# New homes
# – towards zero carbon?

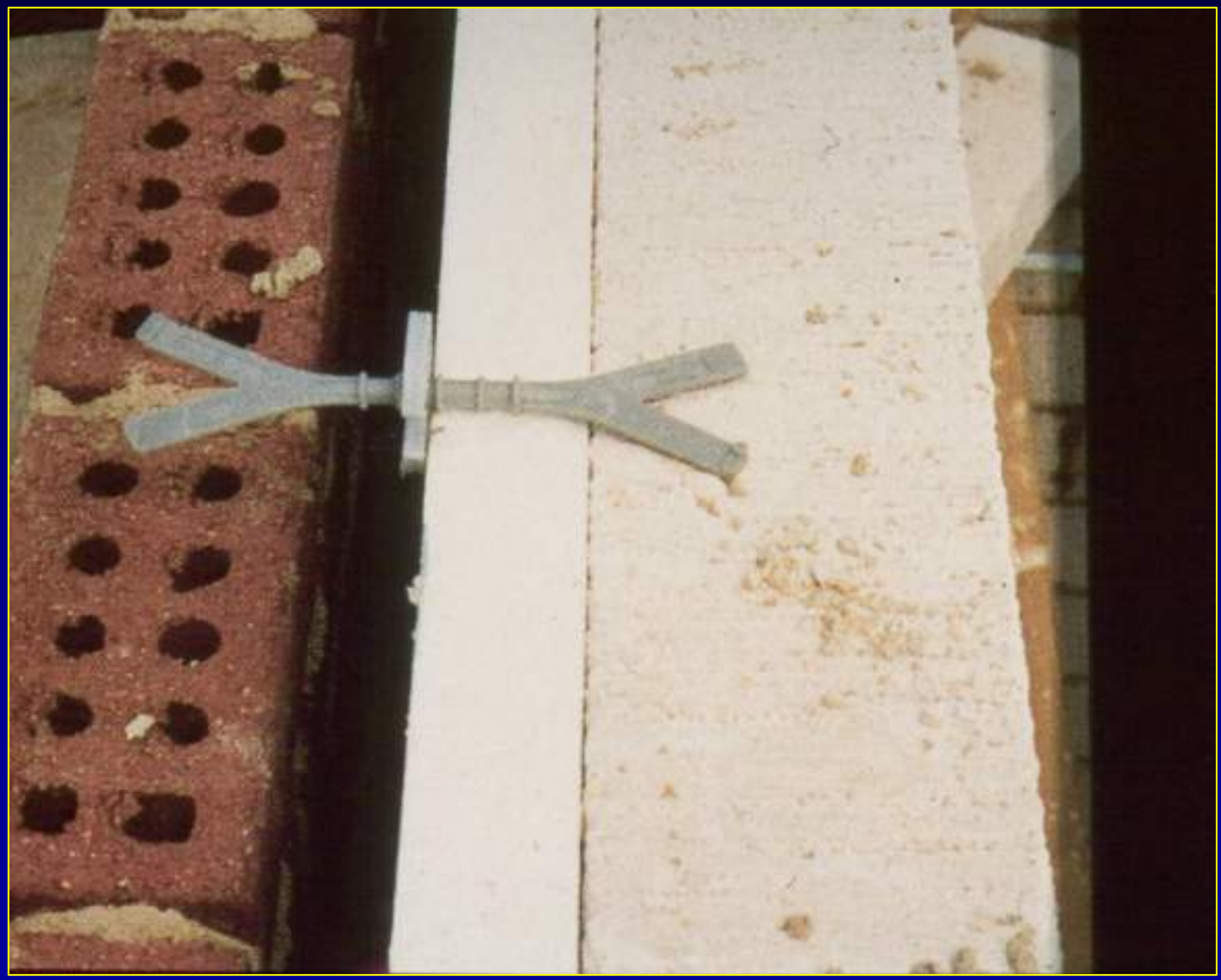
**Patrick Waterfield**

**John Willoughby**

# Part F1/L1A compliance – Base Case

- 3-bed Semi
- Approximately 90 $m^2$ floor area
- Masonry cavity construction
- Built to 2006 F1/L1A standard
- Whole House $CO_2$ target
- Improvement options?

