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Domestic UK Retrofit Challenge:

Current performance and
barriers leading into the
Green Deal

Dr Mark Dowson
Mr Adam Poole



Presentation Overview

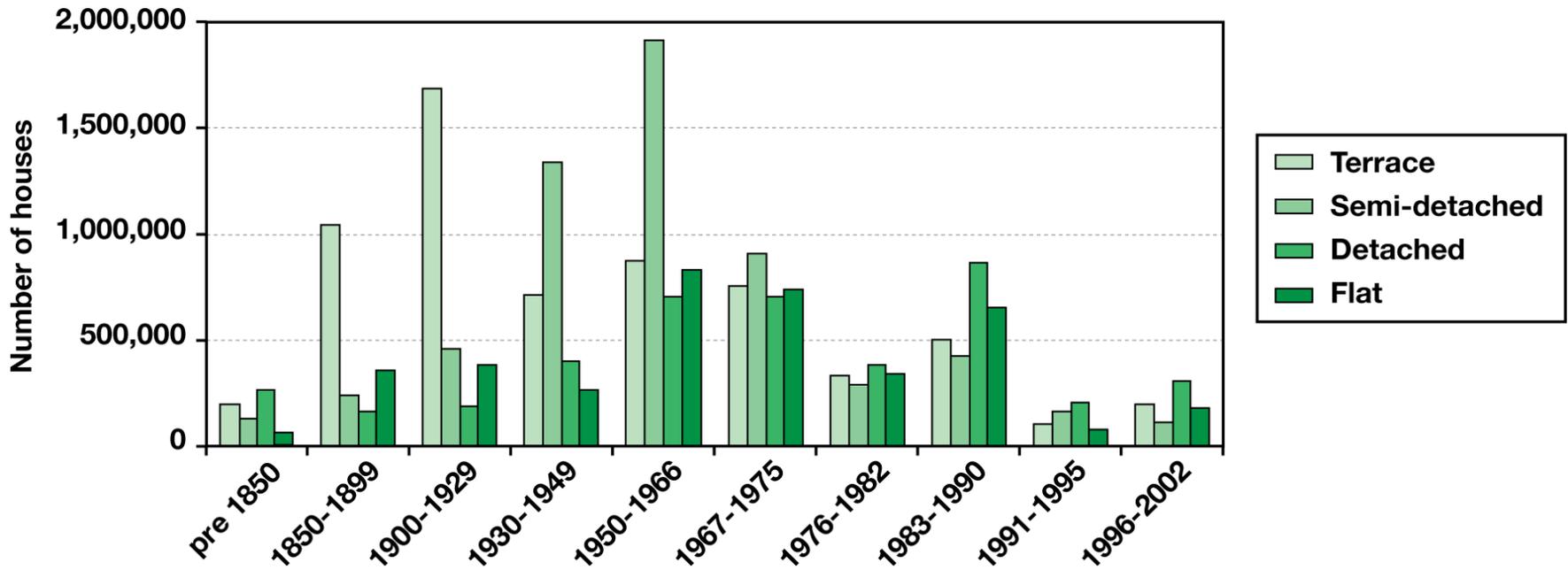
- Overview of domestic UK retrofit challenge
- General barriers to retrofitting
- Specific challenges for the Green Deal
- Outputs of internal business modelling / 'war-gaming' workshops

UK Retrofit Challenge

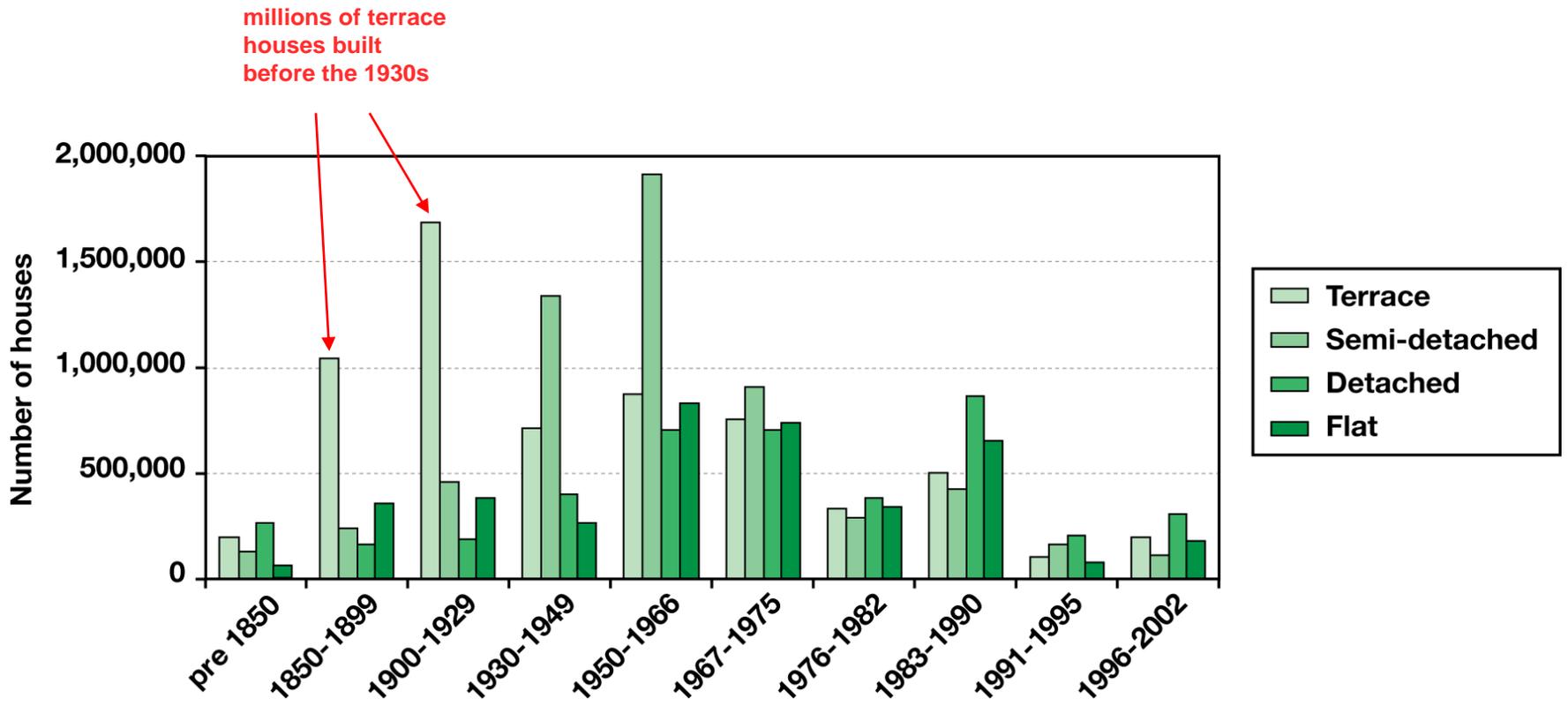
- UK must reduce its CO₂ emissions by 80% by 2050 (against 1990 baseline)
- Over a quarter of current emissions are attributed to the 26 million homes in the UK
- Approximately 80% of the homes we live in today will still be in use in 2050



