







# TSB Retrofit for a Future

Project in Development Material Choices



# **TSB Retrofit for a Future**

- Technology Strategy Board (Ex DTI)
- Seeking data for government
- to be able to start setting CO<sub>2</sub> targets for existing buildings
- Code for Sustainable Homes Refurbishment can follow
- Running competition to find solutions and get data
- 390 entries
- 190 through to First stage
- 85 through to Second stage will be built

# **Existing building stock**

- Is a bigger problem than new build
- We should be aiming for equivalent to Code level 5 but for refurbishment
- TSB target:
  - Was 80% reduction in CO<sub>2</sub>
  - now set at x CO<sub>2</sub> consumption per dwelling
  - Generous £150,000 budget
- Only concerned with CO2 in use
- Not interested in CO2 in materials or construction



- Manufacturers
- Stockists/distributors
- Applicators
- Contractors

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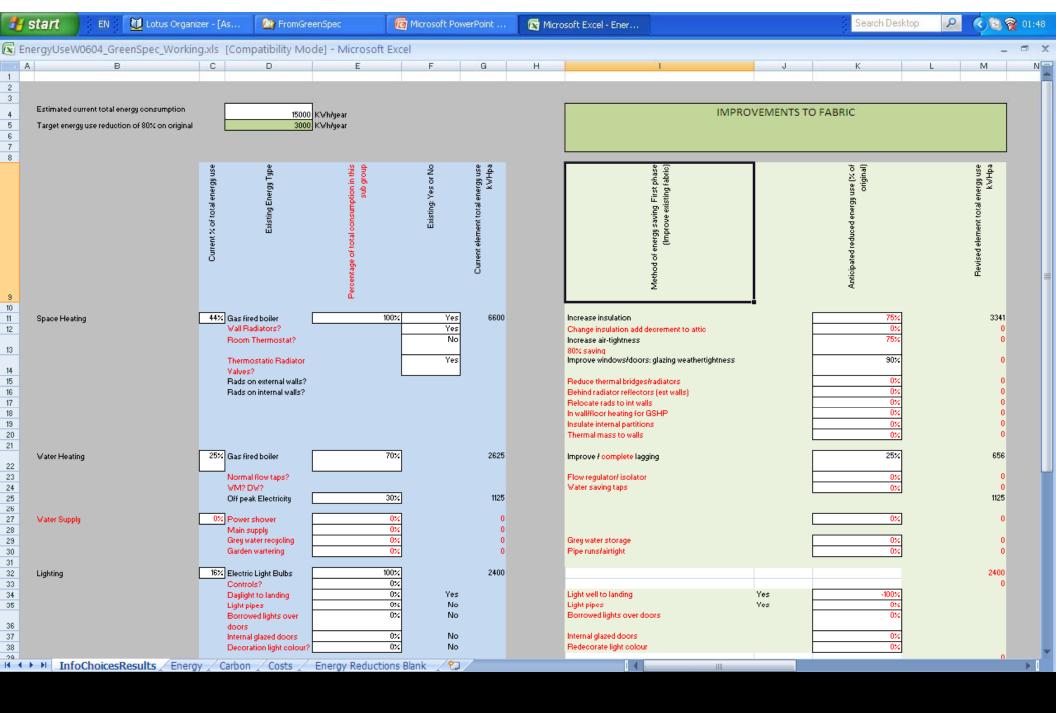
### 18/04/2010

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- Existing base point
  - Energy and carbon imported
  - Energy consumed and carbon released
  - Energy losses
- Proposed interventions
  - Renewable energy inputs & carbon saved
  - Reduced Losses
- <sup>18/04/2010</sup> Energy saved