# Walls – 60mm polyiso - U=0.3 W/m$^2$K

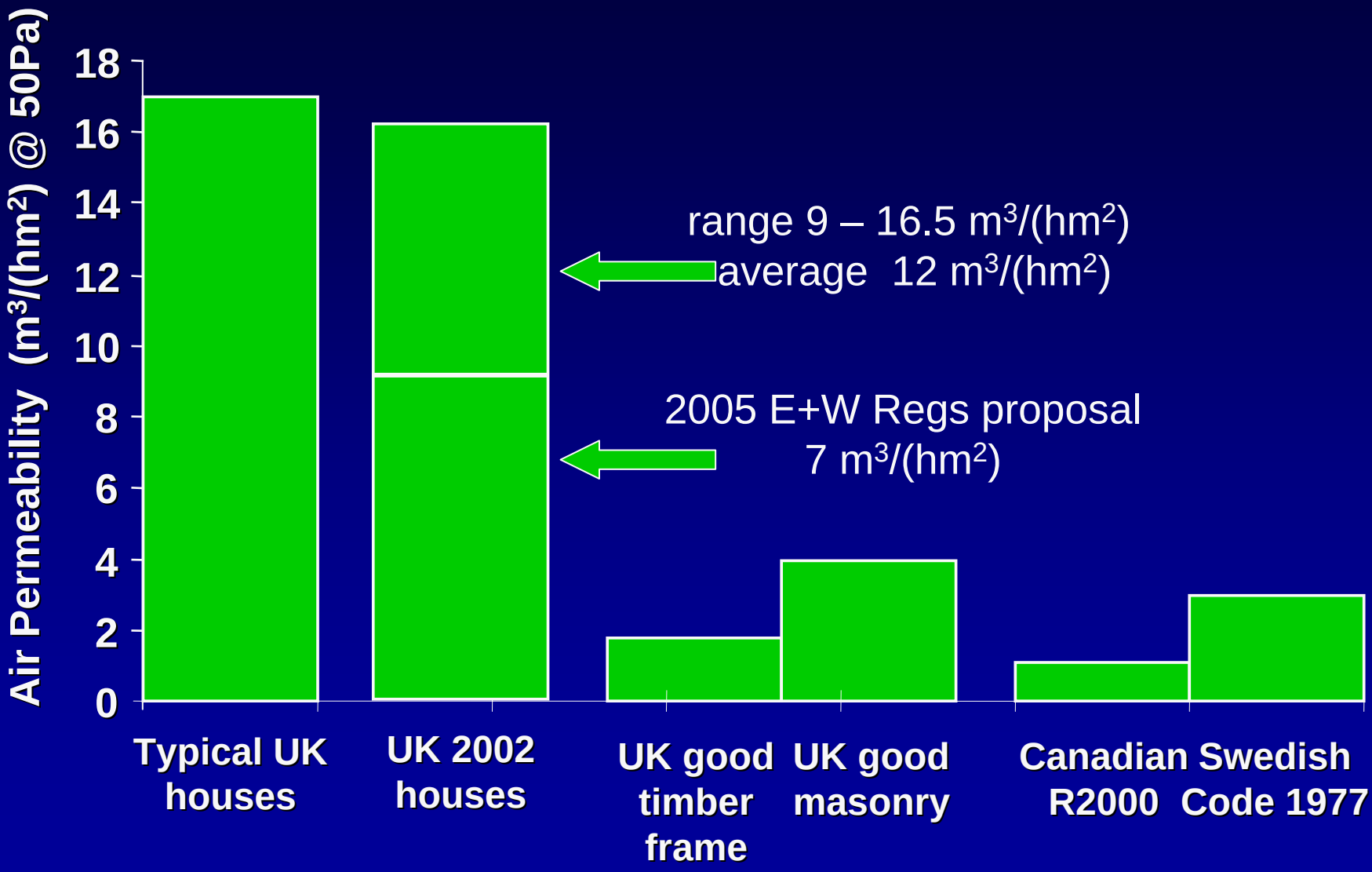


# Roof – 300mm blown MF - U=0.14 W/m$^2$K

# Floor – 50 mm PU – U=0.25 W/m$^2$K

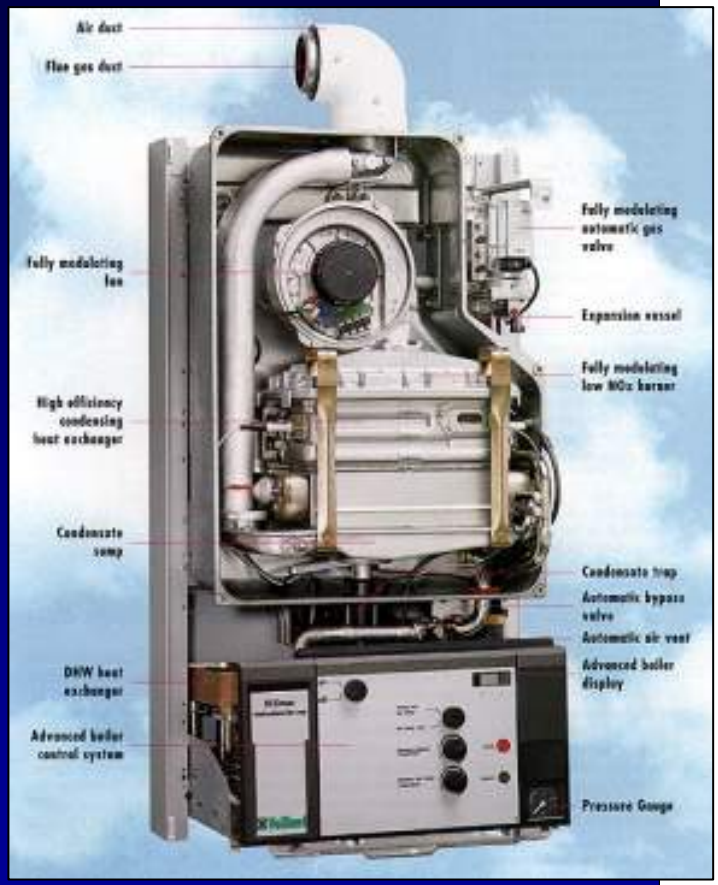
# LowE Ar double glazing – U=1.8 W/m$^2$K

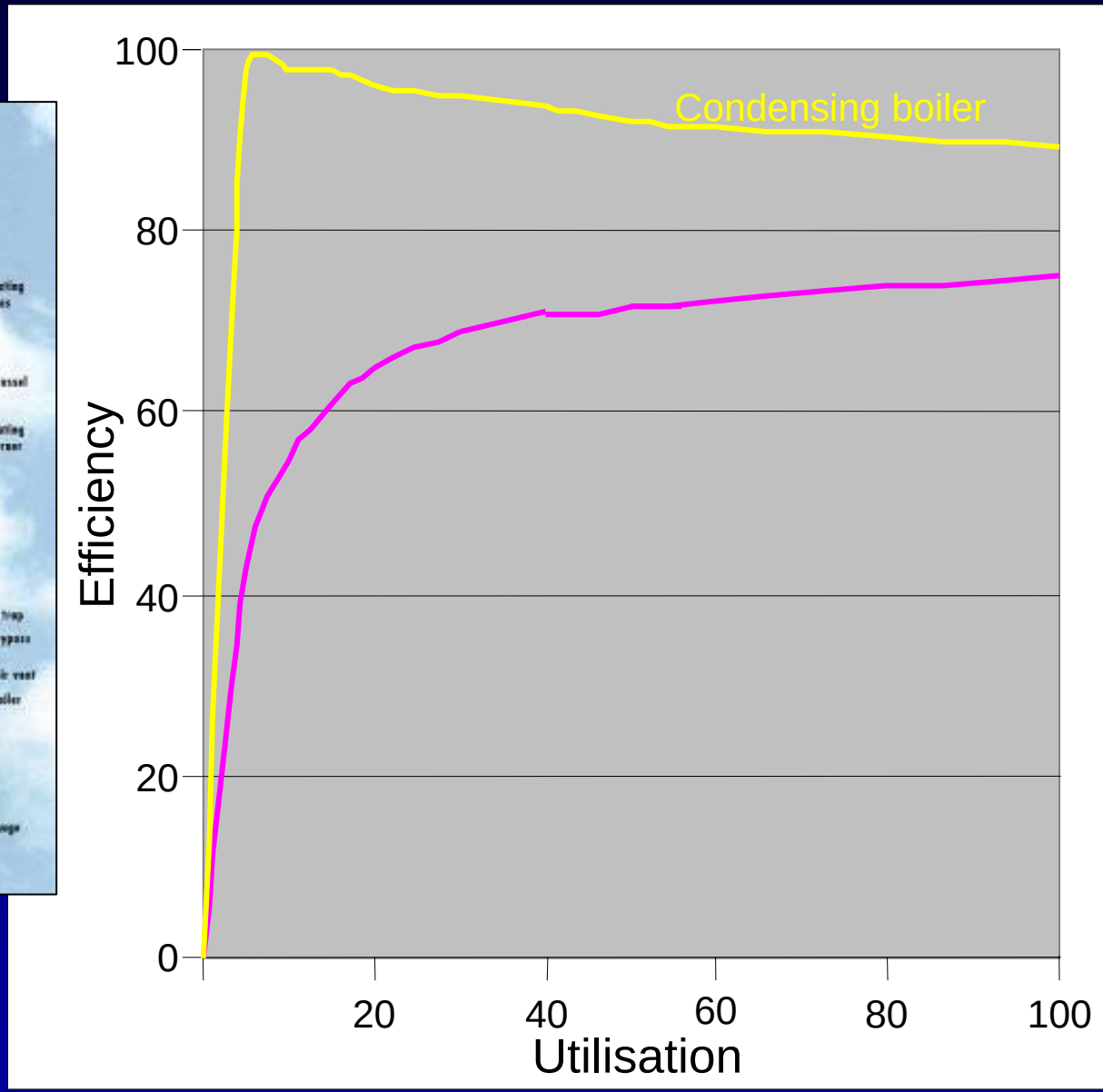
# Air Permeability 10 $m^3/(hm^2)$ @50 Pa