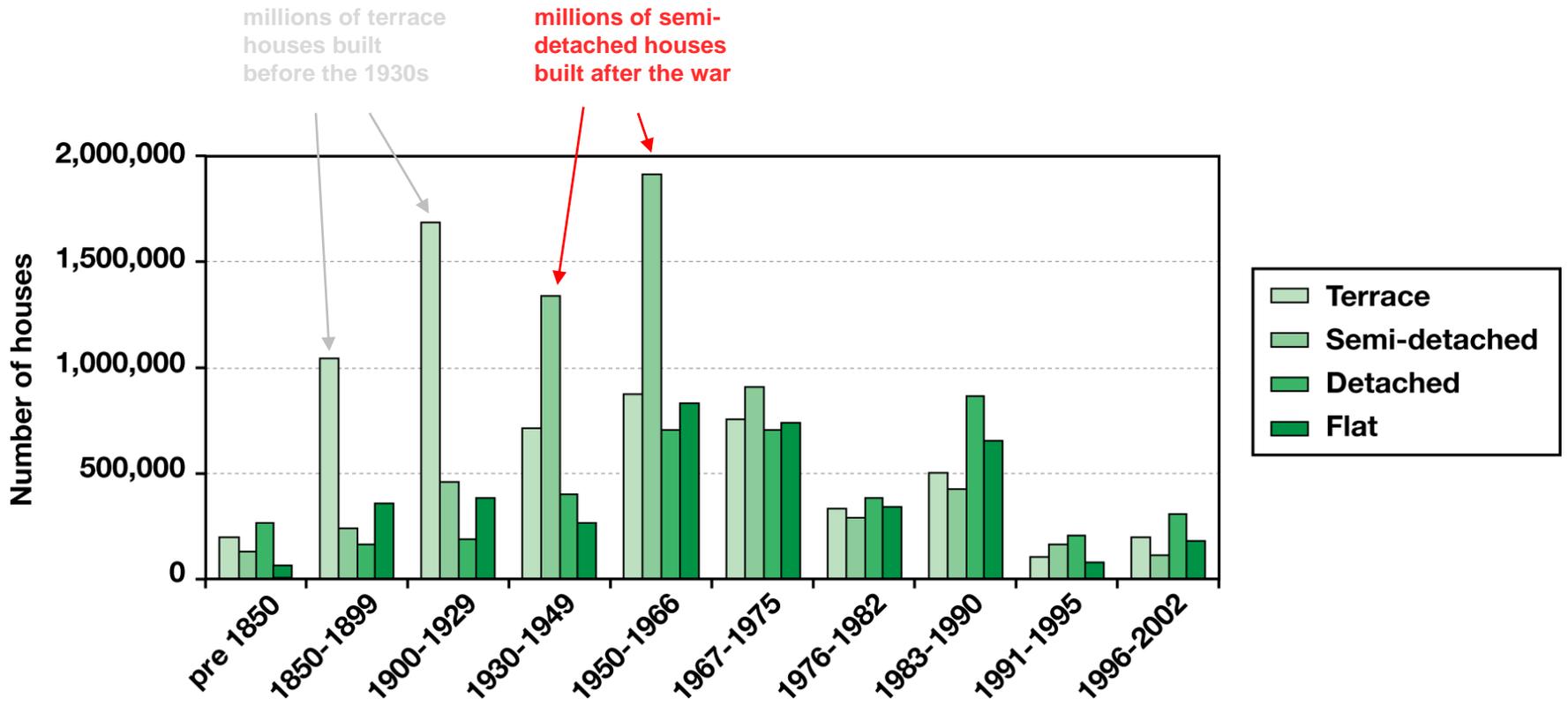
UK housing stock



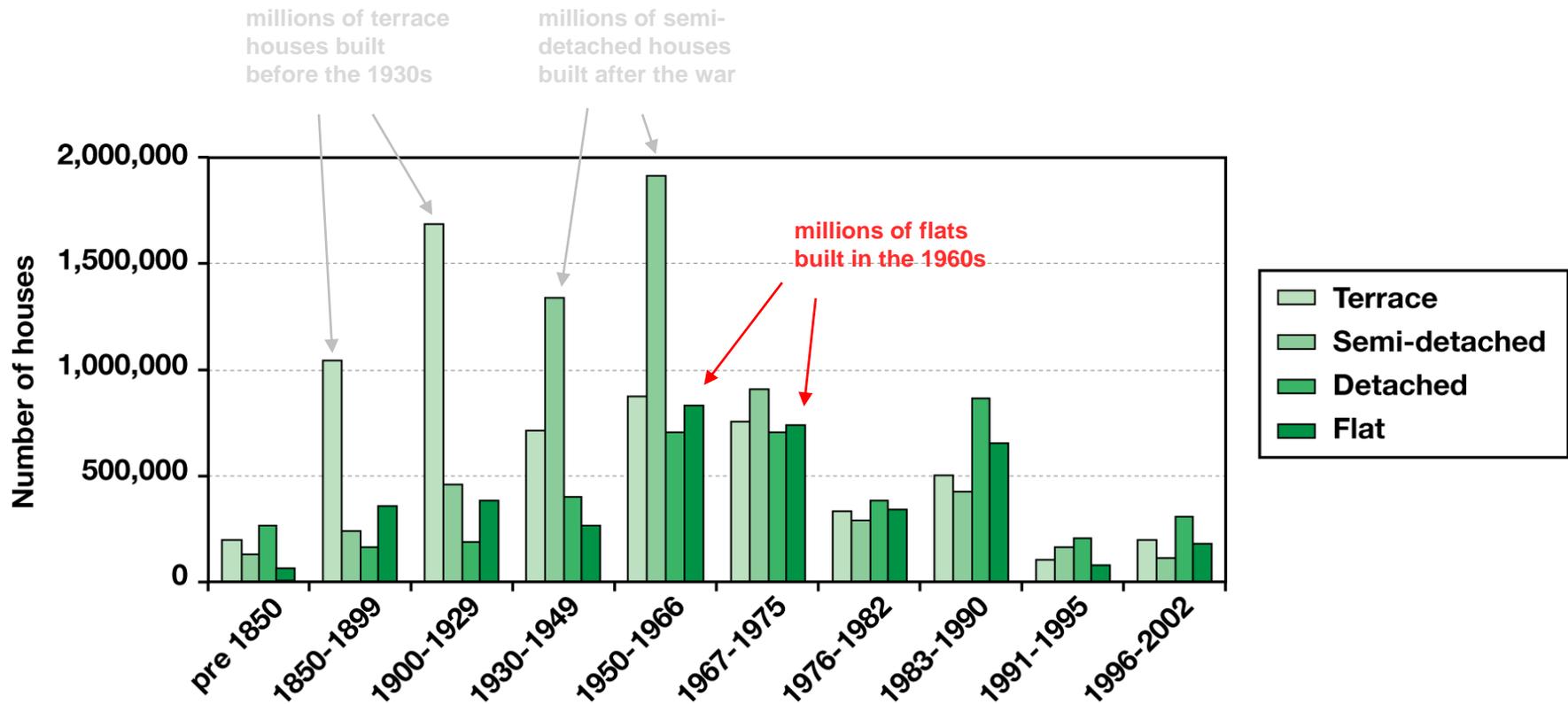
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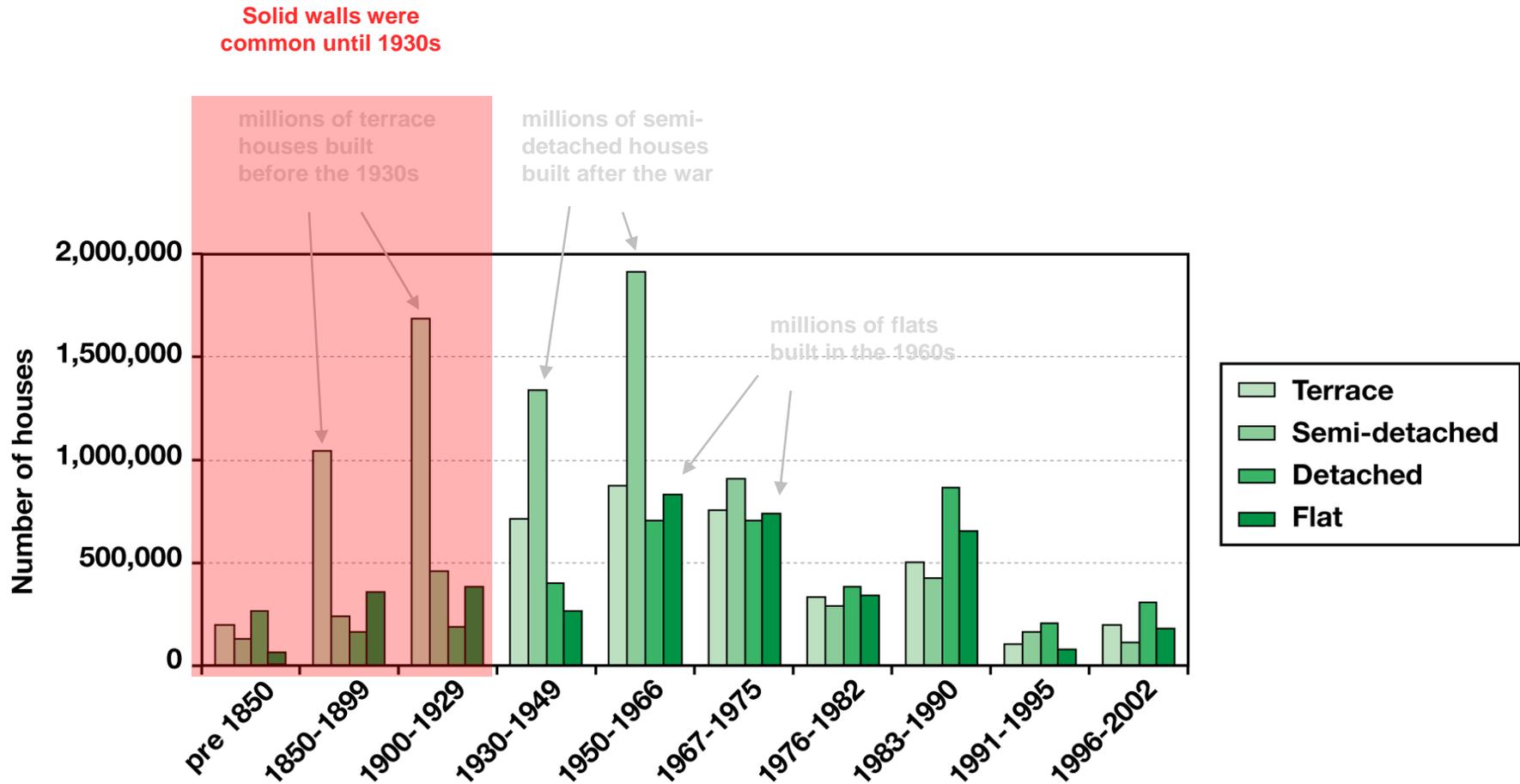
UK housing stock