Estimated current total energy consumption Target energy use reduction of 80% on original	150	00 KWh/year 00 KWh/year	IMPROVEME	NTS TO FABRIC	IMPROVEMENT	S TO FITTINGS /	LIFESTYLE CI	HANGES	MICRO-RENEABLES	6 & LOW-
	Creating Energy Type	Pe centage of total consumption in this sub-group Current element total	8 I	Antificipantel reduced energy use (% of erginal) Review dement total energy use k Weba	Method of energy saving Second phase (Improve fittings/appliances)	Anticipated reduced in energy use (% of revised amount) Revised eterment sotal energy use X Witpa	Method of energy saving Third phase (Renewables and life style changes)	Anticipated technoldin evergy use (% of revised amount) Revised element solal energy use X Wilca	Method of energy generation Can we assign the energy to a specific use?	Anticipated Energy Generation KWNY
Space Heating	44% Gas fired boller Radiators? Thermostat? TRVs?	100% 66	200 Increase insulation Change insulation Add decrement Increase air-tightness 80% saving Improve windows/doors: Beduce thermal	75% 3341 0% 75% 0 glas 50% 0	TRVs on Radiators Improve Thermostat Intuitive controls Single pipe radiator heating	0% 3341 0% 0 0% 0 0% 0	_	0% 0 0% 0 0% 0	Solar collector Photovoltaic panels Wind turbine: unlikely @ greenham Ground source heat pump	300 300 300 300
			bridges/radiators Behind radiator reflectors (ext walk) Relocate rads to int walk In wal/floor heating for GSHP Insulate internal partition	0% 0 0% 0	system Relocate rads to int. walls In wall/foor heating for GSHP	0% 0 0% 0 0% 0	Ļ		Air source heat pump Micro CHP	300
Water Heating	25% Gas fired boiler Normal flow taps?	70% 26	Thermal mass to walls	0% 0	Efficient smaller boller Flow regulator/ isolator	75% 492	Training: Heat purging Reduce hot water usage Visible meters	0% 0 75% 369 0% 0	Solar collector porch? Wrong elevation? Increase thermal mass	300
	WM? DW? Off peak Electricity	30% 11	Water saving taps	0% 0 1125	Water saving taps Efficient heater	0% 0 95% 1069		95% 1015	Solar collector sunspace Thermal storage	0
Water Supply	0% Power shower Main supply Grey water recycling Garden wartering	0% 0% 0%	0 0 0 Grey water storage 0 Pipe runs/airtight	0% 0 0% 0	Water head shower Brd pipe runs to WCs Gravity irrigation system	0% 0 0% 0	Training: Shower taking Reduce mains reliance Reduce mains reliance	0% 0 0% 0 0% 0	Increase Decrement	<b></b> 0
Lighting	16% Electric Light Bulbs Controls?	100% 24	00 Light pipes Borrowed lights Internal glazed doors Redecorate	0% 2400 0% 0 0% 0	Low energy lighting	25% 600	reduced appliance use	25% 150		
Cooking	9% Gas Electric (Oven/Hob) Electric (Microwave)	0%	80 0 70	1080 0 270	More Efficient Appliance	90% 972 75% 0 75% 203	reduced appliance use reduced appliance use reduced appliance use	90% 875 75% 0 75% 152		
Appliacnees	6% Fridge Freezer Kettle	5%	90 45 45	90 45 45	More Efficient Appliance More Efficient Appliance Modulation control More Efficient Appliance	75% 68 75% 34 75% 34	reduced appliance use reduced appliance use	75% 51 75% 25 75% 25		
	Washing Machine	10%	90 Create winter drying cupboard	00 00 00	More Efficient Appliance Drying over bath	65% 59 0% 0	reduced appliance use Solar drying in garden	65% 38	Solar drying in sunspace	0%
	Television Other (too broad)	10%	as Insulation to wastes 45 60	135 90 05 0 45 360	More Efficient Appliance More Efficient Appliance More Efficient Appliance More Efficient Appliance Socket/adapter switching Low wattage dircuit Remove transformers	65% 88 75% 68 75% 34 75% 270 0% 0 0% 0	reduced appliance use reduced appliance use reduced appliance use reduced appliance use Training: turning off	75% 51 75% 25 75% 203 0% 0	Heat recovery on water wastes Total generation Green tarrif supply	0 2400 0
Ventilation	0% Kitchen extractor	0%	0 Airtight the apperture Internal door closers & seals	0% 0 0% 0	Add heat recovery	0% 0	Training: Use Secure window opening	0% 0 0% 0	Whole House Mechanical Ventilation Heat Recovery	
Local Procument	0% Materials 0% Labour 0% Contractor	0% 0% 0%	0	<u> </u>		0% 0	E	<u>0%</u> 0		
		Total Energy kWH/year 150	00 Section Cumulative		Section Cumulative	Total Energy KWH/year 7329 % reduction 16 % reduction 51	Section 3	Total Energy kWH/year 6043 ireduction 9 ireduction 60	Total Energy KWH/year % reduction % reduction Total reduction in energy	ion 16 on 75.71

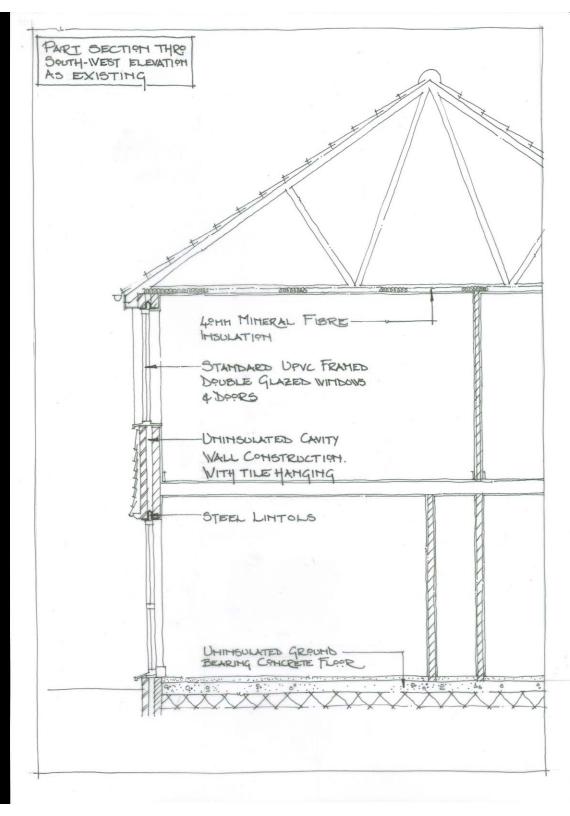


#### 18/04/2010

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# **Existing building**

- 1970s
- End of terrace
- Cavity wall construction
- Concrete tile hanging
   upper floor
- Cold bridge at base of tiling
- Uninsulated cavity
- 40 mm. glass or rock wool in attic (was 50 mm. shrunk after 40 years)
- Uninsulated concrete
   floor