# Extract Ventilation

# Condensing Combi



# Timer and Roomstat


# Temperature Control - TRVs

# Gas-Fired Room Heater - 2° heating

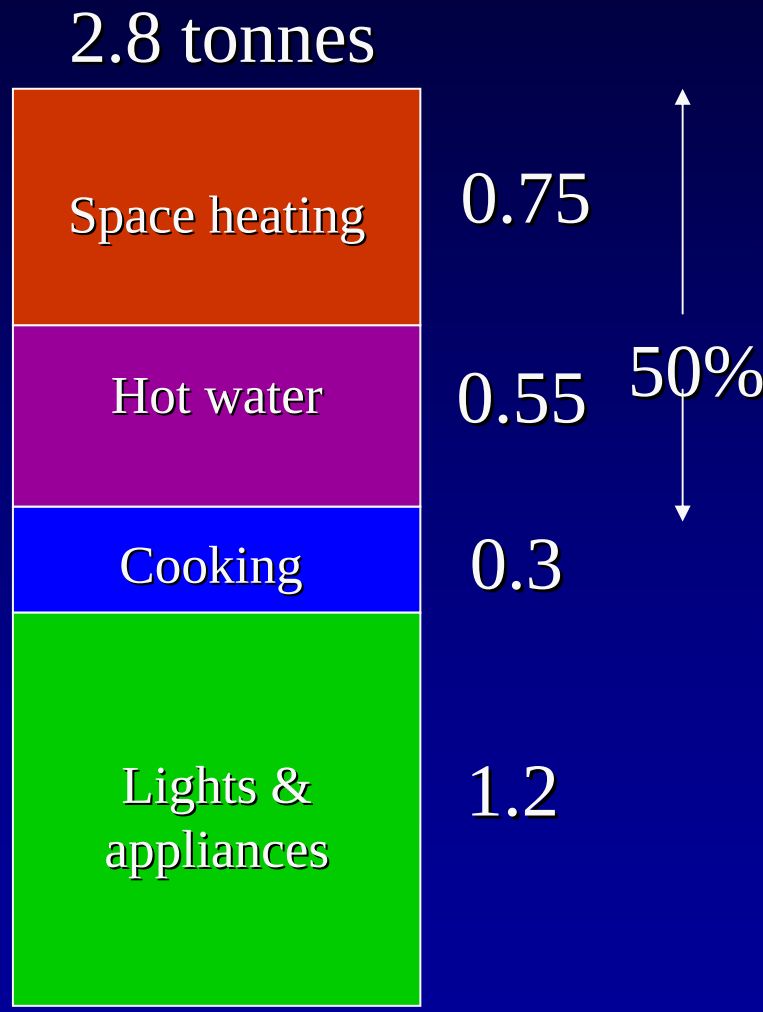
# 30% dedicated low energy lights

# Base Case – Annual Costs

£590

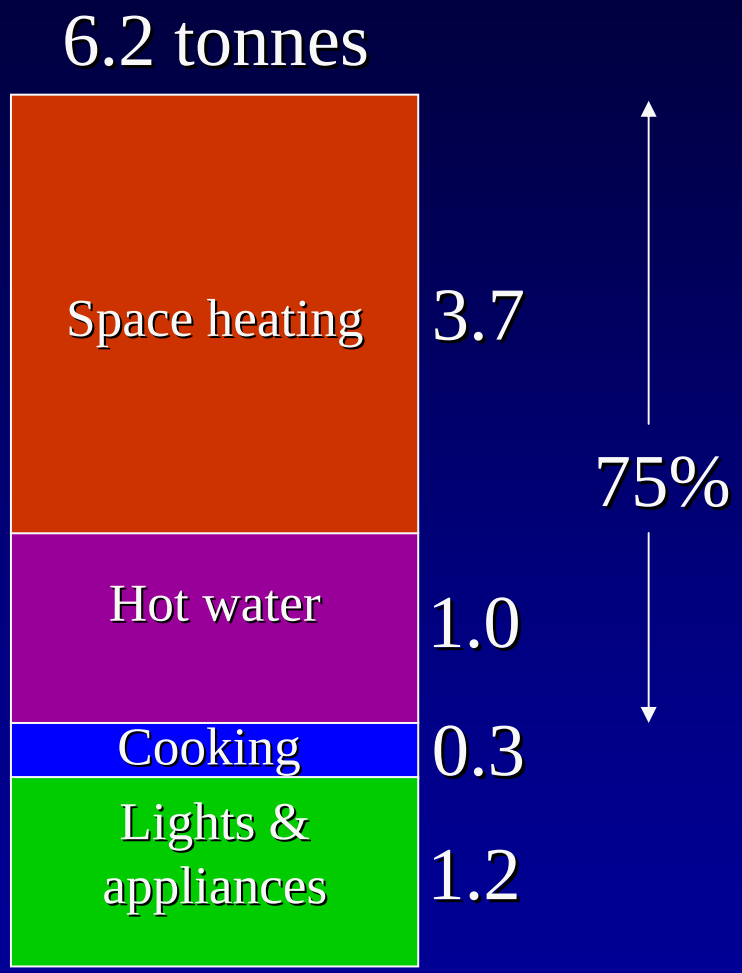
| | |
|---|---|
| Space heating | £100 |
| Hot water | £70 |
| Cooking | £60 |
| Lights & appliances | £300 |
| Stdg Charges | £60 |

# Base Case – $CO_2$ emissions (tonnes pa)



# Typical 30s 3-bed semi

£1,030/yr (£590)



# Improvement measures

- Simple heating measures
- Improved airtightness
- Improved thermal bridging
- Increased insulation
- Low energy lights
- Best Practice standards
- Low energy appliances
- Advanced standards
- Renewables


acl Drayton
20
10
30
RTS5
SAVE


HEATING
SAVING
WATER
RESPONSE RATE
OFF
ON
COMPENSATOR
BEM 5000

# Improvement measures – heating (15 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Heating | £450 | 82 | 1,230 | £366 |

Capital costs based on a development of 30 houses

8 year life for electrical appliances

15 years for heating

30 years for windows and airtightness measures

60 years for fabric measures

# Improvement measures

- Simple heating measures
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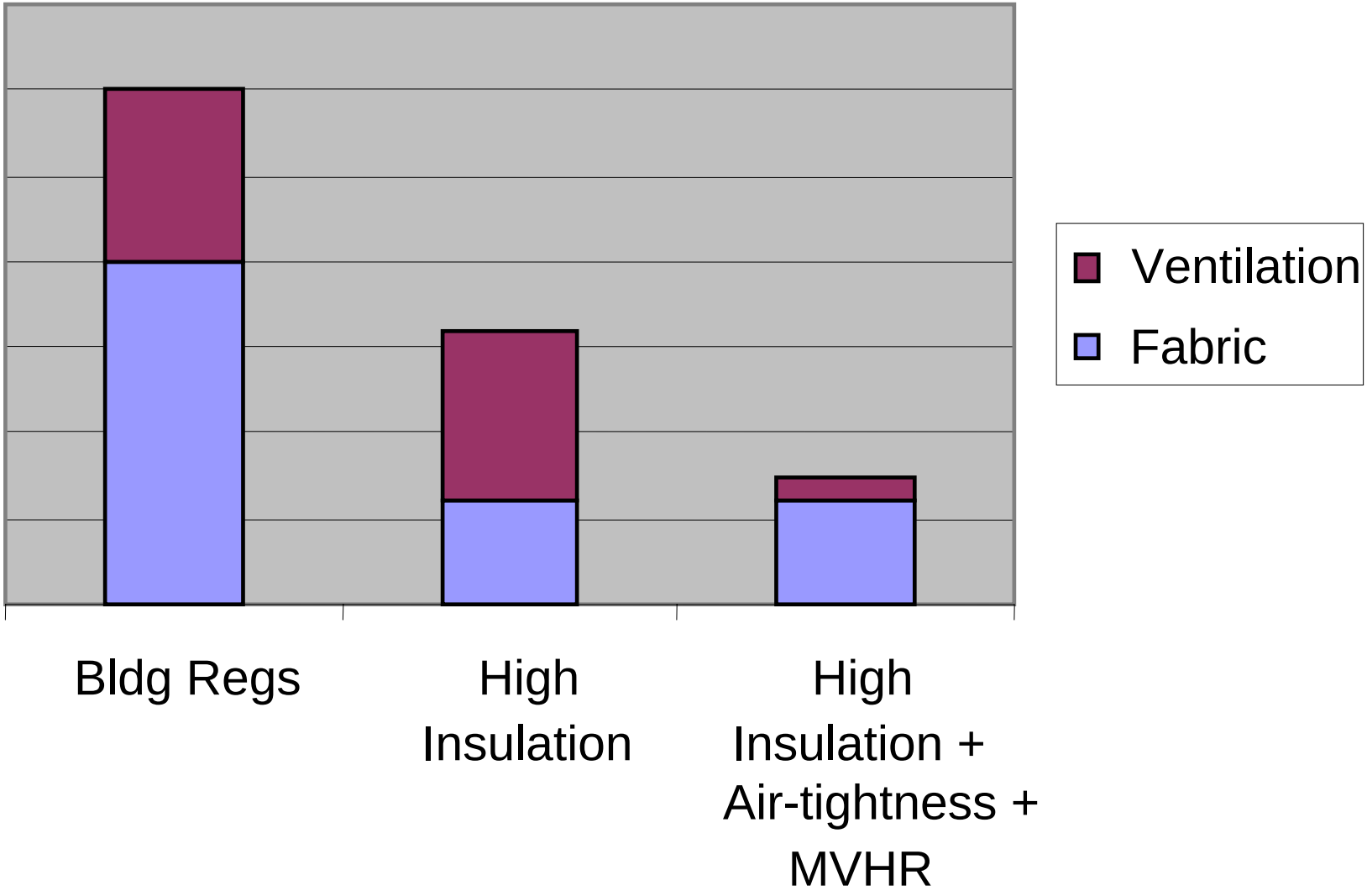
# Fabric and Ventilation Heat Losses



# Wembley (1998) – 3 $m^3/(hm^2)$

# Improvement measures – airtight (30 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Airtightness | £1,079 | 86 | 2,580 | £418 |