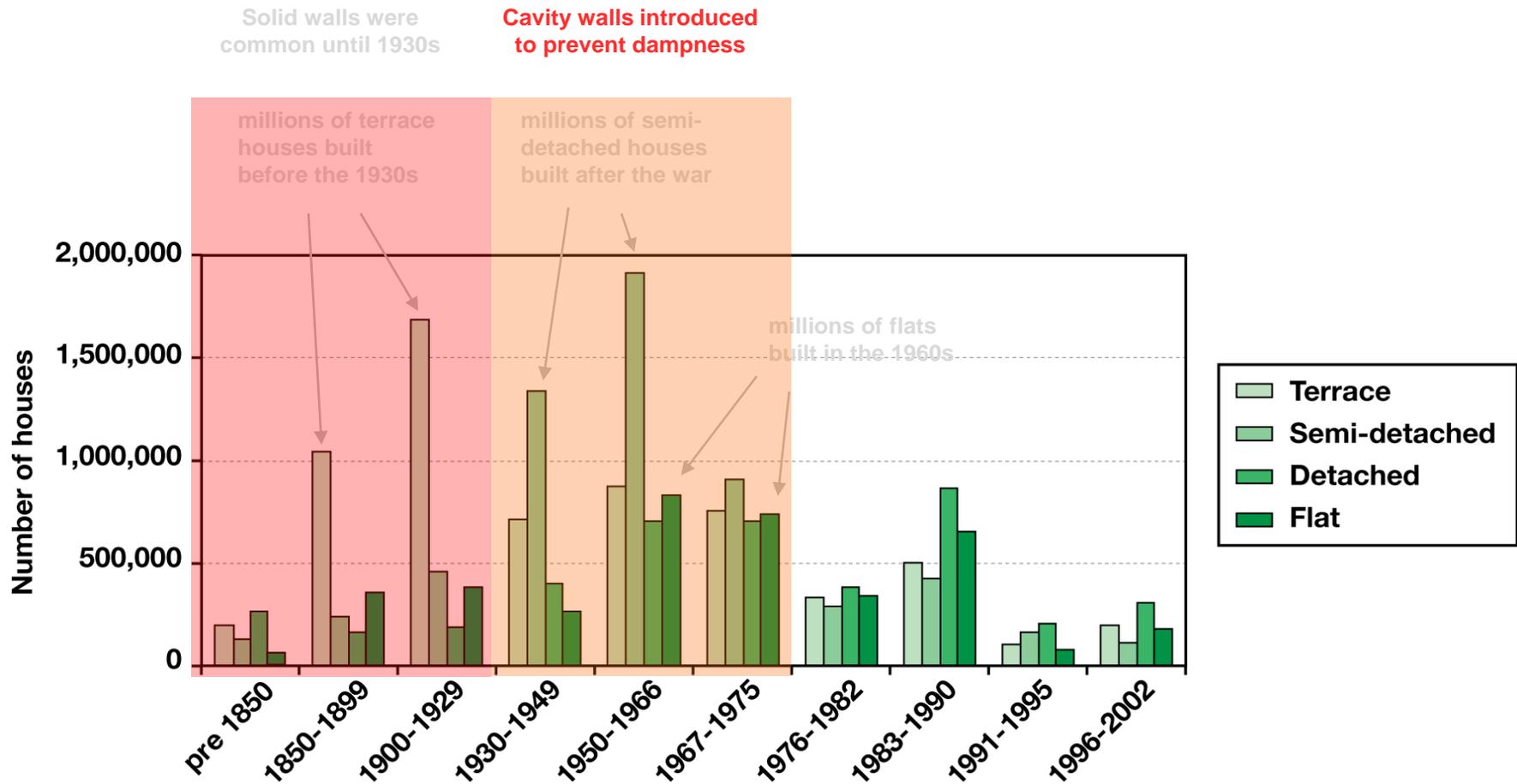
UK housing stock



UK housing stock



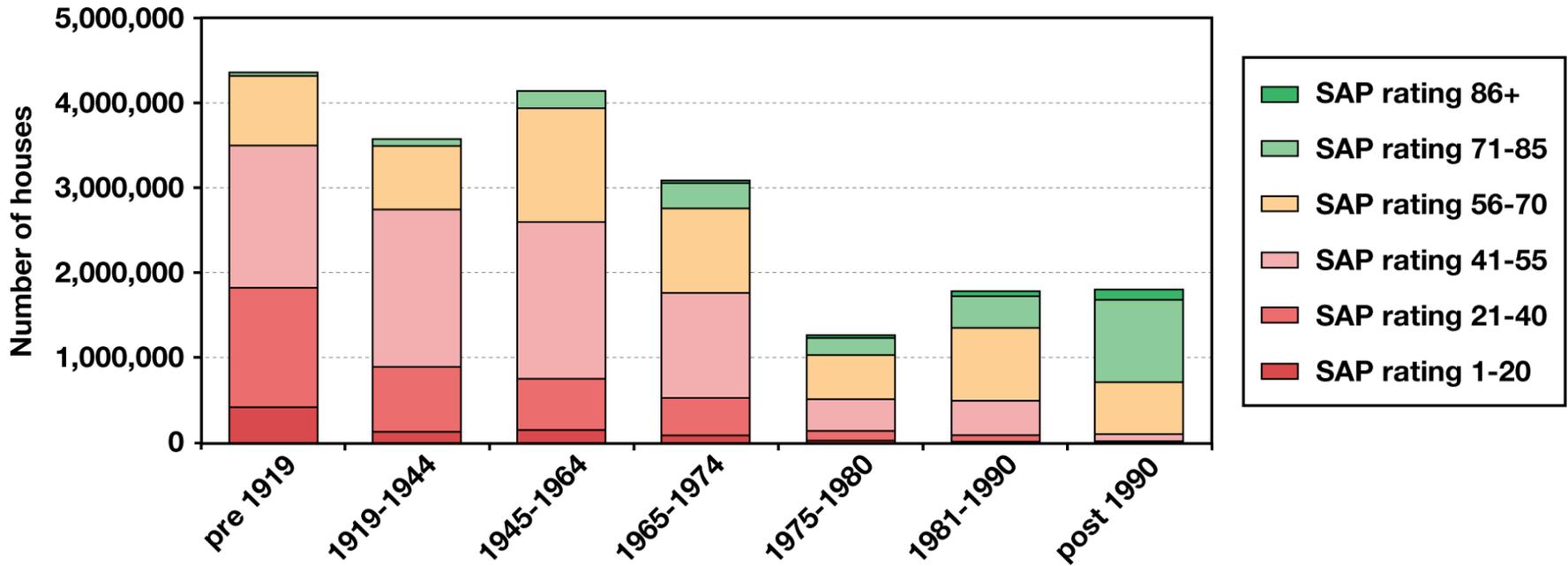
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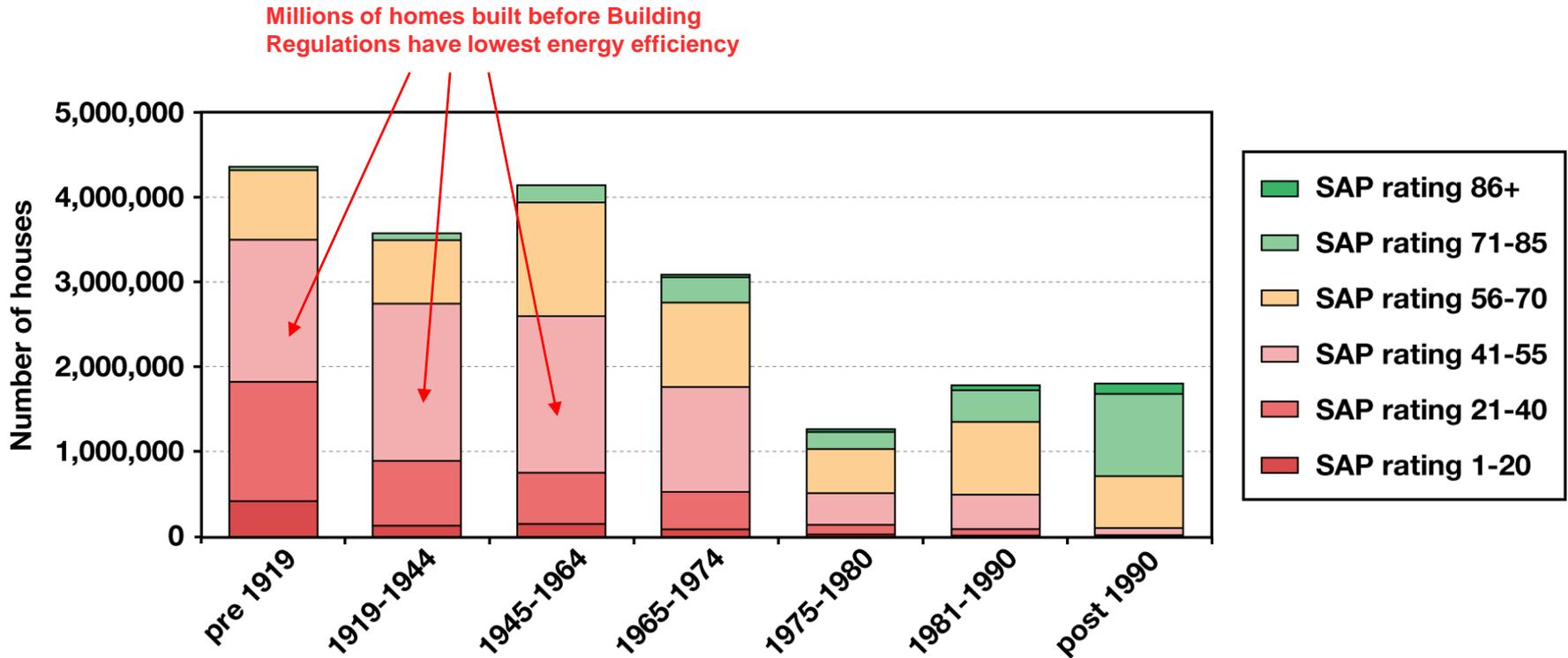
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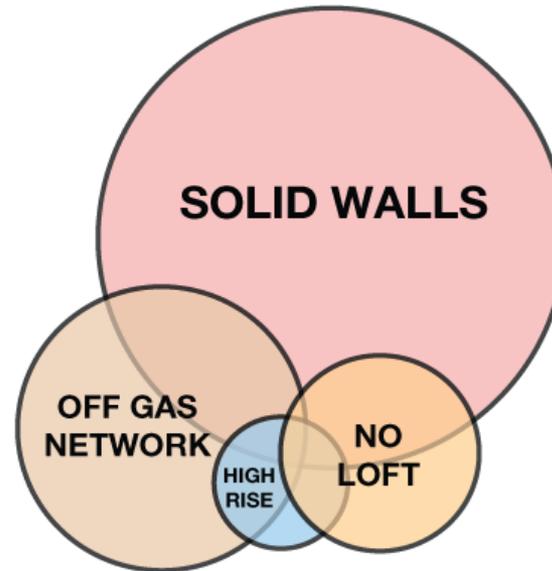
Thermal efficiency of the stock



