. New methods proposed for laser measuring and off-site prefabrication to lower disruption. Potential for interstitial condensation   Very High     Ground floor   Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.   Very High     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High		primaries	walls	Medium	
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Internal wall insulation"Dry lining" requires furniture removal and loss of space during retrofit. Loss of space as insulation effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High cost for single room. New methods proposed for laser measuring and off-site prefabrication to lowerVery HighGround floor insulationRequires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.Very HighMVHRVery low air permeability from draught proofing requires whole house mechanical ventilation.Very High		& Doors	with deep insulation and effective air tightness sealing.		
insulation   effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High cost for single room. New methods proposed for laser measuring and off-site prefabrication to lower disruption. Potential for interstitial condensation     Ground floor insulation   Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.   Very High     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High	•	Internal wall	"Dry lining" requires furniture removal and loss of space during retrofit. Loss of space as insulation	Very High	
cost for single room. New methods proposed for laser measuring and off-site prefabrication to lower   disruption. Potential for interstitial condensation     Ground floor   Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.   Very High     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High	_	insulation	effectiveness increases and extensive making good to doors, skirtings, electrical outlets, etc. High		
disruption. Potential for interstitial condensation   disruption. Potential for interstitial condensation     Ground floor insulation   Requires removal of existing floor or the use of expensive "super insulation" products such as vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.   Very High     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High		cost for single room. New methods proposed for laser measuring and off-site prefabrication to l			
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insulation   vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.     MVHR   Very low air permeability from draught proofing requires whole house mechanical ventilation.   Very High		Ground floor	Requires removal of existing floor or the use of expensive "super insulation" products such as	Very High	
MVHR     Very low air permeability from draught proofing requires whole house mechanical ventilation.     Very High		insulation	vacuum sealed insulation with extensive making good to doors, skirtings, electrical outlets, etc.		
	U	MVHR	Very low air permeability from draught proofing requires whole house mechanical ventilation.	Very High	
MVHR is the most energy efficient but requires whole house ductwork installation and is thus high			MVHR is the most energy efficient but requires whole house ductwork installation and is thus high	, ,	
cost. Skills shortage in design, installation and commissioning and maintenance.			cost. Skills shortage in design, installation and commissioning and maintenance.		
Community Scope ranges from district heating to communal block heating. "Replacing a community gas boiler None to High	N	Community	Scope ranges from district heating to communal block heating. "Replacing a community gas boiler	None to High	
Biomass may not require tenant removal but replacing a block of flats on electrical storage heaters may result		Biomass	may not require tenant removal but replacing a block of flats on electrical storage heaters may result	_	
systems in significant disruption"		systems	in significant disruption"		

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## **Subjective Skills Analysis**

	Low	Medium	High	Skills	Comment
CFL				DIY	
Appliances	*			DIY	White goods energy advisors
Draught exclusion Q15 to Q10		*		Joiner/specialist contractor	Specialist contractors identified in interviews
Cavity wall insulation		*		Specialist contractor, Builder	Cavity wall Insulation contractor
Extract fans			*	Electrician	
Loft insulation	*			Insulation contractor (Australian experience)	Nay be DIY, otherwise builder or specialist contractor
Photovoltaics			*	Electrician, Reefer	Specialist contractor under Microgeneration scheme
Boiler & controls			*	Plumber, Electrician, Builder	Future maintenance works
Cylinder & controls			*	Plumber, Electrician	
Solar Thermal			*	Plumber, Electrician, Roofer, Builder	Specialist contractor under Microgeneration scheme
Openings (windows & doors)		*		Builder, Joiner, specialist contractor	Builder or window contractor
External Wall		*		Specialist contractor,	Specialist EWI contractor, all trades attending.
Draught proof Q10 to Q5		*		All trades	Requires specialist tapes and mastics, knowledge & commitment from all trades. Supported with Tool Box talks
Air-tight construction Q5 to ≤Q3			*	All trades	Requires specialist tapes and mastics, knowledge & commitment from all trades. Supported with Tool Box talks and in-depth planning & supervision.
Mechanical Ventilation with Heat Recovery (MVHR)			*	Specialist contractor, builder, electrician	Specialist design, installation, commissioning and maintenance. Requires access to hidden ductwork and MVHR unit.
Internal Wall Insulation		*		Builder, Plasterer, Decorator	Builder or specialist contractor, all trades attending
Floor insulation		*		Builder	Builder, all trades attending
Making good		*		Builder, plaster, decorator	All building works require "making good" and redecorating

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## FutureFit: Affinity Sutton HA Sept 2011

Source: http://www.affinitysutton.com/PDF/6416\_futurefit\_report\_web.pdf Difficulty in achieving significant

- savings where works have already been carried out (insulate roofs, cavity walls, double glazing).
- Invitation to take part in a free ecoproject sent to more than 800 residents resulted in only a 5% response rate [760 non-responders].
- 23% withdrew their permission, either leading up to or during the works period. They stated that the works were "too inconvenient", "too disruptive".
- From survey to completion, the number of visits to site ranged from 6 to 20.

Figure 2: Workforce issues log – breakdown by theme



The queries log tracked 166 issues, nearly half of which were technical. This highlighted the knowledge gap in an industry that has focused solely on Decent Homes for the last decade.

The supply chain is very keen to take up this agenda but will need training, commitment and volume if it is to be able to meet the Green Deal challenge.



# Summary of the proposed methodology:

- Consider lights and appliances
- Consider occupant behaviour
- Assess the emissions using SAP or EPBD equivalent (requires 'u' values, knowledge of heating design, etc)
- Carry out appraisal pased on technical options & disruption
- Carry out project management appraisal costs, skilled labour availability, furniture/carpets, redecorate, supply chain, etc.
- Decide the acceptable level of disruption
- Retrofit measures, leave "snag-free"
- Report on estimated final emissions savings MONITOR?