NB Most of cost due to MVHR

# Improvement measures

- Simple heating measures
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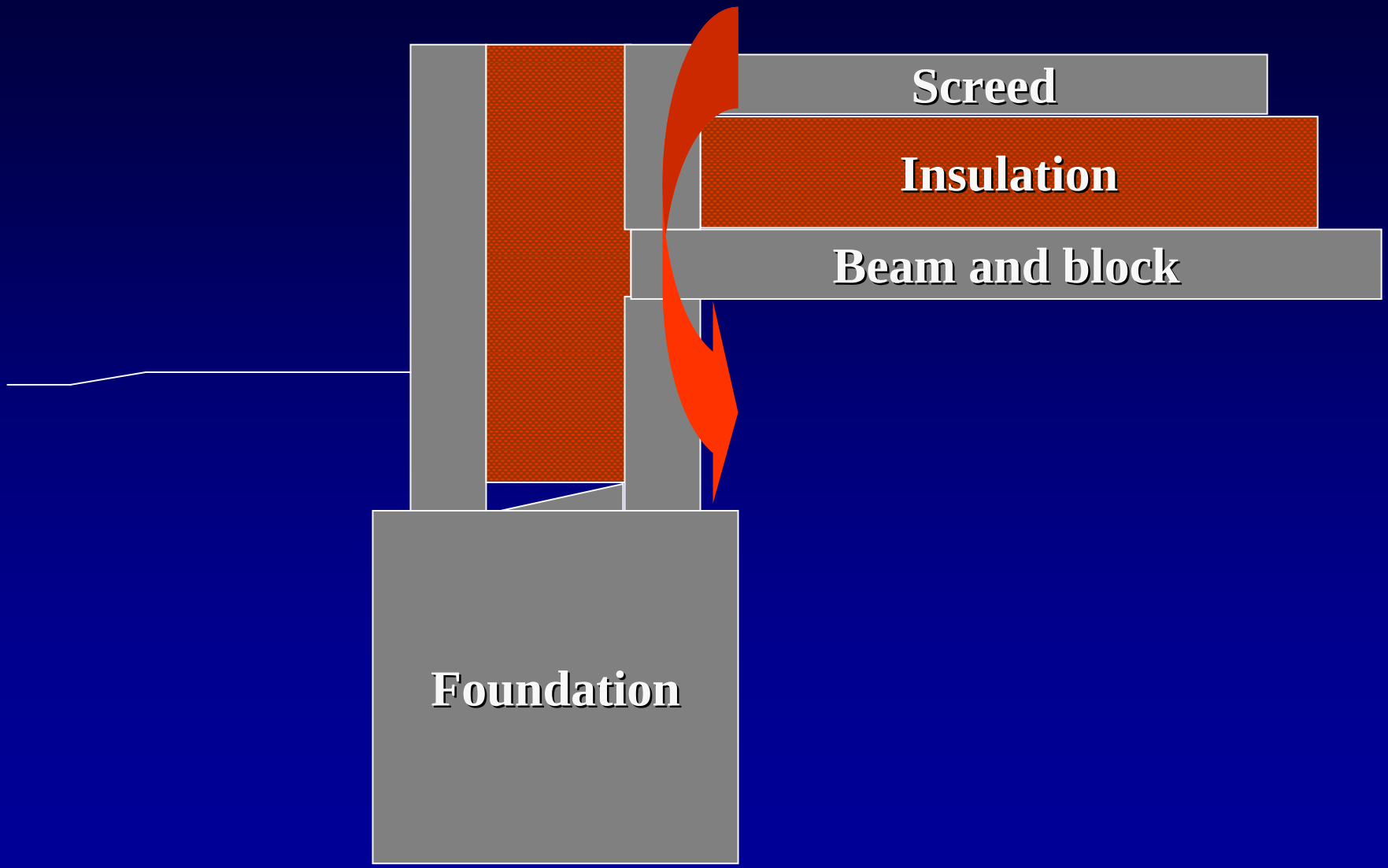
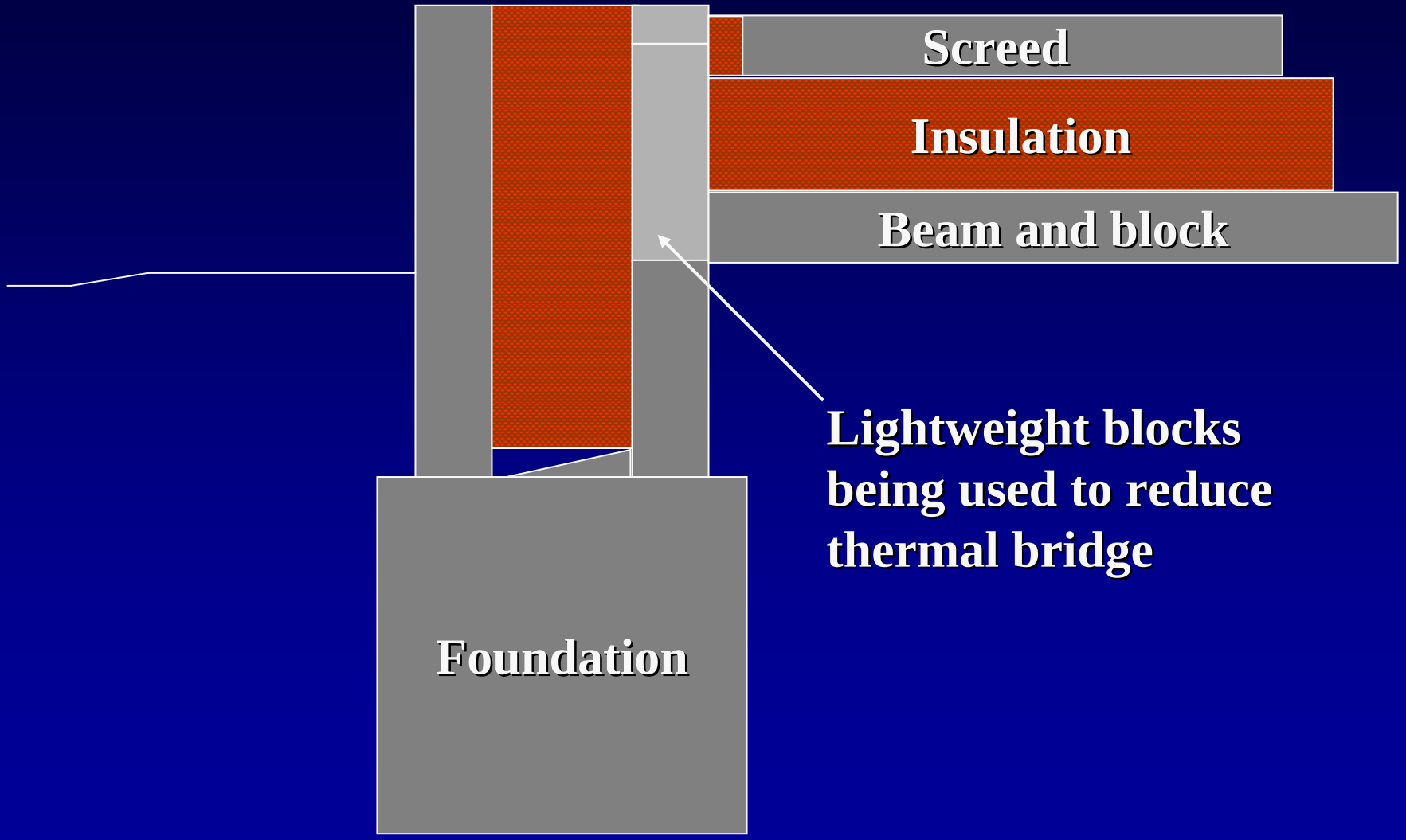
- Renewables

# Linear thermal bridges



# Linear thermal bridges



# Hillcrest Park, Exeter (2004)

# Improvement measures – bridges (30 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Thermal bridges | £205 | 92 | 5,520 | £37 |

NB Other measures to reduce thermal bridging include separate lintels – little if any overcost

# Improvement measures

- Simple heating measures
- Improved airtightness
- Improved thermal bridging
- Increased insulation
- Low energy lights
- Best Practice standards
- Low energy appliances
- Advanced standards
- Renewables