Thermal efficiency of the stock

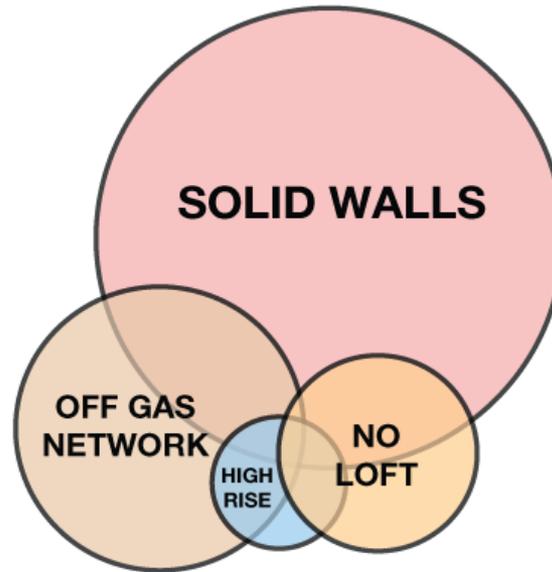


Hard to treat stock



	England	Scotland	Wales	N. Ireland	All UK
Total dwellings	21m	2.3m	1.3m	0.7m	25.3m
Solid wall homes	6.5m	0.7m	0.2m	0.1m	7.5m
Homes with no loft	1.5m	unknown	unknown	unknown	~2m
High rise dwellings	0.4m	0.5m	unknown	unknown	~1.5m
Homes of the gas grid	2.7m	0.3m	0.2m	0.5m	3.7m
Total hard-to-treat	9m	0.7m	0.3m	0.5m	10.3m

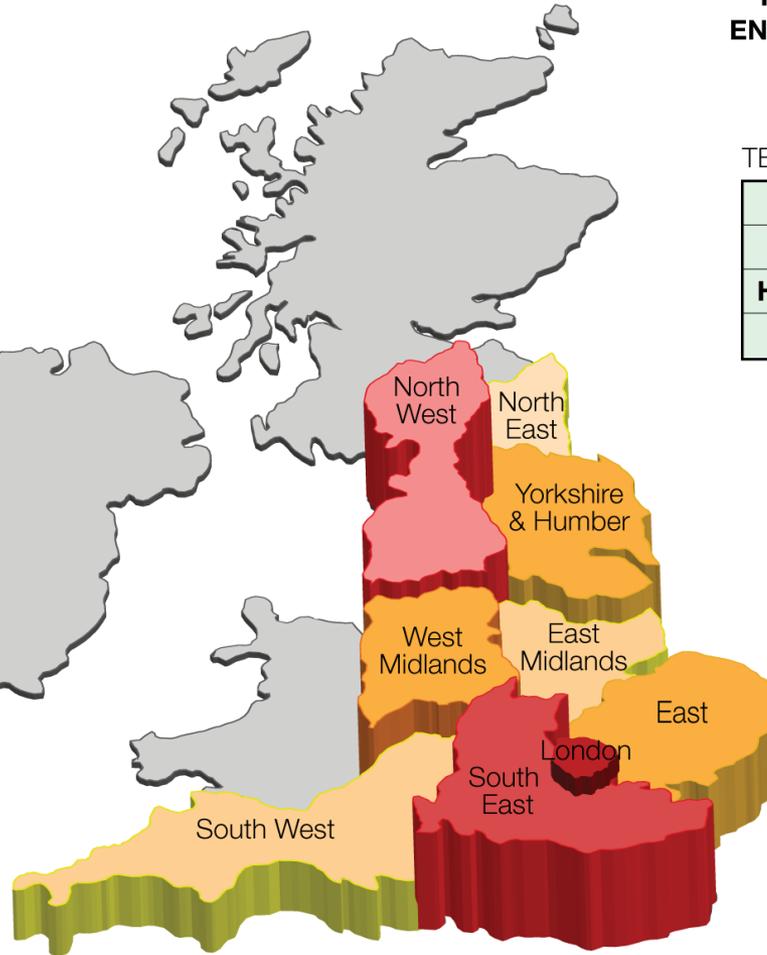
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8 million homes in England are not fully double glazed

- >1,500,000
- >1,250,000
- >1,000,000
- >750,000
- >500,000
- >250,000



PERCENTAGE OF HOMES IN ENGLAND WITH OVER 50% OF WINDOWS SINGLE GLAZED

TENURE:

Private rented	24.2%
Local authority	16.3%
Housing Association	12.7%
Owner occupied	12.1%

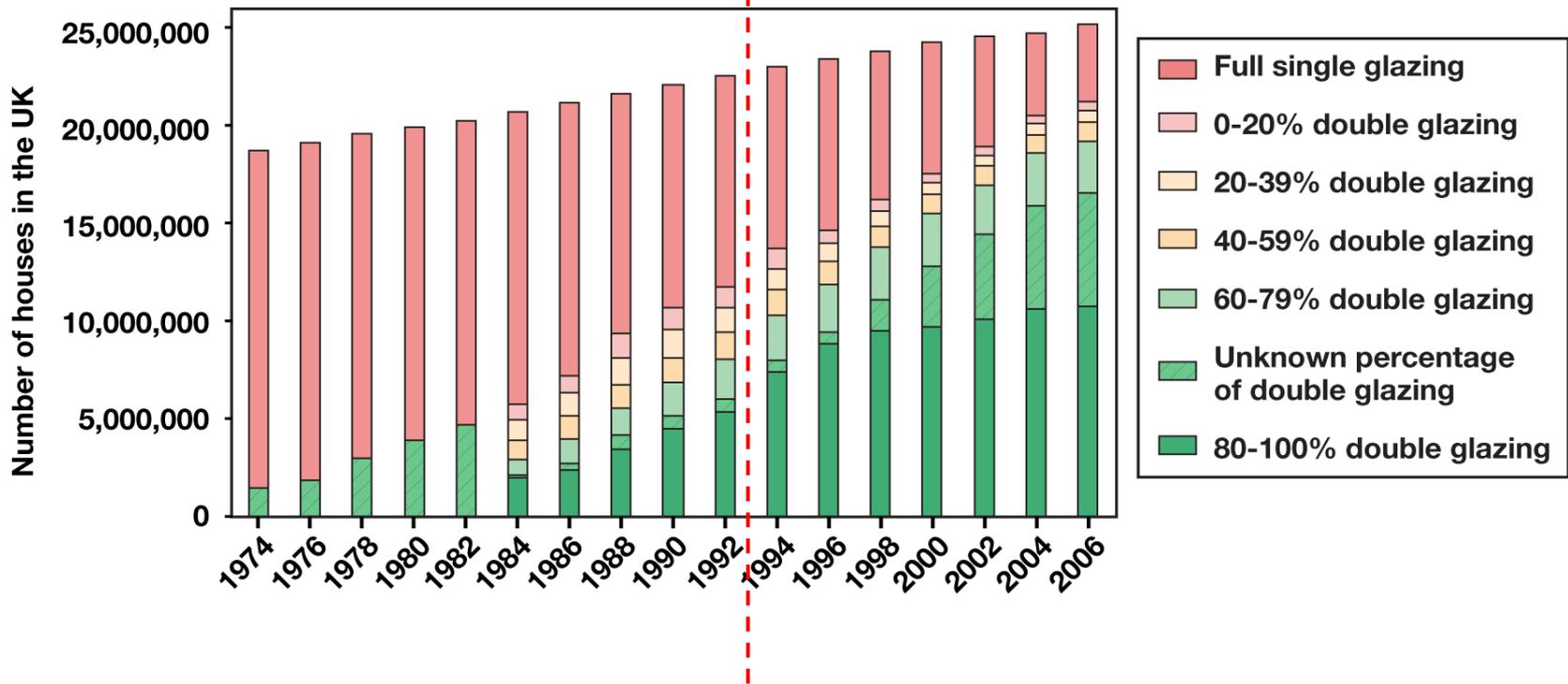
TYPE:

Flats	29.0%
Terrace	15.1%
Detached	12.6%
Semi-detached	10.6%

AGE:

Pre-1919	33.7%
1919-1944	14.4%
1945-1964	9.0%
1965-1980	7.9%
1981-1990	11.0%
Post 1990	3.4%

Up to 14 million homes have double glazing installed over 20 years ago



Barriers to retrofitting

- Up to 1.2 million homes are in conservation areas
- Up to 300,000 homes are listed
- Added cost, disruption, time, planning issues and technical expertise (e.g. moisture control) required to improve these properties

Barriers to retrofitting

- Discrepancies between predicted and actual savings
 - UCL¹ modelled the predicted energy savings of 1372 dwellings retrofitted with loft and cavity wall insulation. 49% energy savings were predicted across the stock. In reality the average savings were 10% in central heated homes and 17% in homes without central heating.

