BACKGROUND MATERIAL B: FORESIGHT SCENARIOS FOR THE UK DOMESTIC SECTOR

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1 AIM OF DOCUMENT

This document provides the working detail of the estimates of initial (Foresight) projections of UK domestic energy consumption and emissions to 2050. It forms part of the 40% House Project, funded by the Tyndall Centre. It is the outcome of several meetings on discussing scenarios within the 40% House project team, and subsequent updates and analyses.

2 INTRODUCTION

The 40% House project takes as its starting point the 2003 Energy White Paper *Our energy future – creating a low carbon economy*, in which the UK government set a target to reduce CO_2 emissions by 60% from 1990 levels by 2050 (DTI 2003). This followed the recommendations of the Royal Commission on Environmental Pollution's twenty-second report, *Energy: the changing climate* (RCEP 2000).

The year 2050 is a distant horizon. Most 'long-term' policy-making looks forward to 2020 or 2030, but the climate change policy agenda looks forward twice as far. In order to step outside current habits of thinking and engage with possible future change over several decades, the 40% house project team made extensive use of ForeSight scenarios.

The ForeSight programme was launched by the UK government in 1994 as a way of looking ahead and preparing for the future. It 'brings together the voices of business, government, the science base and others to identify the threats and opportunities that we are likely to face over the next ten to twenty years or more' (DTI 2001).

2.1 THE FORESIGHT APPROACH

The four ForeSight scenarios are four broad views of how the future might turn out. They are intended as tools for forward planning, rather than as predictions of what the future world will be like. By using them, the 40% House team sought to develop several distinct visions of the future, and to relate these general visions more explicitly to possible future changes in the management of the UK housing stock. The four ForeSight scenarios became cardinal reference points for discussions within the team, and helped us formulate our own vision of how the future might be – the 40% House scenario.

The ForeSight scenarios were used to help decide specific issues to do with the future of the housing stock. These issues were as detailed as the future size of the population and the amount of loft insulation that might be installed, given the broad socio-economic framework provided by ForeSight. In this way, the four ForeSight scenarios became shorthand for four sets of input variables to the UK Domestic Carbon Model and for the results that emerged from running the UKDCM. (The UKDCM is described in background material A).

40% HOUSE PROJECT BACKGROUND MATERIAL B: FORESIGHT SCENARIOS FOR THE UK DOMESTIC SECTOR

This paper provides a brief summary of each of the ForeSight scenarios and the decisions taken by the 40% House team in relation to input variables for the UKDCM, with some comment on why these values were chosen.

The four scenarios are described in the following sections:

- World Markets
- Global Sustainability (also known as Global Responsibility)
- Local Stewardship
- Provincial Enterprise (also known as National Enterprise)

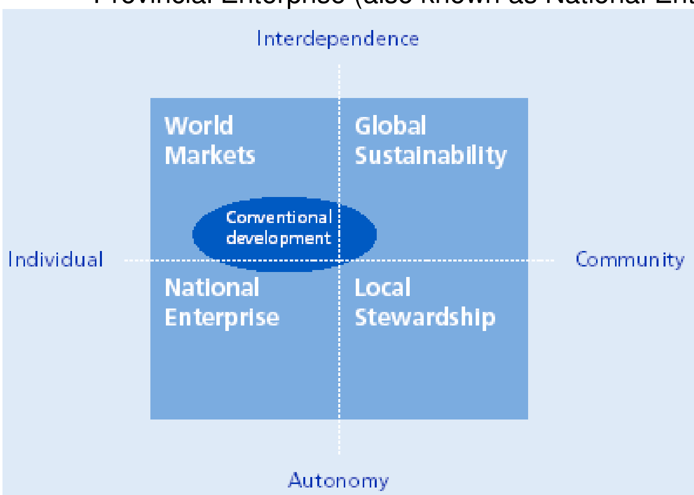


Fig 1 The four ForeSight scenarios (DTI 2002)

These four scenarios can be represented along two axes – one a continuum of interpersonal relationships between highly individualist values and a strong community ethos; and the other a continuum of inter-governmental relationships between national self-reliance and interdependent globalisation (figure 1).