# 150 mm fully filled cavities

# Improved insulation U-values

| | | $W/m^2K$ | |
|---|---|---|---|
| Walls | 150 mm MF | 0.21 | (0.3) |
| Roof | 350 mm MF | 0.12 | (0.14) |
| Floor | 100 mm PU | 0.16 | (0.25) |
| Windows | super lowE Ar | 1.5 | (1.8) |
| Doors | insulated | 1.0 | (3.0) |

# Improvement measures – insulation (60 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Insulation | £785 | 226 | 13,560 | £58 |

# Improvement measures

- Simple heating measures
- Improved airtightness
- Improved thermal bridging
- Increased insulation
- Low energy lights
- Best Practice standards
- Low energy appliances
- Advanced standards
- Renewables

# 70% Dedicated Low Energy Lighting

# Improvement measures – lighting (8 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Insulation | £75 | 57 | 456 | £164 |

# Improvement measures

- Simple heating measures
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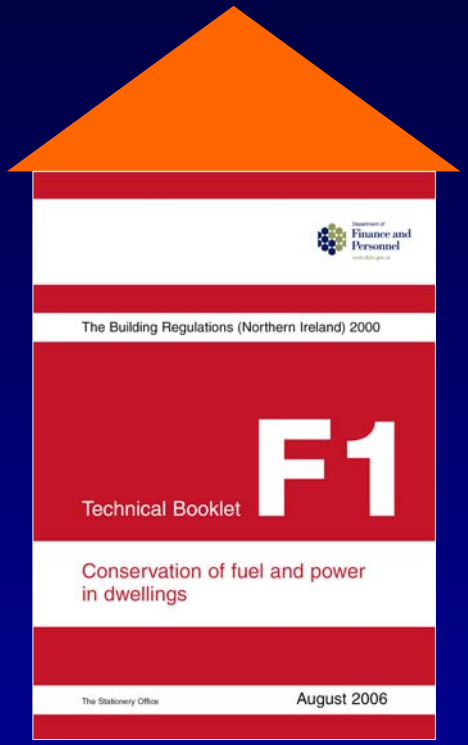
# Interim EST Best Practice standards




TER

x 0.75 =

Best Practice

Additional limits also required

# Interim EST Best Practice standards


TER

x 0.75 =

Best Practice

Additional limits also required

# Improvement measures – Best Practice Std

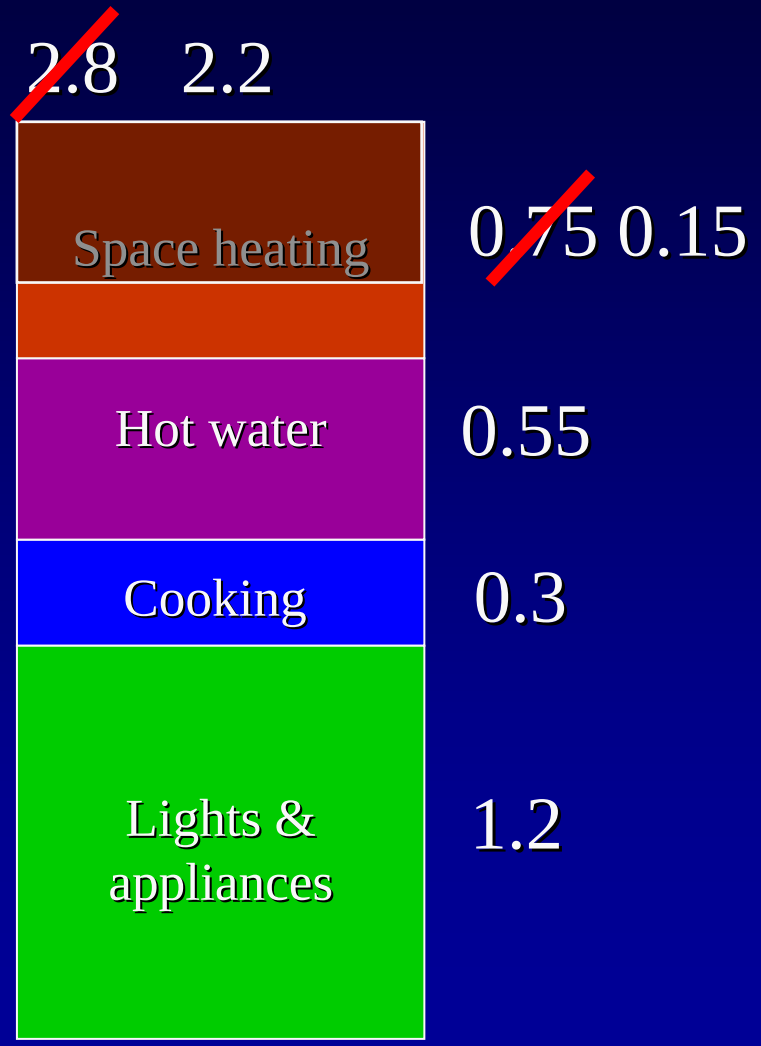
| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Best Practice Standard | £4,294 | 705 | 23,634 | £182 |

# Best Practice

~~£590~~ £510

| | |
|---|---|
| Space heating | ~~£100~~ £20 |
| Hot water | £70 |
| Cooking | £60 |
| Lights & appliances | £300 |
| Stdg Charges | £60 |

# Best Practice – $CO_2$ emissions (tonnes pa)




**Switching to A rated appliances in all new homes**

**10,250 tonnes $CO_2$/yr**

**£1.75 million/yr**

# Improvement measures –appliances (8 yrs)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Electrical appliances | £1,400 | 386 | 3,088 | £453 |
| Electrical appliances | £300* | 386 | 3,088 | £97 |

*marginal extra cost of more efficient system

# Improvement measures

- Simple heating measures
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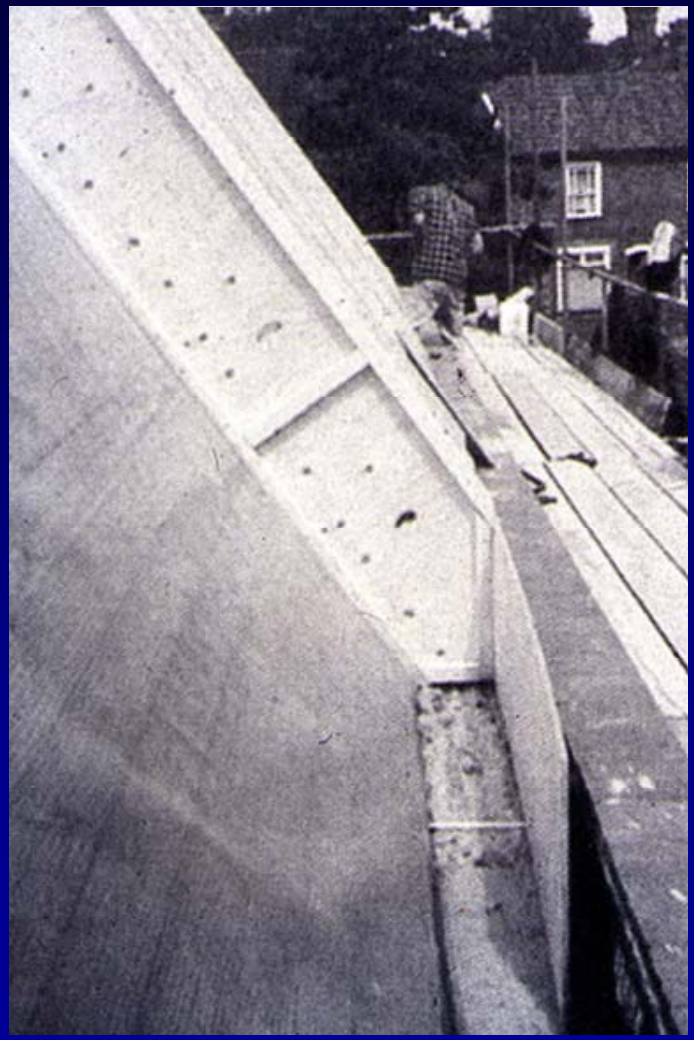
# Advanced Standard



| | | U (W/m$^2$K) |
|---|---|---|
| Roof | 500mm MF | 0.08 |
| Walls | 250mm MF | 0.11 |
| Floor | 300mm EPS | 0.11 |
| Triple glazed lowE Kr | | 0.8 |
| 1 m$^3$/(hm$^2$) @50 Pa | | |
| Advanced MVHR | | |