# **Consider the options**

- Look at each element and consider
   options
- Consider impact on energy and carbon
- Consider impact on occupant
- Weigh up the pros and cons

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2	Element	Construction	Cavities	Observation comment on existing	Option	subtractions	additions	Dimensions	For	Acainst	Servicing implications	Other fabric implications		remporary works
з	Ground floor	Where is DPM? Ground bearing, Concrete slab, Screed, Underlay? Carpet Where is DPM?	None	Where is DPM? Is slab wet/cold or dry/warm? Unlikely to be insulated,	1.1	10 Carpet & underlay (relay?), 50 screed	30 "kinsulation", 20 deck board, 10 relay carpet & underlay	c	Improve GF insulation	Screed Waste, insufficient insulation, Existing Heating pipes, Screed drying time, Carpet relay	Heating pipes in existing screed	DPM location? DPM damage? DPM relay?	Provision for secure night time drying. Are secure by design windows sufficient?	Ten Ten ren Paik Trai opp Ten
4	Ground floor	Ground bearing, Concrete slab, Screed, Underlay? Carpet	None	Where is DPM? Is slab wet/cold or dry/warm? Unlikely to be insulated,	1.1. 1	10 Carpet & underlay (relay?), 50 screed	30 'decrement insulation', 20 deck board, 10 relay carpet & underlay	c	Improve GF insulation	Screed Waste, insufficient insulation, Existing Heating pipes, Screed drying time, Carpet relay	Heating pipes in existing screed	DPM location? DPM damage? DPM relay?	Provision for secure night time drying. Are secure by design windows sufficient?	Ten ren Paix Trai opp
5	Ground floor	Where is DPM? Ground bearing, Concrete slab, Screed, Underlay? Carpet	None	Where is DPM? Is slab wet/cold or dry/warm? Unlikely to be insulated,	1.2	10 Carpet & underlay (relay?), 50 screed	10 Insulation, 75 underfloor heating in screed, 10 Carpet & underlay		Improve GF	Tenant decant, Screed Waste, Existin Heating pipes to remove Carpet relay	Low grade heat source Underfloor heating	DPM location? DPM damage? DPM relay? Insulated thermal mass ceiling useful	Provision for secure night time drying. Are secure by design windows sufficient?	Ten Ten ren Paio Trai opp
6	Ground floor	Where is DPM? Ground bearing, Concrete slab, Screed, Underlay? Carpet	None	Where is DPM? Is slab wet/cold or dry/warm? Unlikely to be insulated,	1.3	10 Carpet & underlay (relay?), 50 screed	30 Insulation 20 In-board heating pipes 10 Relay carpet & underlay	c		Insufficient insulation	Heating pipes in existing screed	Insulated and thermal mass ceiling useful	Provision for secure night time drying. Are secure by design windows sufficient?	Ten Tem Paik Trai opp
	Ground floor	Where is DPM? Ground bearing, Concrete slab, Screed, Underlay? Carpet		Where is DPM? Is slab wet/cold or dry/warm?		10 Carpet & underlay (relay?),	Insulating screed, undefloor heating in screed		Improve GF	insulating screed resists heat	Heating pipes in	Insulated and thermal	Provision for secure night time drying. Are secure by design	Ten Ten rem Paix Trai
	Ground floor Ground floor	Ground bearing, Concrete slab, Screed, Underlay? Carpet	None	Unlikely to be insulated, Where is DPM? Is slab wet/cold or dry/warm? Unlikely to be insulated,		50 screed 10 Carpet & underlay (relay?), 50 screed	screed Insulating underlayment board, Carpet	-10	) insulation	transfer	existing screed Heating pipes in existing screed	mass ceiling useful	windows sufficient?	opp
		Masonry Cavity wall:	14											<b>_</b>
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# **Assess the shortlisted**

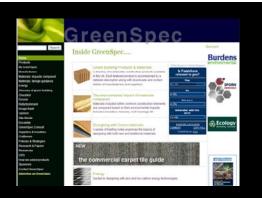
- Look at each element and consider thicknesses and k values
- Carry out SAP assessments
- Consider impact on energy and carbon
- Weigh up the pros and cons