2.2 WORLD MARKETS

World Markets: a world defined by an emphasis on private consumption and highly developed and integrated world trading systems

Societal commentary

- Core values are consumerist
- People aspire to personal independence, material wealth and mobility to the exclusion of wider social goals
- Limited environmental concern
- This leads to highest GDP growth at 3% per annum
- Low taxation
- Low regulation
- High building rate results in loss of green field sites

Domestic sector

- Low energy prices
- Larger dwellings
- More dwellings (31 million by 2050)
- Fewer people per dwelling

- More appliances, including air conditioners

Energy sector
- Renewables Obligation frozen at 10%
- Renewables and coal cannot compete with CCGT in medium term.
- Long term carbon-based generation (mainly gas)
- New technologies, materials and construction processes are adopted
- High efficiency products are developed

World Market stories
- Food markets are increasingly dominated by the large retailers.
- Traditional primary industries decline, replaced by ICT and biotechnology
- Tele-working increases and insecure employment common
- High mobility

2.3 GLOBAL SUSTAINABILITY

Global Sustainability: a world in which social and ecological values are considered in economic decisions, and in which strong collective action through global institutions tackles environmental problems

Societal commentary
- Core value is sustainable development
- People aspire to high levels of welfare within communities with shared values, more equally distributed opportunities and sound environment
- Subsidies and tax incentives support adoption of energy efficient measures
- GDP growth at 2% per annum (or 2.25%)
- Strong international agreement on carbon reduction

Domestic sector
- Less growth in dwelling size (despite increased income)
- Household formation falls
- 27.5 million houses by 2050
- Rapid turnover of housing stock (ie high demolition)
- 'Per capita consumption declines at 0.5% per annum, but domestic energy demand unchanged due to increasing household size'
- High energy costs creates market for small scale conversion (dCHP)

Energy sector
- By 2020, high efficiency gas CHP and renewables (30% of supply)
- In order of size - Off-shore wind, energy crops, biomass, waste, on-shore wind
- Nuclear and coal stations not replaced
- High energy demands means promotion of local production dCHP, renewables
- Also hydrogen introduced
- Implies very low CO_2 for each kWh produced.
- Best available environmental technologies and practices adopted
- High uptake of local renewables (PV, solar thermal). Heat pumps for non-gas homes.

Global sustainability stories
- Intangible goods and services generate the largest part of economic value

- Private cars increase in cost, public transport heavily subsidised
- High-skill, high-wage workforce

2.4 LOCAL STEWARDSHIP

Local Stewardship: a world of highly devolved political structures where actions are decided on and implemented at the community and neighbourhood level. Conservation of natural resources is a key concern. Labour-intensive activities are preferred to capital-intensive ones in order to conserve fuel, provide work and boost local economies.

Societal commentary

- The needs of the community are valued at least as highly as the needs of the individual
- People are generally settled in one area and expect to live as adults near to where they grew up
- Strong reliance on aware citizens to behave responsibly
- Low economic growth and relatively slow technological change

Domestic sector

- Shrinking construction industry with an emphasis on refurbishment and community self-build
- Move away from large cities towards smaller towns and rural areas
- Population remains fairly steady while number of households falls slightly

Energy sector

- Energy consumption falls (0.75-1.5% pa)
- High prices for fossil fuels
- Maximal use of local renewable energy resources
- Nuclear power stations not replaced
- Small renaissance of coal industry burning fuel close to re-opened pits in clean-burn power stations
- Low carbon emissions are achieved through low consumption rather than technically complex methods of achieving low CO_2 per kWh

Local Stewardship stories

- People trade goods and services widely to supplement/replace income from the waged economy
- Fewer long-distance journeys are made and car-sharing is an economic necessity for many as well as a social and environmental good for all

2.5 NATIONAL ENTERPRISE (ALSO KNOWN AS PROVINCIAL ENTERPRISE)

A world in which people aspire to personal independence and material wealth within a nationally rooted cultural identity. Liberalised markets, together with a commitment to build capabilities and resources to secure a high degree of self-reliance and security, are believed to best deliver these goals. Political and cultural institutions are strengthened to buttress national autonomy in a more fragmented world

Core Values

- Consumerist values and a pride in national identity lead to an ethic of 'buy British'
- Distrust of European political and economic institutions
- Economic globalisation continues with growing international investment, but is somewhat constrained by national 'protectionist' monopolies in key sectors (utilities, infrastructure, media).