# Improvement measures – Advanced std

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Advanced standard | £13,750 | 1,840 | 37,500 | £367 |

# Advanced with low energy appliances

£340 (£590)

| | |
|---|---|
| Hot water | £70 |
| Cooking | £60 |
| Lights & appliances | £150 |
| Stdg Charges | £60 |

# Advanced Standard – $CO_2$ emissions

1.4 (2.8)

| | |
|---|---|
| Hot water | 0.55 |
| Cooking | 0.3 |
| Lights & appliances | 0.6 |

# Improvement measures

- Simple heating measures
- Improved airtightness
- Improved thermal bridging
- Increased insulation
- Low energy lights
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- Low energy appliances
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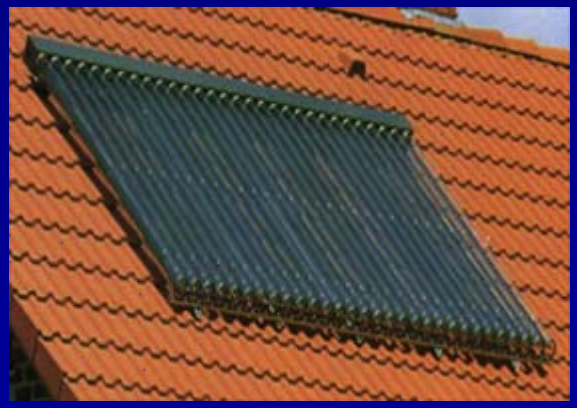
# Renewable technologies

Biomass

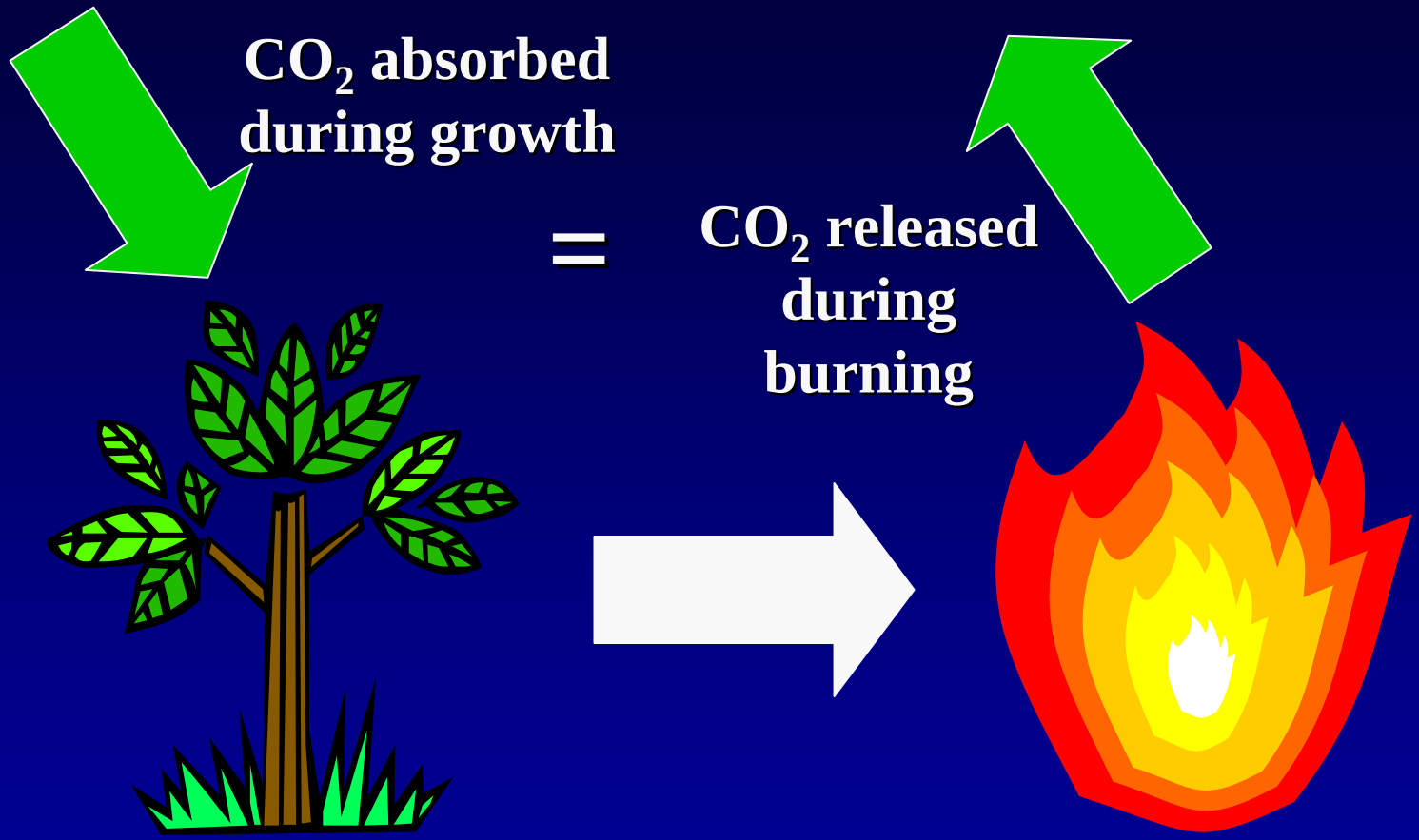
Solar electric (PV)