🚽 Screen 1 of 6 👻 🕨

#### 11 Greenham, Bretton PETERBOROUGH PE3 9YP

#### Specification used for SAP model revision B detailed

Elements	Baseline	Proposed changes
Walls ground floor	11mm. cement + 2mm. gypsum 100mm. concrete block inner leaf (λ=1.70) 50mm. air space 102mm. brick outer leaf (λ=0.77) U=1.80	11mm. cement + 2mm. gypsum 100mm. concrete block inner leaf <b>50mm. blown rock wool (λ=0,041)</b> in cavity 102mm. brick <b>200mm. dense wood Gutex Thermosafe-gf (λ=0,043)</b> 5mm. render (λ=0.8) U=0.16
Walls first floor	11mm. cement + 2mm. gypsum 100mm. concrete block inner leaf ( $\lambda$ =1.70) 50mm. air space 100mm. concrete block outer leaf ( $\lambda$ =1.70) Wall tiles on battens ( $\lambda$ =1.5) U=2.0	11mm. cement + 2mm. gypsum 100mm. concrete block inner leaf <b>50mm. blown rock wool (<math>\lambda</math>=0.041)</b> in cavity 100mm. concrete block outer leaf <b>200mm. dense wood Gutex Thermosafe-gf (<math>\lambda</math>=0.043)</b> 5mm. render ( $\lambda$ =0.8) U=0.16
Ceilling first floor	.12.5.mm. plaster wallboard (λ=0.18) U=3,70	12.5 mm plaster wallboard ( $\lambda$ =0.18) Trussed rafters 100 x 50 mm. bottom chord 100 mm. cellulose fibre between trussed rafter bottom chord ( $\lambda$ =0.046) 100 mm. Gutex Multiplex Top over trussed rafter bottom chord ( $\lambda$ =0.046) U=0.22
Pitched roof	Timber rafters No insulation Tiles on battens 18mm. concrete roof tiles (λ=1.5)	rafters Air tightness layer PE 0,15mm Pro Clima Intello Plus or Pro Clima DB+ 200mm. dense wood Gutex Thermosafe Multiplex Top ( $\lambda$ =0.046) 200mm. dense wood Gutex Thermoflex ( $\lambda$ =0,039) Wind tightness layer PE 0,15mm ( $\lambda$ =0.17) Pro clima Solitex Plus 18mm. concrete roof tiles ( $\lambda$ =1.5) U=0.10







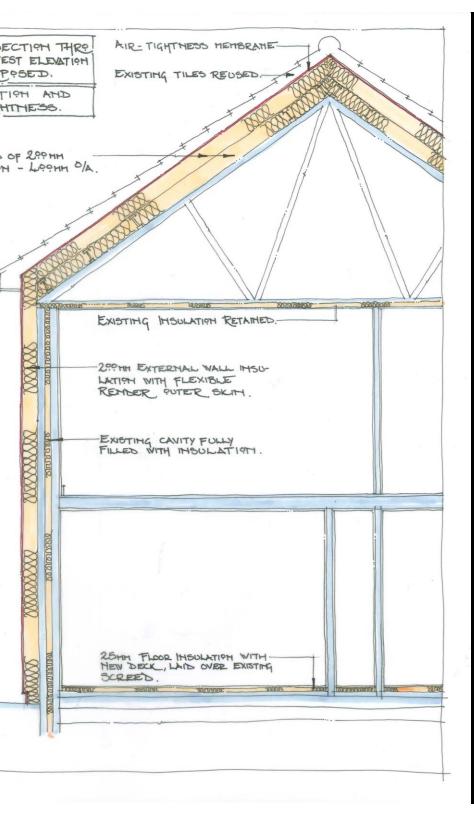
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## Inuit Indians

Wind tight igloo, Insulated windtight moisture permeable fur coat,

- Reduce heating/energy demands by insulating roof and external wall
  - Tea cosy approach
  - Wrap up all construction with insulation
  - Wrap up cold bridges

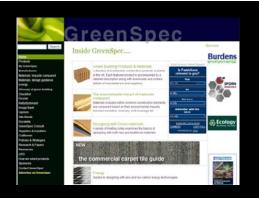




# **Outside of building**

- Concrete tile hanging removed and saved
- Cold bridge projection cut off flush
- Cavity insulated

- External insulated render
  - **Remove existing insulation** 
    - cellulose fibre 100 mm.
    - Wood fibre 100 mm.
    - 20 mm. insulation to concrete floor
      - Vacuum Insulating panel
      - Aerogel Insulation quilt
      - High decrement dense wood fibre