Societal commentary

- Core values are consumerist, needs are met through private consumption.
- Little concern about social equity.
- Little concern for environment – other than where it meets people's recreational needs.
- Pace of devolution is slow, though local assemblies (Scottish, Welsh) act to protect economic activity at the local level.
- "Top-down" policy style – policies are pushed nationally rather than regionally.
- GDP +1.75% (higher than LS but lower than GS)

Domestic sector

- Population numbers increase slowly.
- Housing demand and average household size remain stable (because of medium economic growth and low social provision).
- Presumption in favour of new housing (planning side) will be in the form of additions to existing towns and villages.
- Weak local planning controls.
- New developments in green belts & countryside.
- Coastal housing takes place but limited by low investment in new housing (coastal defence protects all sectors on coastline including housing and environment).
- Build quality in poorer areas declines, while high quality buildings are developed close to centres of economic activity.
- Strain on resources in South East and London – especially water. Water quality is also affected – this may result in greater use of electric water purification systems. However, water demand is also limited by price mechanisms.
- Greater demand for housing in these areas – spill over to green belts and countryside
- Better housing practices in S.East (affluence) as quality of housing in other areas declines

Energy sector

- Security is key issue.
- Plentiful supply of fossil fuels.
- Tendency to preserve existing sources of energy including indigenous coal and nuclear (by extending lives of existing stations).
- Prices are relatively high because some high-cost forms of generation are maintained.
- Despite high prices, pursuit of energy efficiency is limited due to lack of available capital and low priority of environmental investments.
- Low ownership of building-integrated enewables.
- Some development of CHP

Technology and Construction

- Rate of innovation generally low: Low investment in research and technological development + restricted international competition.
- Traditional UK construction techniques continue to play major role.
- Construction remains labour intensive - low skill micro-enterprises predominate.
- ICT & Biotech main drivers of change.

Provincial Enterprise stories

- Diets do not change significantly – meat consumption remains high.
- Government protects UK Agri-Food industries to ensure high-quality food at modest prices.
- Patchy uptake of GMOs – drawing on UK science and industrial supply base.
- Higher levels of unemployment.
- Working hours continue to increase – especially low-income groups who augment via informal sector.
- Disposable income rises at slightly below historic rates.

3 END-USES, TECHNOLOGIES AND MODEL PARAMETERS

This section summarises the input variables chosen by the team for the UKDCM under each of the four Foresight scenarios.

3.1 CAVITY WALL INSULATION

No significant new technology is assumed for cavity wall insulation, thus future u-values will reflect best current practice at present.

Table 1: U-values for cavity walls (W/m^{2}K)

	WM	GS	PE	LS
Pre 96	0.4	0.4	0.4	0.4
1997-2003	0.35	0.35	0.35	0.35
2004-2010	0.3	0.3	0.3	0.3
2011-2020	0.3	0.3	0.3	0.3
2021-2030	0.3	0.3	0.3	0.3
2031-2040	0.3	0.3	0.3	0.3
2041-2050	0.3	0.3	0.3	0.3
Rate of removal	0.00%	0.00%	0.00%	0.00%

No decay in performance is assumed, nor is any removal of installed installation.

The Energy Efficiency Commitment (EEC) will mean large increase in installation until 2008 in all cases, with the sustainability scenarios increasing in ownership beyond this date.

Table 2: Uptake of cavity wall insulation under different FS scenarios

	Uptake of cavity wall insulation
WM	Occurrence rises from existing levels to 60% of all 80% of exposed cavity walls

	by 2008 rising to 70% by 2015, and plateau afterwards to 2050
GS	Occurrence rises from existing levels to 60% of all 80% of exposed cavity walls by 2008 rising to 100% (of 80%) by 2015
PE	Occurrence rises from existing levels to 60% of all 80% of exposed cavity walls by 2008 rising to 70% by 2015, and plateau afterwards to 2050
LS	Occurrence rises from existing levels to 60% of 80% of all exposed cavity walls by 2008 rising to 100% of 80% by 2020

3.2 NEW WALLS

It is expected that the UK building regulations for 2005 will have u-values of 0.25 for new walls. To reach 0.1 will require larger cavities, which could be a requirement for the subsequent building regulations revision (say 2010), assumed under the sustainability scenarios.

Table 3: U-values for new walls (W/m^{2}K)

	WM	GS	PE	LS
1997-2003	0.35	0.35	0.35	0.45
2004-2010	0.25	0.25	0.25	0.35
2011-2020	0.25	0.1	0.25	0.1
2021-2030	0.25	0.1	0.25	0.1
2031-2040	0.25	0.1	0.25	0.1
2041-2050	0.25	0.1	0.25	0.1

3.3 EXTERNAL INSULATION

It is possible to add external insulation to many existing walls. The u-values for such insulation is given in Table below.