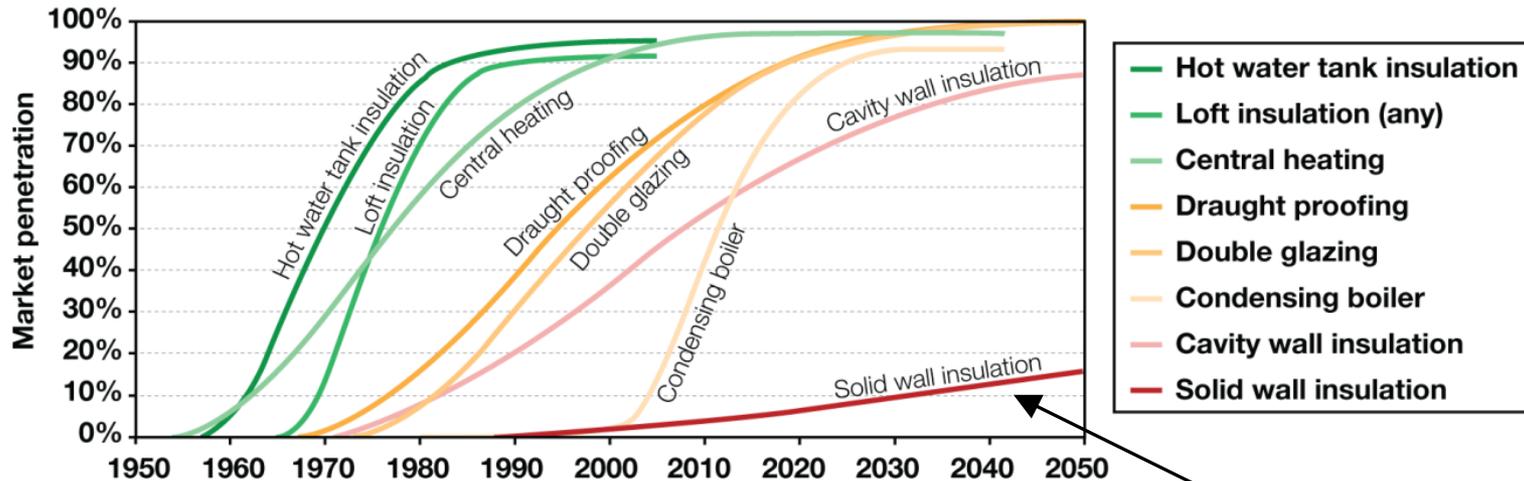
- Combination of gaps in insulation and thermal comfort “take-back” (i.e. occupants raising the temperature of their homes after the refurbishment) reduced energy savings by up to 39%.

Barriers to retrofitting

- Uncertainty regarding capital costs & payback periods
- Not all properties and/or occupants qualify for grants
- Too much insulation could cause summertime overheating

Barriers to retrofitting

- Industry does not have the capacity to retrofit all solid walled homes by 2050
 - ~180,000 installations/year required to retrofit all 6.6 million by 2050
 - EEPH estimate the industries maximum capacity is 15,000-20,000 installations/year
 - Capacity (and expertise) must increase 10 fold.



Barriers to retrofitting

- Lack of public incentives and marketing
- Energy efficiency not viewed as a priority when upgrading homes
- Lack of incentives for landlords (if tenants are reaping the benefits)

Specific challenges for the Green Deal

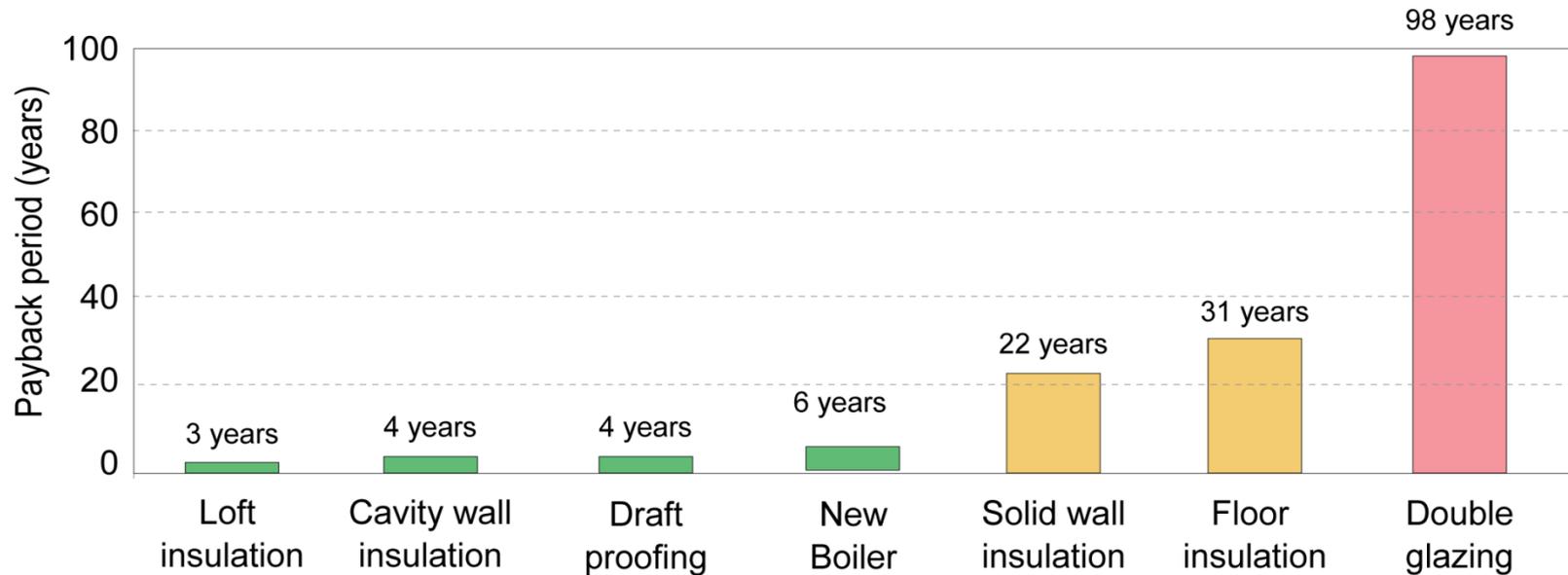
- **All of the above, plus more!**
- Lack of public engagement with scheme – low penetration rates in early trials
 - Only 4.8% of customers signed up to Affinity Suttons “FutureFit” project (resembling the Green Deal finance mechanism) in 2011. A further 23% of people dropped out before retrofit works.
 - B&Q offered a 40% grant to clear out a homeowners loft and install loft insulation. Out of 400 homes that expressed interest, only 126 went ahead with an energy audit and only 66 went ahead with the retrofit works. Follow up surveys revealed that people who dropped out following the audit were sceptical that long term savings would be achieved.

Specific challenges for the Green Deal

- Size of Green Deal loan (and respective carbon savings obtained) is limited by the Golden Rule
- Those in fuel poverty look to be ignored by the scheme, as 92% of the fuel bill savings will be used to pay off the Green Deal loan.
- With Green Deal loans attached to the household, buyers will not be incentivised to take on the property if the 'frozen' baseline fuel bill of the previous occupants is high.
- Lack of incentives for private investors looking for a high IRR in the region of 10-15%

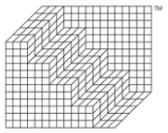
Cost effectiveness of measures

- Investors will want to target low hanging fruit
- Lack of incentives for measures with long paybacks



What does all of this mean?

- Complex agenda and a very challenging target
- A lot of technical expertise is required
- A greater appreciation for marketing and public engagement
- Better understanding of investor incentives required
- How the finance market will operate in a competitive situation



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War-gaming the Green Deal

War-gaming the Green Deal



Interested in policy and what goes wrong

Q: What does a policy look like that has not been wargamed?

A: Lansley's Health Service reforms

Why

- Untended Consequences
- Effect of competition

Battle Test Your Innovation Strategy

Leading companies use war games to focus better on their competitors, while improving the way they identify, shape, and seize opportunities to innovate.

You thought you did everything right—gathered market research and consumer insights; brainstormed, prototyped, and tested a promising new idea; developed detailed financial models and a solid marketing plan. Yet your company's new product or service didn't perform as expected. What did you overlook?

If you answered “**the competition,**” you're far from alone. In our experience, companies making decisions about developing and launching new products commonly **fail to anticipate their rivals' motivations and actions**. Moreover, the failure often contributes to innovation-related disappointments, many of which are below the radar and quite insidious: your rival, for example, discounts prices to encourage customers to stock up on its product rather than try yours, ties up distributors so you can't get shelf space, or duplicates your service to dissuade consumers from switching.

https://www.mckinseyquarterly.com/Strategy/Strategy_in_Practice/Battle-test_your_innovation_strategy_3038

How to anticipate rivals' motivations and actions?