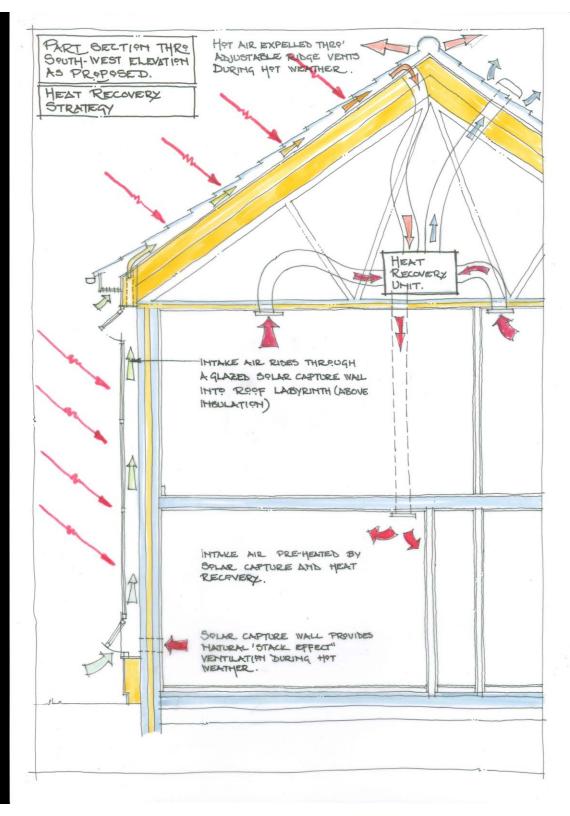


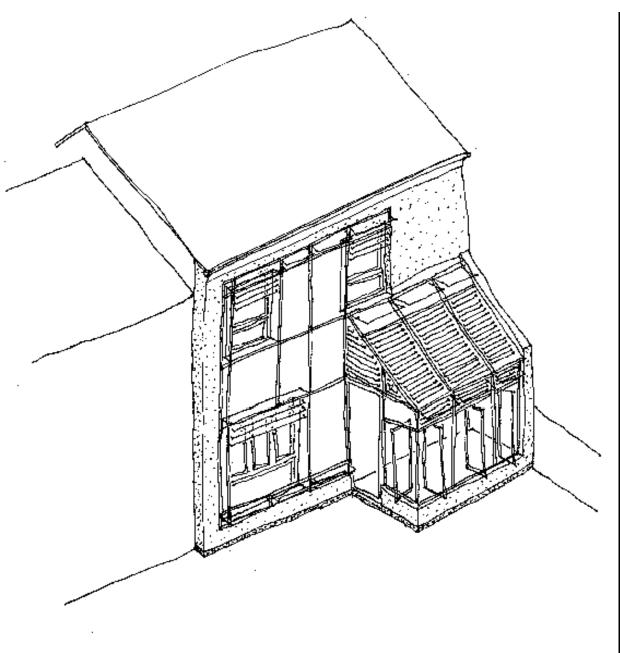


- Heat gain in roof tiles transferred to
   labyrinth below
- Edinburgh refurbishment exploited
   these gains
- Heat loss into party wall identified by Leeds Met University as a major loss
- Add a simplified Trembe wall
- Collect heat from all 3

## Labyrinth Heat Recovery

- Under concrete roof tiles re-laid
- Batten and counterbatten labyrinth
- Cold bridge projection cut off flush
- Cavity insulated
- Party wall heat loss recovered too
- External insulated render
- Tubes through insulation
- Glazed wall: like Trombe wall