Solar thermal

Wind

# Wood fuel – carbon neutral



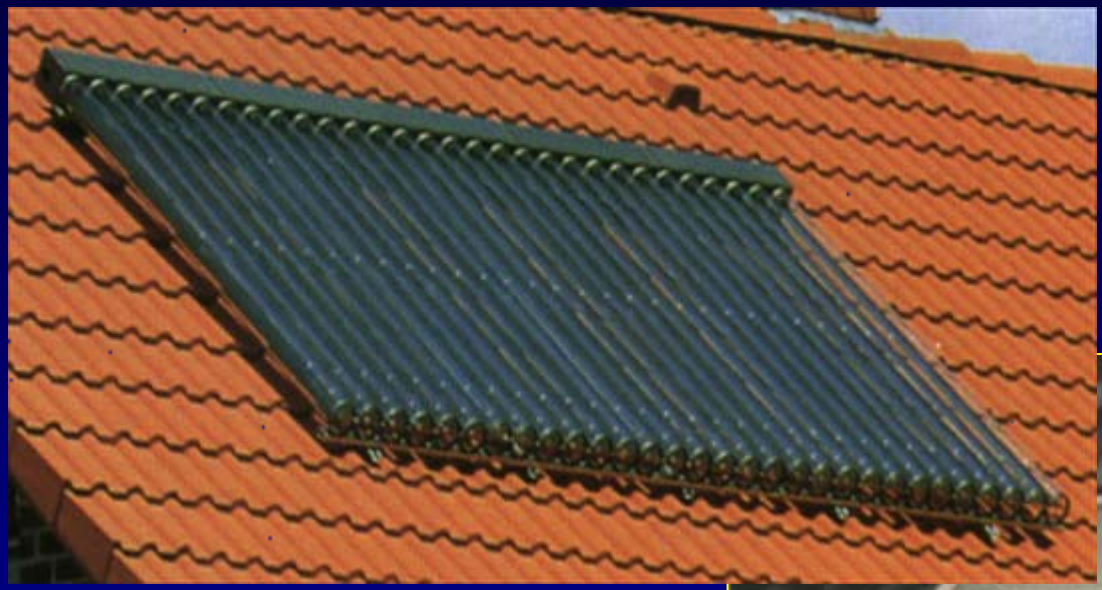

**Little $CO_2$ released from felling and transportation**

# Improvement measures – wood boiler (15yr)

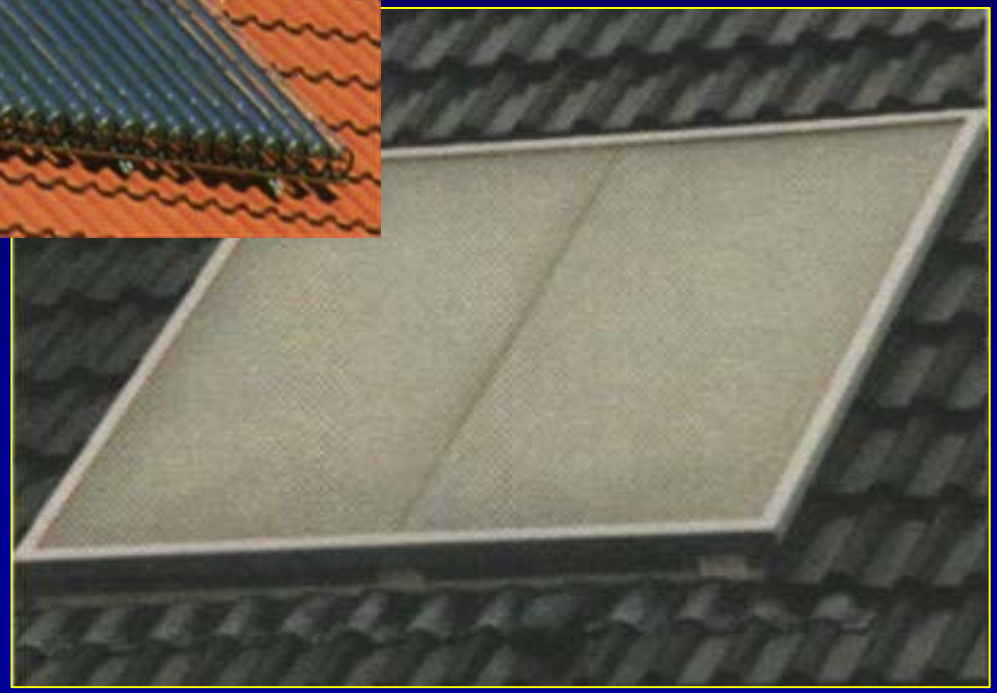
| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Wood boiler | £5,000 | 1,042 | 15,630 | £320 |

- NB Compared to Base Case

# Renewables – solar hot water



Evacuated tubes



Flat plate

# Improvement measures – solar hot water (15 yr)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| Solar hot water | £2,500 | 275 | 4,125 | £606 |

# Renewables – solar photovoltaics

Lights & appliances 15 $m^2$

All $CO_2$ emissions 40 $m^2$

# Improvement measures – Photovoltaics (15 yr)

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| 28 $m^2$ PV | £20,000 | 1,431 | 21,470 | £932 |

# Renewables – wind


1kW

5kW

225kW

# Improvement measures – wind power

| Measure | Cost | $CO_2$ saving (kg/yr) | Lifetime $CO_2$ (kg) saved | £spent/tonne saved |
|---|---|---|---|---|
| 400 W | £1,500 | 150 | 1,200 (8 yr) | £1,250 |
| 6 kW turbine | £20,000 | 5,000 | 50,000 (10) | £400 |
| 75 kW turbine | £120,000 | 60,000 | 900,000 (15) | £200 |
| 850 kW turbine | £1m | 740,000 | 18,450,000 (25) | £55 |

# Improvement measures – low cost

**Less than £200 / tonne**

- **Thermal bridges**
- **Large scale wind power (NOT green tariff!)**
- **Insulation**
- **Low energy lights**
- **Low energy appliances (marginal cost)**
- **Best Practice standard**

# Improvement measures – medium cost

**£200 - £600 / tonne**

- **Wood heating & hot water**
- **Advanced Standard**
- **Improved gas heating**
- **Improved airtightness**
- **Low energy appliances (whole cost)**

# Improvement measures – high cost

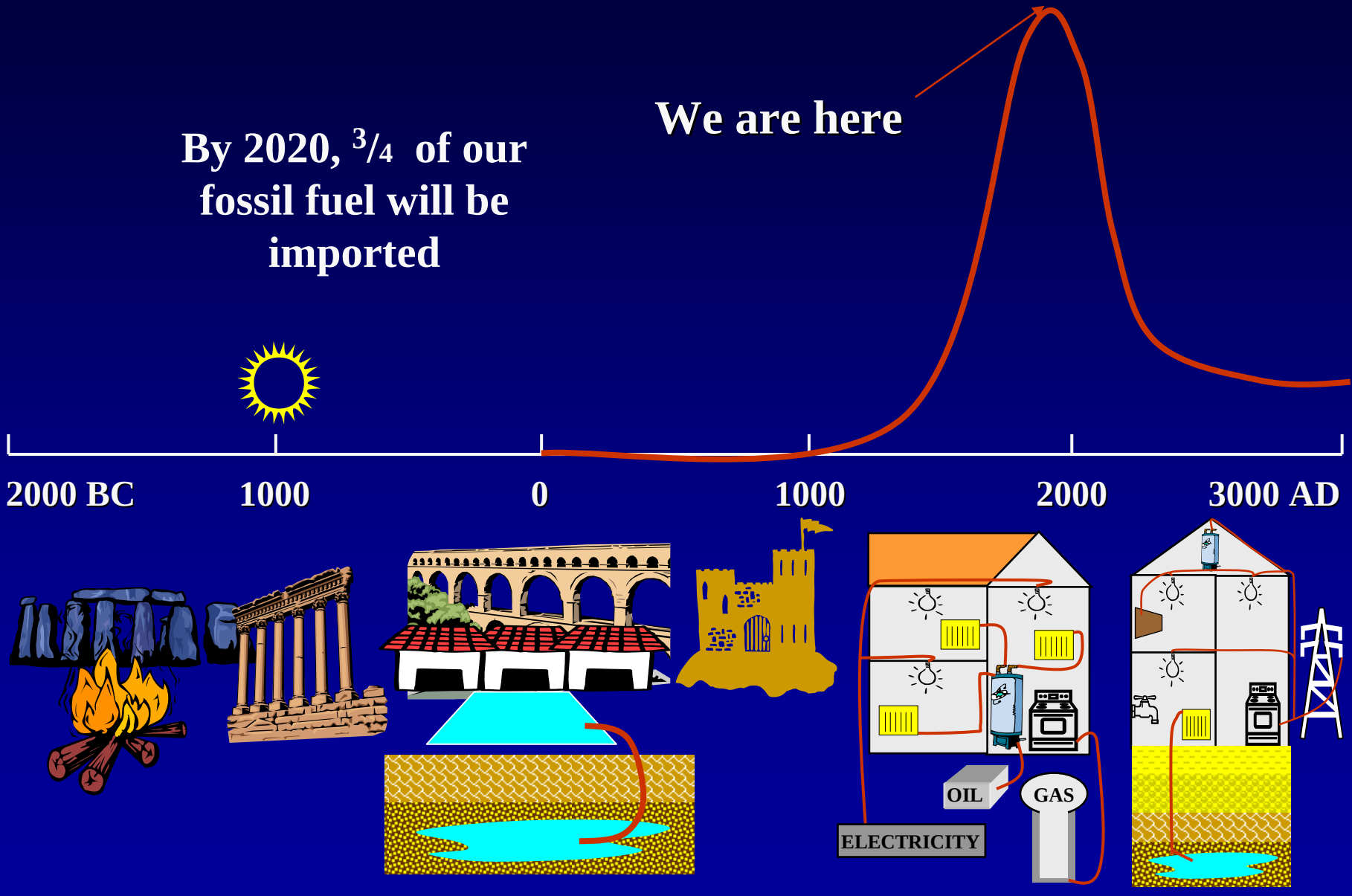
**over £600 / tonne**

- **Solar hot water**
- **Photovoltaics**
- **Small scale wind**

# The double whammy….

**We are here**

**By 2020, ¾ of our fossil fuel will be imported**



# The double whammy….

10 years, leading to droughts, agricultural failure and wat

# Countdown to global catastrophe

By Michael McCarthy
Environment Editor

THE GLOBAL warming danger threshold for the world is clearly marked for the first time in an international report to be published tomorrow – and the bad news is, the world has nearly reached it already.

The countdown to climate-change catastrophe is spelt out by a task force of senior politicians, business leaders and academics from around the world – and it is remarkably brief. In as little as 10 years, or even less, their report indicates, the point of no return with global warming may have been reached.