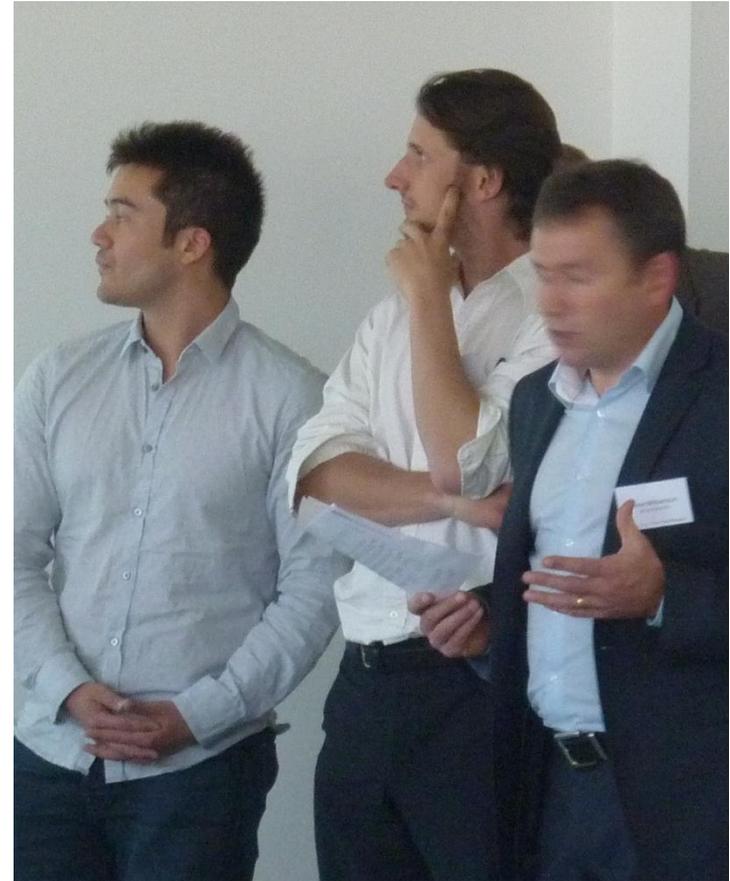
By borrowing from the military

- Forces/investments are assembled
- Each sides' objectives can only be guessed at
- There is negotiation and subterfuge
- Unforeseen things happen
- They do 'battle'
- There is an outcome
- People may or may not live to invest another day



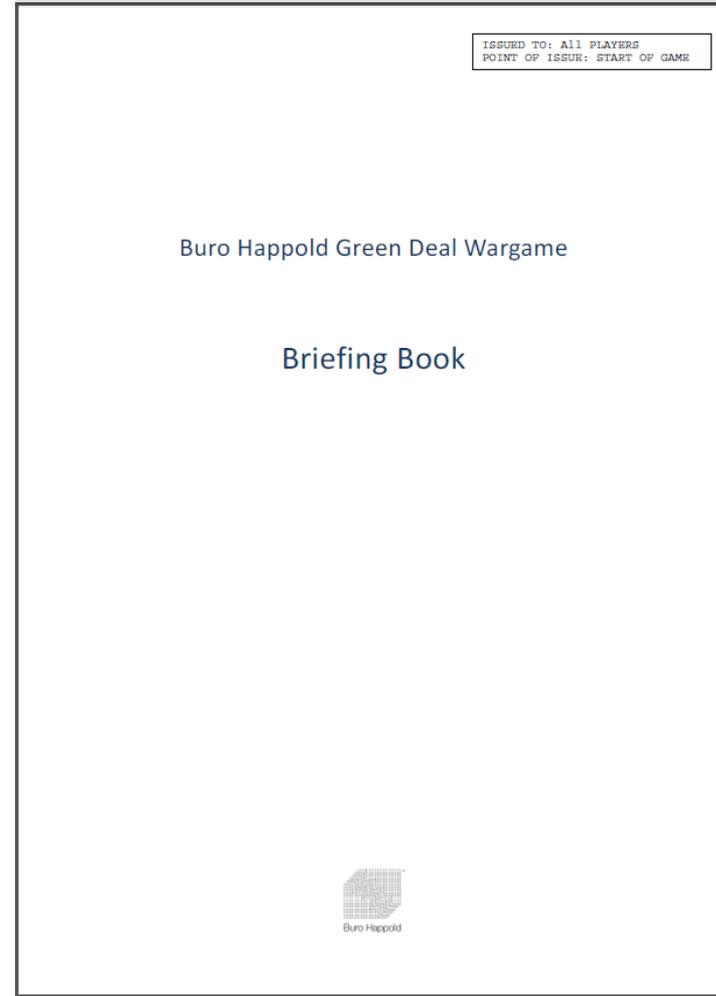
Wargaming the Green Deal

- Wanted to ‘reverse engineer’ the business game concept
- Wanted something difficult
 - Multiple stakeholders
 - Widely different objectives
 - Unsteady coalitions
 - Endless negotiation
 - Ambitious wrecking agenda

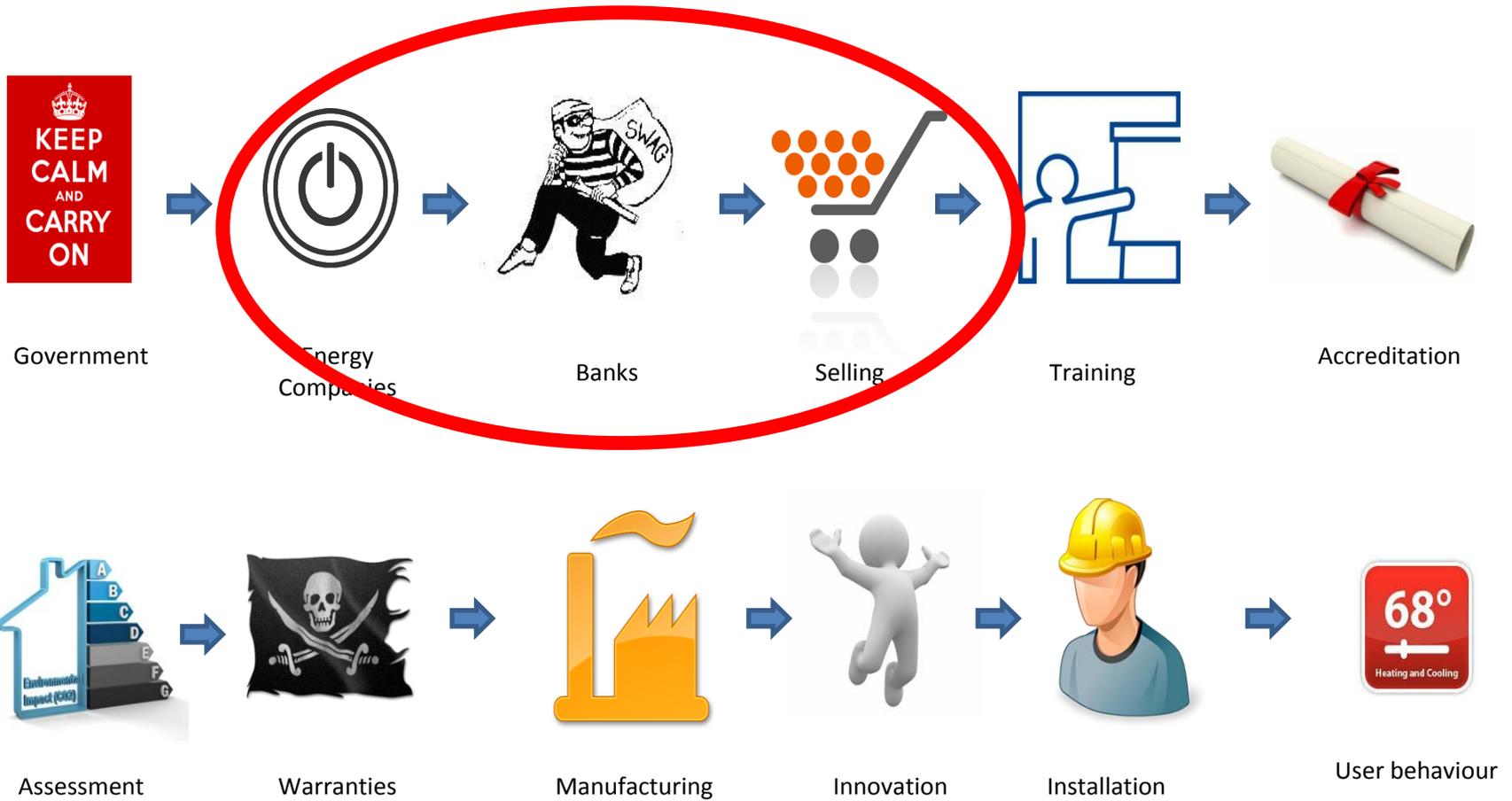


We started with a briefing book

- This was everything we knew about the green deal
- Verified by insiders



Green Deal – Where to focus



Where the action takes place

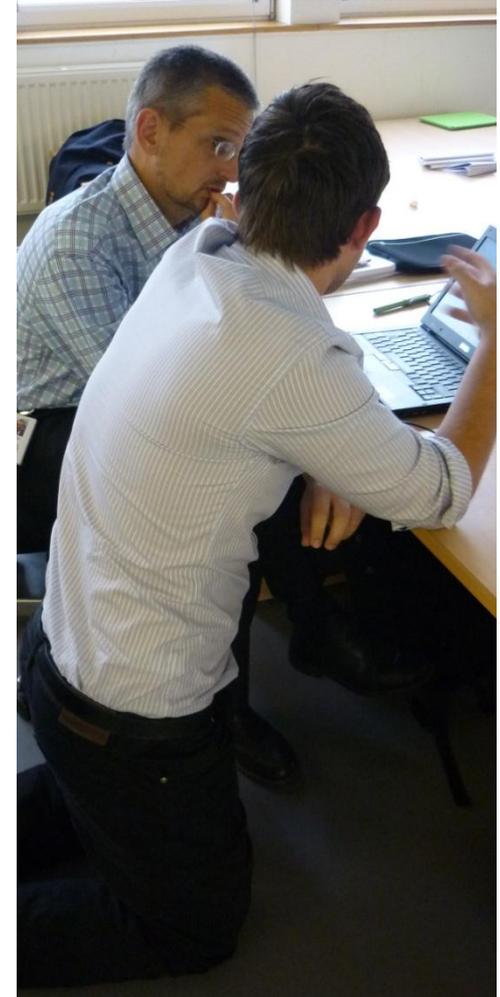
- In a universe of fictitious energy companies, retailers and banks
- Between each company's main board and its Green Deal Department
- Within alliances between 1 energy company, 1 retailer and 1 bank (a consortium)
- Between consortia
- Between government and consortia