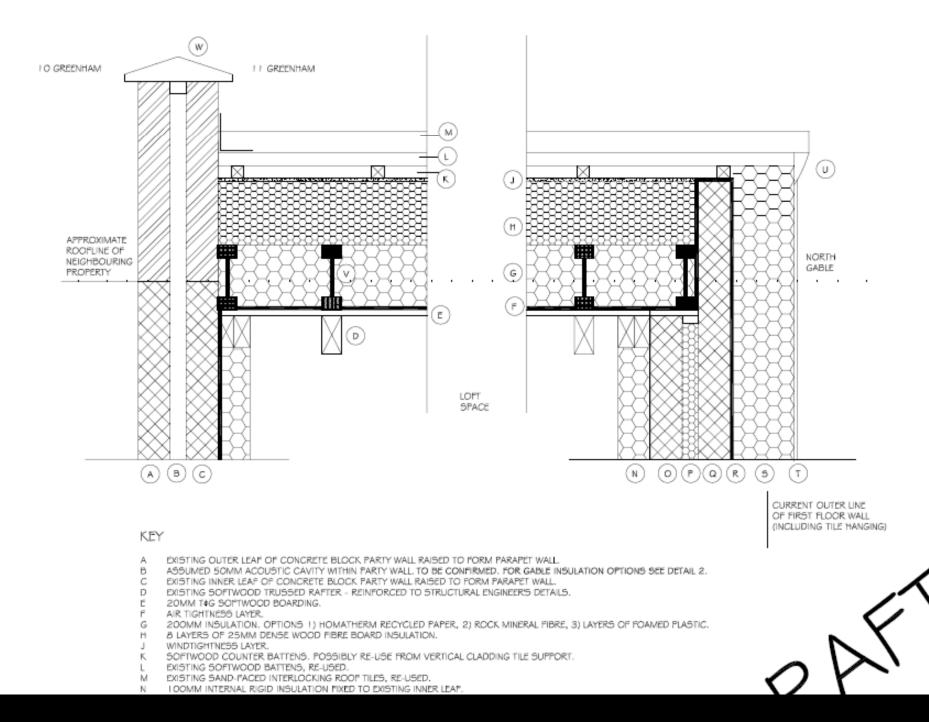
SKETCH SHOWING SOLAR WALL WITH SUNSPACE AND PERIPHERAL RENDERED INSULATION

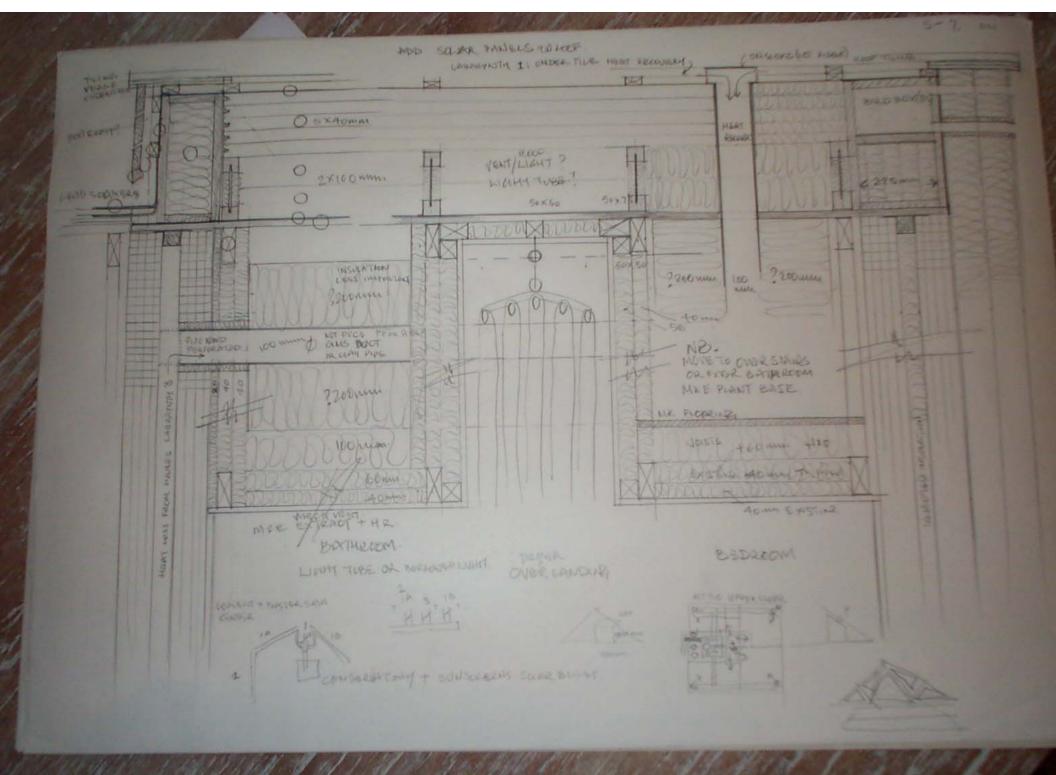
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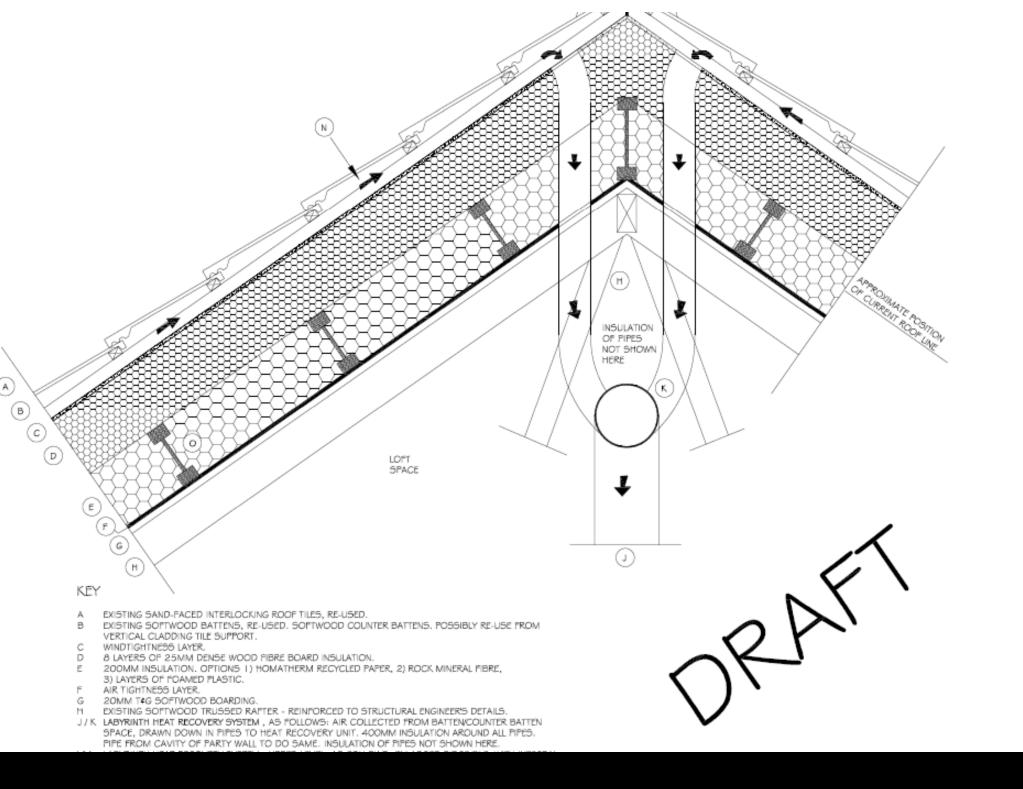
11 GREENHAM, BRETTON

# Porch/ Lobbies

- Weather lobbies on front and rear doors
- Help prevent excessive heat loss and coolth gains
- Ventilate and shade in summer
- Trap sun in winter