The report, Meeting The Cli-

**ATMOSPHERIC CARBON DIOXIDE**

$CO_2$ concentration, parts per million


changes. These could include widespread agricultural failure, water shortages and major droughts, increased disease, sea-level rise and the death of

to affect the climate. But it points out that global average temperature has already risen by 0.8 degrees since then, with more rises already in the

# $CO_2$ emissions lead to climate change

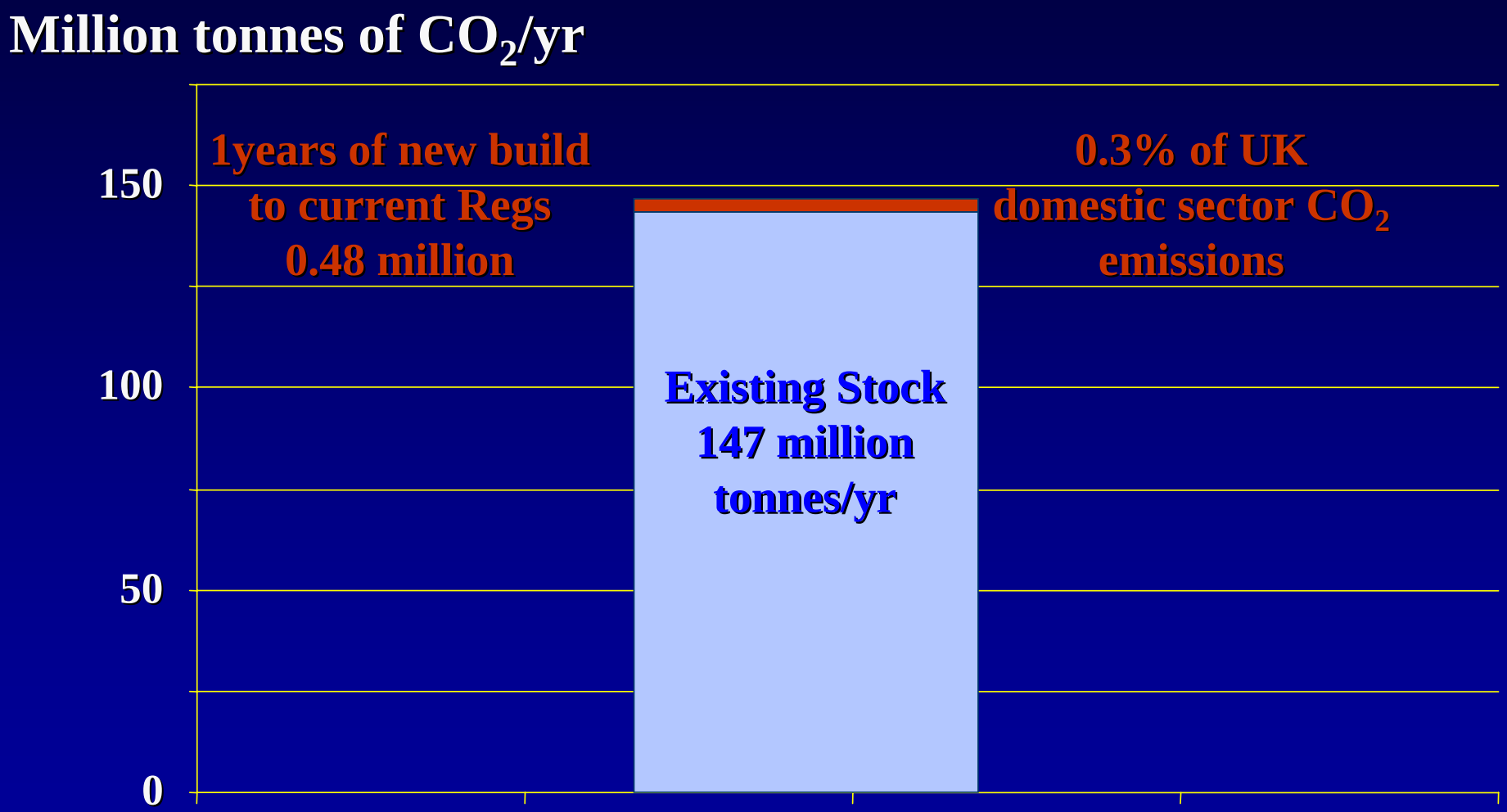
Nine out of ten hottest years in the last decade

25,000 deaths in 2003 heatwave

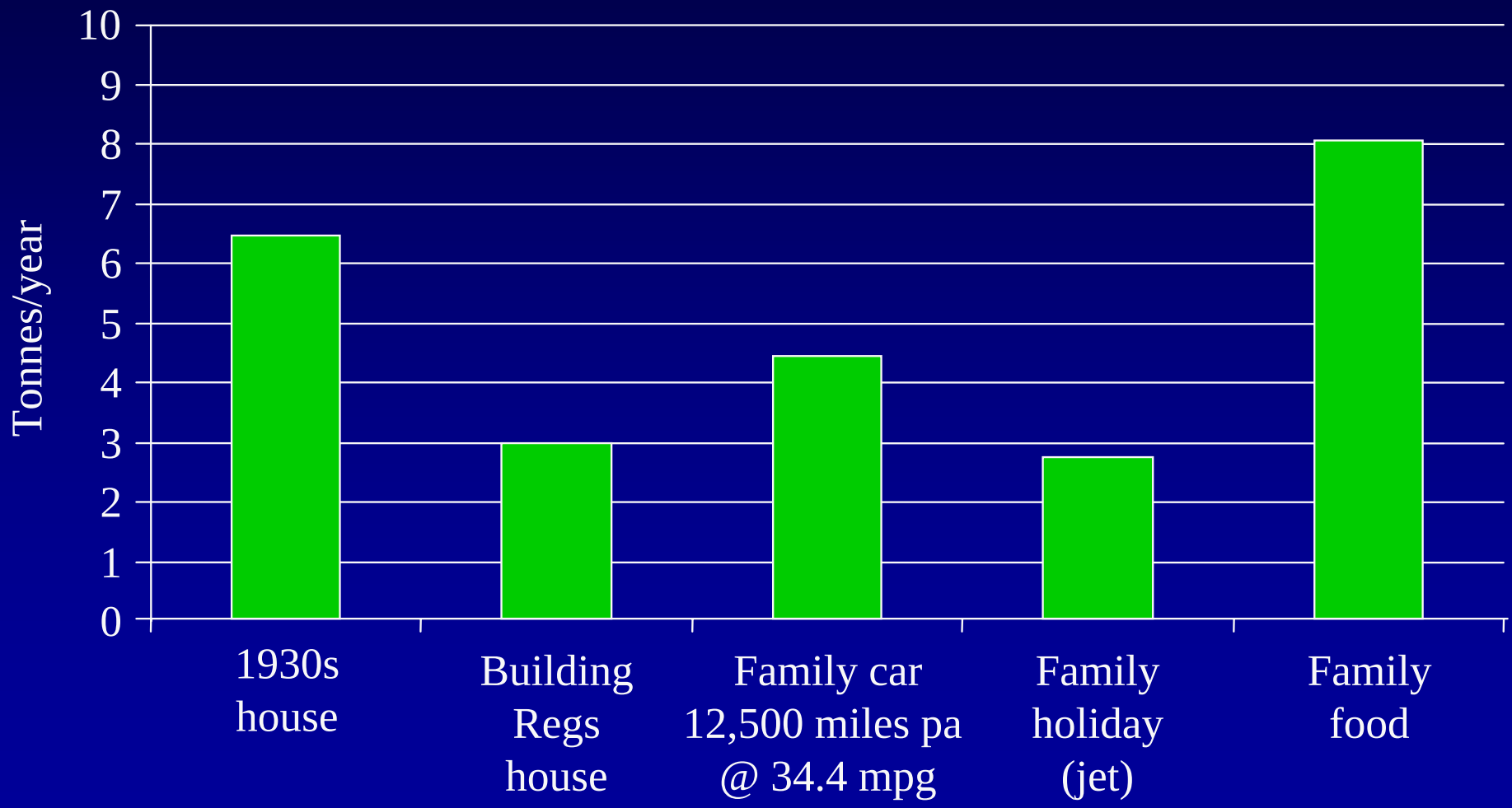
We can't go on adding to $CO_2$ emissions

All new dwellings should have zero emissions

# New build or existing stock?



# Annual $CO_2$ Emissions



# Thanks for your time

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