The Process

Consortium members are required to keep the alliance together while

- Producing & presenting a business plan
- Negotiating around differing attitudes to risk, reward and return
- Managing cashflow and the supply chain
- Pursuing individual rather than group victory
- Competing with other consortia
 - over particular segments of the market
 - and parts of the supply chain
- Identifying lobbying positions to get government to change the rules
- Coping with changing external events such as the oil price,



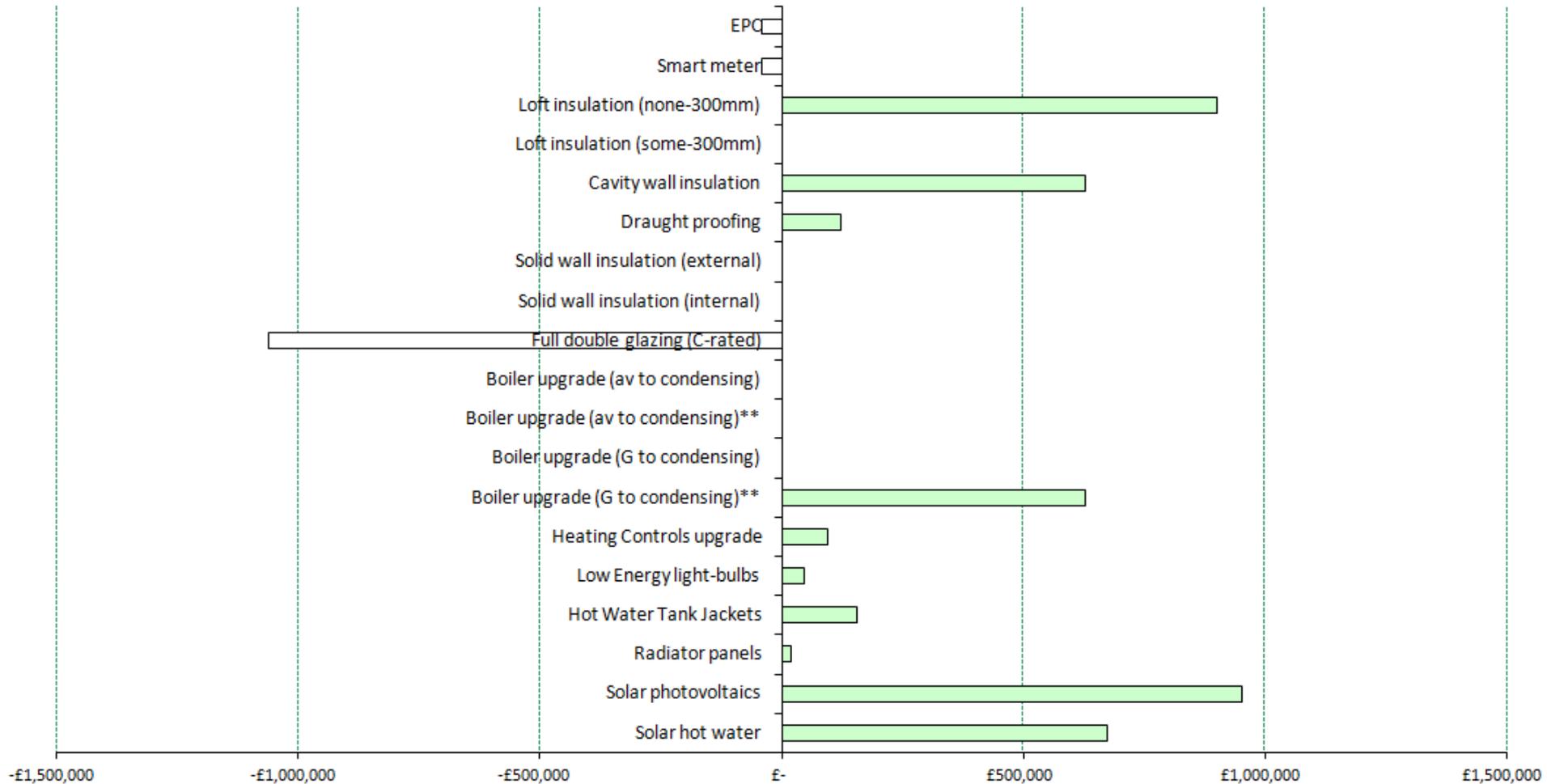
500 homes with insulation, new glazing, new boiler, PV panels & solar thermal

Total number of homes treated	INTERVENTIONS:	YEAR 0	YEAR 1	YEAR 2
	↓ 500 0 500 500 0 0 500 0 0 0 500 500 500 500 500 0 500 500	PRELIMINARY MEASURES		
EPC		500	0	0
Smart meter		500	0	0
FABRIC IMPROVEMENTS				
Loft insulation (none-300mm)		500	0	0
Loft insulation (some-300mm)		0	0	0
Cavity wall insulation		500	0	0
Draught proofing		500	0	0
Solid wall insulation (external)		0	0	0
Solid wall insulation (internal)		0	0	0
Full double glazing (C-rated)		500	0	0
SERVICES UPGRADES				
Boiler upgrade (av to condensing)		0	0	0
Boiler upgrade (av to condensing)**		0	0	0
Boiler upgrade (G to condensing)		0	0	0
Boiler upgrade (G to condensing)**		500	0	0
Heating Controls upgrade		500	0	0
10 x Compact fluorescent lightbulbs		500	0	0
Hot Water Tank Jackets		500	0	0
5 x Radiator panels		500	0	0
RENEWABLES				
Air source heat pumps	0	0	0	
Solar photovoltaics	500	0	0	
Solar hot water	500	0	0	

** Select this option for the boiler if loft or cavity insulation is being installed as well

Net present value of all measures

NPV BY MEASURE (snapshot at year 20):



How accurate is the process?

- Involves a number of assumptions, particularly
 - household sales conversion rates
 - required internal rates of return (11+%)
- Involves chance events and randomised outcomes so **illustrative** than predictive
- Scope for **Machiavellian** gaming verified by energy insiders
- We have run 4 teams that have produced a range of outcomes that are pretty similar

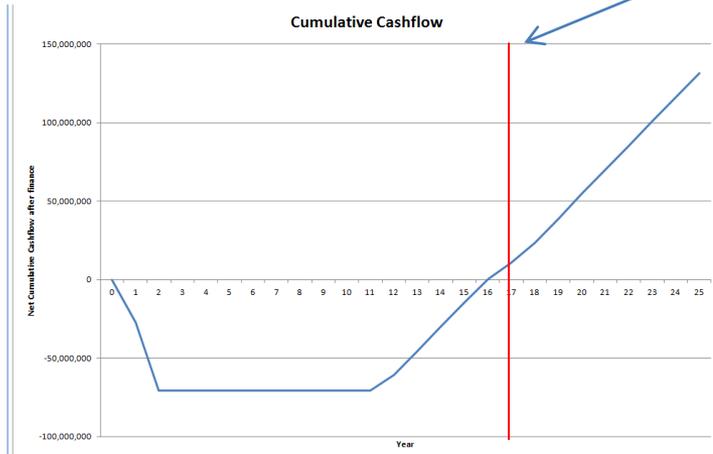
Results

- Who took part: 24 engineers / MBAs / students + industry people
- Results reflect team modelling exercise – this is what they report back to their boards
- Not yet made the scheme work for the game parameters we have set:
 - IRR targets,
 - amount of capital
 - conversion rates
- This process is generating a series of useful policy suggestions

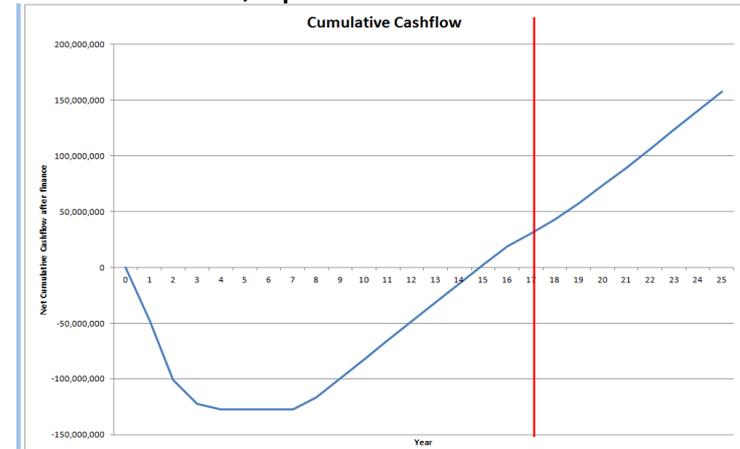
World may change at this point: Saudi says it will stop exporting oil