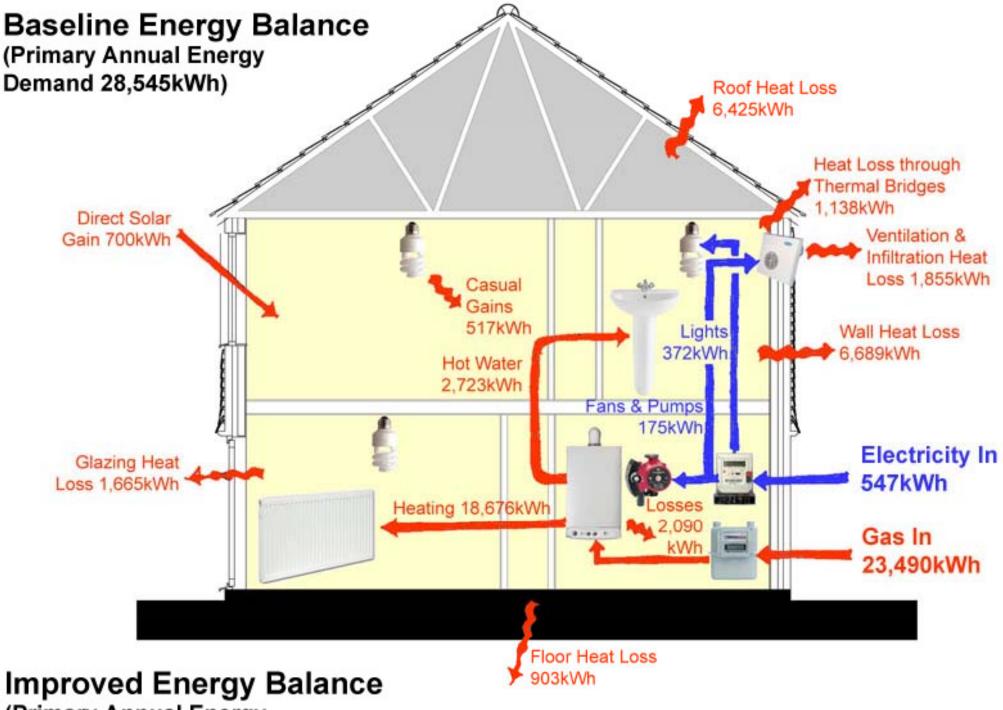




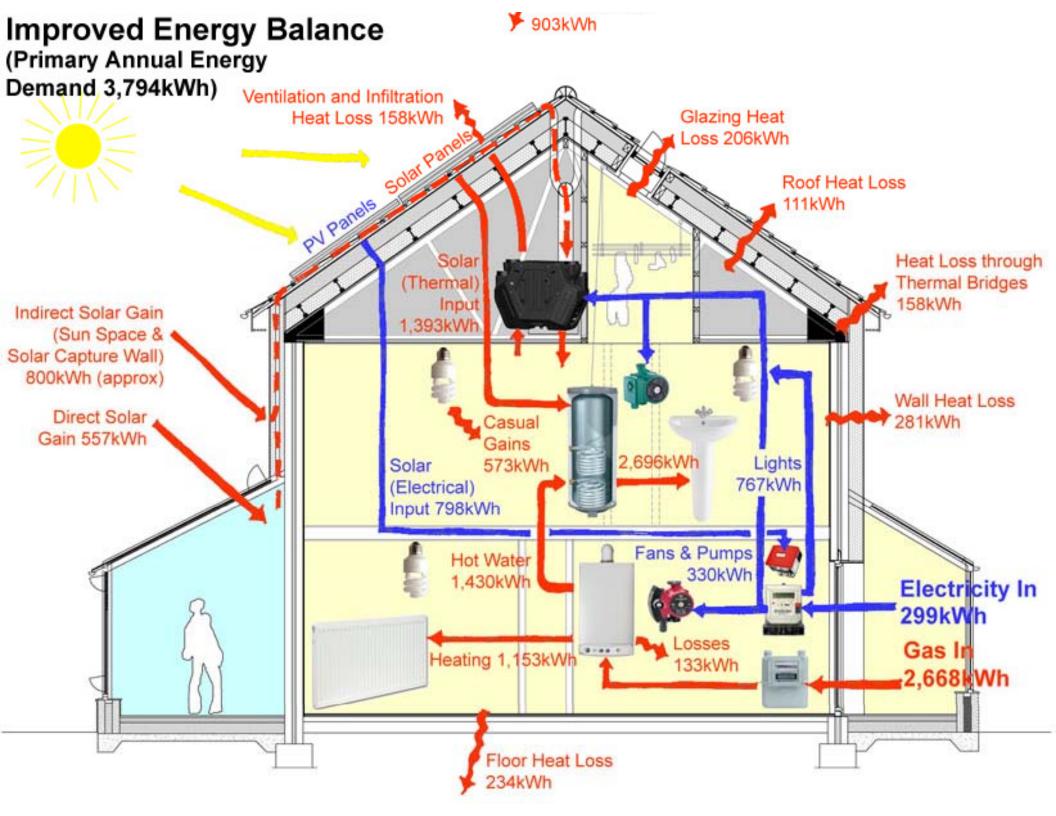
- Starting point
  - How bad it is
  - Building fabric and services
- Proposals
  - How good it could be
  - Improvement made
  - Building fabric,

<sup>18/04/2010</sup> – services, meters, monitoring and controls <sup>23</sup>

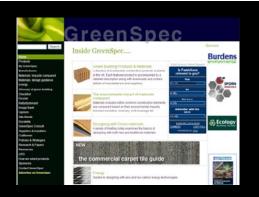
### **11 Greenham, Peterborough**



(Primary Annual Energy











- Determine the cost of each component
- Price the parts and labour
- Keep in budget
- Cost Effectiveness: £.00 per CO<sub>2</sub> saved