Results: Round 1

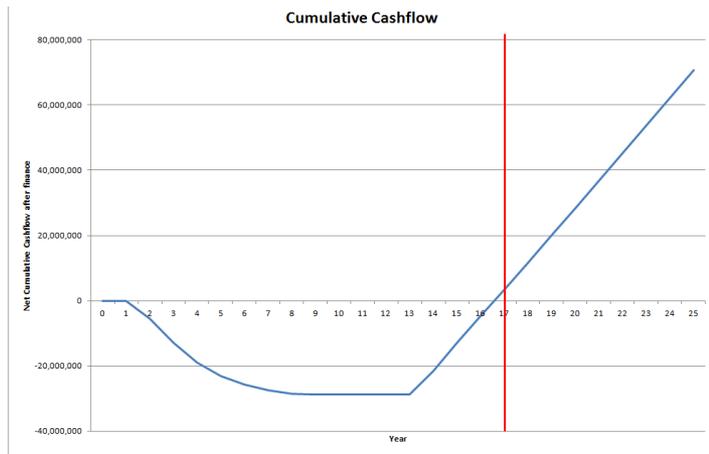
IRR: 6.52%, spent 84% of funds



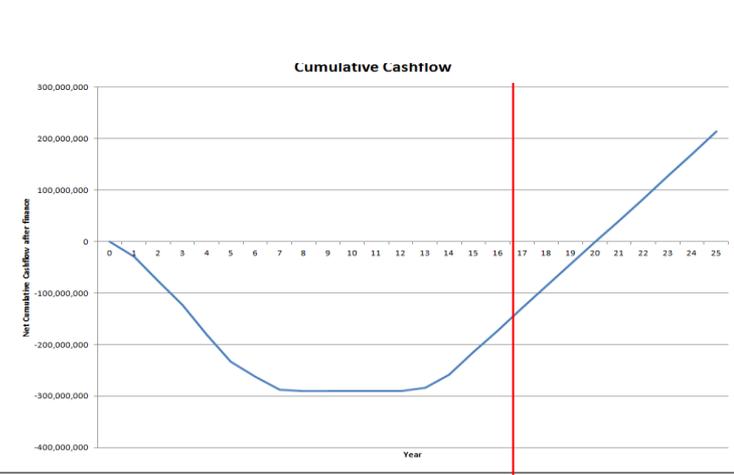
IRR: 8.54%, spent 81% of funds



IRR: 6.52%, spent 84% of funds



IRR: 3.61% overspent funds by 485%



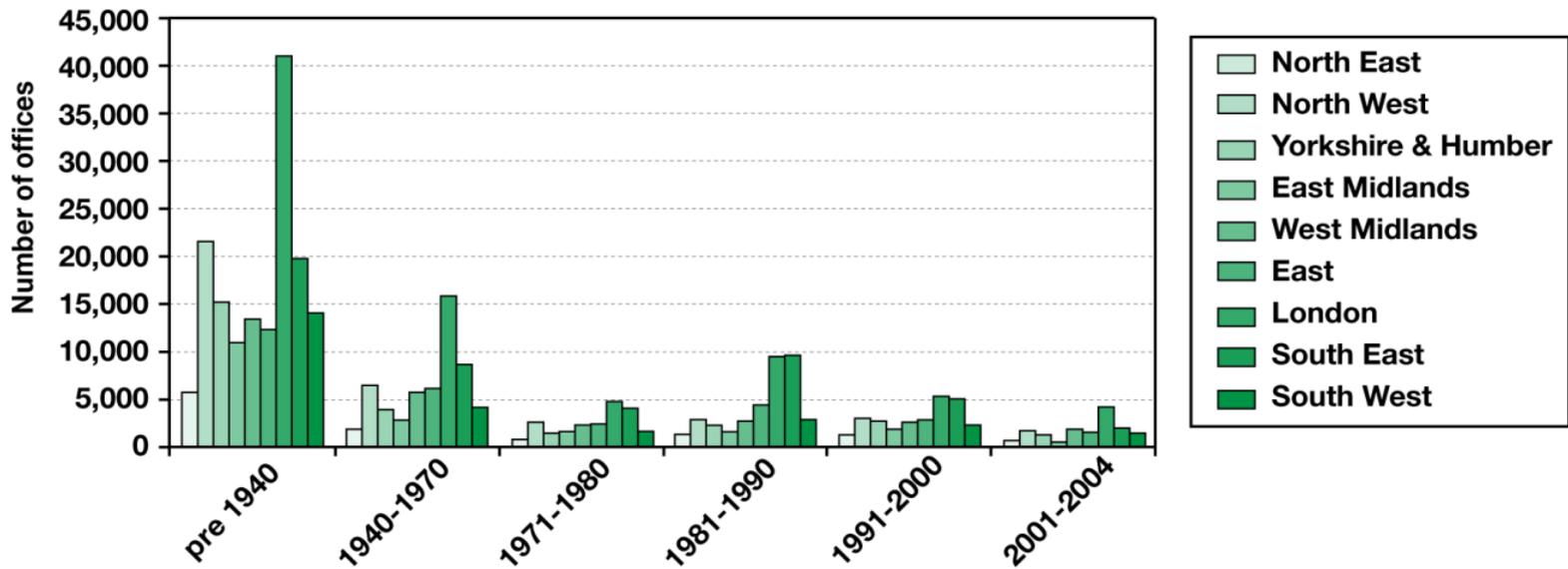
Conclusions

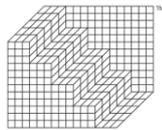
- Energy companies are being invited to sell substantially less product
- Doesn't work with cost of money
- How ECO funding gets spent looks to be poorly policed
- Effort being put into increasing demand while leaving supply unaddressed
- Suppliers have created a monopoly vehicle
- Everyone went after the low-hanging fruit.
- There is an endgame: where you are when the scheme might be rescued



And not forgetting..

- Non-domestic stock accounts for a further 20% of UK CO₂ emissions
- Over half of the stock constructed before Building Regulations

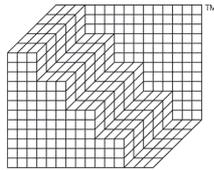




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ENERGY POLICY

Domestic UK retrofit challenge: Barriers, incentives and current performance leading into the Green Deal

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HIGHLIGHTS

- CERT, CESP, Decent homes and Warm Front have not targeted the full extent of private and social homes.
- There is a risk that Green Deal will fail due to low consumer appeal and low incentives for investors.
- Up to half of the predicted energy savings from whole house retrofits may not be achieved in practice.
- Passivhaus is identified as best practice for retrofits, yet there is a lack of skills and components.
- Embodied energy in materials and components must be better understood to achieve life cycle savings.

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ABSTRACT

This paper reviews the thermal performance of the existing UK housing stock, the main fabric efficiency incentive schemes and the barriers to obtaining deep energy and CO₂ savings throughout the stock. The UK faces a major challenge to improve the thermal performance of its existing housing stock. Millions of dwellings possess ‘hard-to-heat’ solid walls and have glazing which is not cost-effective to improve. A range of fabric efficiency incentive schemes exist, but many do not target the full range of private and social housing. From now on, the Green Deal will be the UK’s key energy efficiency policy. However, the scheme is forecasted to have low consumer appeal and low incentives for investors. Moreover, calculated Green Deal loan repayments will be reliant upon estimated energy savings, yet it is claimed that retrofit measures may only be half as effective as anticipated due to a lack of monitoring, poor quality installation and the increased use of heating following refurbishment. Looking to Germany, there has been success through the Passivhaus standard, but the UK currently lacks appropriate skills and cost effective components to replicate this approach. In addition, the embodied energy in retrofit products and materials threatens to counter operational savings.

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1. Introduction

The thermal performance of our existing building stock must improve significantly for the UK to meet its target to reduce CO₂ emissions by 80% against the 1990 baseline by 2050 (Climate Change Act, 2008). In 2008, the country’s 26 million dwellings were estimated to be responsible for 27% of all UK CO₂ emissions (Urley and Shorrock, 2008). According to recent forecasts, 75–85% of the current UK building stock will still be in use by 2050 (Power, 2008; Ravetz, 2008). This is a major issue, since millions of these properties contain poorly performing solid walls, single glazing and un-

insulated roofs/floors responsible for a significant amount of wasted heat. These features can be expensive and disruptive to improve, furthermore, improvement can be limited by available space and planning restrictions (Beaumont, 2007; EEPH, 2008). There is scope to retrofit these buildings to make deep cuts in CO₂ emissions, but effective implementation is no trivial task. Solutions must account for the variety in age, size, quality, composition, function and social value of the existing building stock, as well as the different needs, expectations and budgets of homes owners and occupiers.

2. Survey of English housing stock

The English Housing Survey is a national survey commissioned by the Department for Communities and Local Government to monitor the age, type, tenure and condition of the English housing stock. Approximately 6200 houses undergo physical inspections annually by qualified surveyors with findings extrapolated to

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