#### **RETROFIT FOR THE FUTURE - CARBON CHALLENGE**

#### **11 GREENHAM**

#### ELEMENTAL COST PLAN **REVISION A**

ELEMENT	WORK SECTION	COST	COMMENTS
		£	
SUBSTRUCTURE	WORKS TO EXISTING FLOORS	3,410.00	
SOBSTRUCTURE	WORKS TO EXISTING FLOORS	3,410.00	
ROOF	FORM ATTIC PLATFORM	994.00	
	FORM CLOTHES AREA	1,061.00	
	INSULATION	11,799.00	
	AIR AND WIND TIGHNESS MEMBRANES	488.00	
	WORK TO ROOF STRUCTURE	3,902.00	
	BUILDERS WORK INCL. RWG	2,959.00	
EXTERNAL WALLS	RAISE GABLE END	010.00	
EXTERNAL WALLS		910.00	
	INSULATION	6,197.00	
	RENDER	2,342.00	
	AIRTIGHTNESS MEMBRANES	861.00	
	BUILDERS WORK	1,788.00	
WINDOWS AND	NEW WINDOWS	8,410.00	
EXTERNAL DOORS	BUILDERS WORK	247.00	
	SUNSPACE CONSTRUCTION	10 750 00	
SUNSPACE, PORCH &	SUNSPACE CONSTRUCTION	13,756.00	
SOLAR COLLECTOR	PORCH COMPLETE	7,146.00	
	SOLAR COLLECTOR WALL	11,879.00	
NTERNAL WALLS	INSULATION AND AIRTIGHT MEMBRANE	575.00	
	BUILDERS WORK	1,780.00	
FIXTURES & FITTINGS	LIGHT TUBE	602.00	
	SUNDRIES	454.00	
	CONDICIES		
DECORATIONS		1,500.00	
SERVICES	PHOTOVOLTAIC PANELS: 10m2 MONOCRYSTALINE	4,250.00	Including £4250 grant contributior
	WHOLE HOUSE MV SYSTEM	2,500.00	mendaling 24200 grant contribution
	WHOLE HOUSE MV STSTEM	2,500.00	
	SOLAR HOT WATER: 8m2 EVACUATED TUBE	3,000.00	Including COOOO great contribution
			Including £3000 grant contribution
	LED LIGHTING AND DC CABLE NETWORK	1,500.00	
DRAINAGE	BELOW GROUND DRAINAGE	784.00	
PRELIMINARIES	SCAFFOLDING	1,559.00	
ILLIWIN/ARIES			
	GENERAL (Including supervision/welfare/H & S/skips e	c) 11,650.00	
<b>IETERING</b>	SMART METERING AND DISPLAY EQUIPMENT	3,500.00	
	SUB TOTAL	111,803.00	131368.5
			0
CONSULTANTS FEES	@ 13%	13,975.38	16421.07
enant Education and Inc	entivisation	1,500.00	0 1762.5
shart Equodion and Inc		1,000.00	0
	Total	127,278.38	149552.1
	VAT @ 17.5%	22,273.72	
	PROJECT TOTAL COSTS	149,552.09	

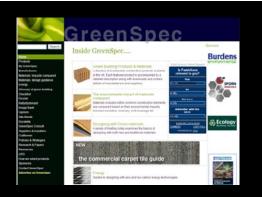
#### NOTES

18/04/2010

1 VAT ASSUMED AT 17.5%(NOT15%)

2 ALL COSTS EXCLUDE REPLACEMENT KITCHENS/BATHROOMS AND FLOOR COVERINGS AND ASSOCIATED REDECORATION 3 POTENTIAL 50% GRANT REBATES ON CERTAIN ITEMS HAVE BEEN INCLUDED WITHIN THESE COSTS

3



# Materials



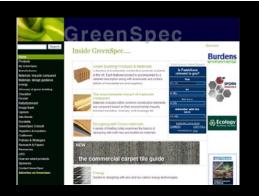


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# TSB Retrofit Brief – Low Carbon in Use

- Materials
  - Can also be Low Carbon in manufacture
  - And also be:
    - Zero Carbon
    - or Carbon Negative
  - Carbon Sequestration during growth







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# Scope & Spec

- Scope of work:
  - Existing
  - Removals, Modifications
    - Material reclaims, reuses & exchanges
  - Additions
- Specification:
  - Applications
  - Materials
- 18/04/2010 Products © NGS 2008-10 BrianMurphy

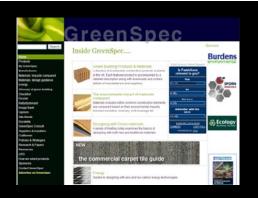
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TSB-RETROFIT- COMPETITION- UKCEED-ENTRY
OUTLINE · SPECIFICATION
Brian Murphy GreenSpec¶
Tuesday, 10 November 2009
Extracted from Spreadsheet Tuesday, 10 November 2009
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C00 → ANALYSIS:¶
C10/00.1 → Site·Survey: Biodiversity¶
Location(s): Site¶
Level(s): All¶
¶
C13/00.4 - Resource efficiency: Analyse Pre-alteration survey for any additional reapplication uses for surplus
materials¶
Level(s): All¶
¶
C13/00.5 - Surplus to requirements materials: offer to Employer's maintenace department for use on estate
Location(s): On site
Level(s): None¶
Material: Existing sand faced concrete
¶
C13/00.6 - Surplus to requirements materials: unused and unuasable materials to transfer station for segregation
and recycling or reuse
Location(s): Off site
Level(s): None
Overall thickness: Material: Existing sand faced concrete
Service provider: EcoCentre Dogsthorpe Peterborough¶
C13/00.2 - Building Survey: Biodiveristy
Reference Drawing(s): Existing
Location(s): Building
Level(s): All¶
Orientation or elevation: All¶
```

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# © GreenSpec

- Brian Murphy BSc Dip Arch (Hons+Dist)
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- Specification Writer by Choice
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