Table 4: External wall insulation u-values (W/m^{2}K)

	WM	GS	PE	LS
Pre 96	0.5	0.5	0.5	0.5
1997-2003	0.45	0.45	0.45	0.45
2004-2010	0.3	0.3	0.3	0.3
2011-2020	0.3	0.15	0.3	0.15
2021-2030	0.3	0.15	0.3	0.15
2031-2040	0.3	0.15	0.3	0.15
2041-2050	0.3	0.15	0.3	0.15
Rate of removal	4.00%	4.00%	4.00%	4.00%

Rate of removal is assumed to be an average of 25 years, due to technical failing of fixings, etc. No deterioration in thermal performance is assumed during the lifetime.

A high uptake for external wall insulation is assumed in the sustainability scenarios (LS and GS).

Table 5: Uptake of external wall insulation

	Uptake of external wall insulation
WM	Occurrence rises linearly from existing levels to 30% of all social sector solid wall by 2050 (weak regulation)
GS	Occurrence rises from existing levels to 100% of all exposed (available) solid

	walls by 2015. (Legislation will be drafted from 2010 encouraging ext insulation (or int ins - for solid walls with façade problem.) Faster than LS because more money.
PE	Occurrence rises linearly from existing levels to 30% of all social sector solid wall by 2050 (Penetration stays at same because though weak social provision and low GDP, higher energy prices result in greater penetration)
LS	Occurrence rises from existing levels to 100% of all exposed solid walls by that can be insulated 2050

3.4 LOFT INSULATION

The level of insulation will be the same for both retrofit and new build housing.

Table 6: Level of loft insulation (mm)

	WM	GS	PE	LS
Pre 96	As Given	As Given	As Given	As Given
1997-2003	200	200	200	200
2004-2010	250	250	250	250
2011-2020	250	300	250	300
2021-2030	250	300	250	300
2031-2040	250	300	250	300
2041-2050	250	300	250	300
Rate of removal	2.00%	3.50%	2.00%	3.50%

250mm is the standard for the 2005 building regulations. 300mm was taken as the technical potential.

High installation as a result of EEC.

Table 7: Uptake of loft insulation

	Uptake of loft insulation
WM	Occurrence rises linearly from existing levels to 30% of all social sector dwellings by 2050; and 30% of all semis and detached (loft conversions) benefit from Building Regulation standard. (help of weak regulation to help fuel poor)
GS	Rising from current average loft thickness per dwelling category for those that have loft insulation to 100% of available lofts (70% of potential because of loft flooring) 2020 (1 million houses a year out of around 15 mill, assumed houses available therefore 2020)
PE	Rising from current average loft thickness per dwelling category for those that have loft insulation to 60% of available lofts 2008 rising to 70% by 2020 and plateau thereafter.
LS	Rising from current average loft thickness per dwelling category for those that have loft insulation to 100% of available lofts 2020.

3.5 WINDOWS

New building regulations mean most replacement will be double glazing, the only exception is some conservation areas.

However, there is still large potential to reduce u-values. The following have been proposed for existing households:

Table 8: Window U-values for existing households (replacement) (W/m^{2}K)

	WM	GS	PE	LS
Pre 96	2.5	2.5	2.5	2.5
1997-2003	2.2	2.2	2.1	2.1
2004-2010	1.7	1.9	2.1	2
2011-2020	1.7	0.6	2.1	0.8
2021-2030	1.6	0.6	2	0.8
2031-2040	1.5	0.6	2	0.8
2041-2050	1.4	0.6	2	0.8
Rate of removal	4%	2.50%	2.00%	2.00%

Table 9: Window U-values for new-build (W/m^{2}K)

	WM	GS	PE	LS
1997-2003	2.2	2.2	2.2	2.1
2004-2010	1.7	1.7	1.7	2
2011-2020	1.7	0.6	1.7	0.8
2021-2030	1.7	0.6	1.7	0.8
2031-2040	1.7	0.6	1.7	0.8
2041-2050	1.7	0.6	1.7	0.8

2005 Building regulations for new houses implies u-value of 1.7 or so. The sustainability scenarios assume that the low values are reached in the 2010 Building regulations.

Table 10: Uptake of double glazing in existing homes

	Uptake of double glazing in existing homes
WM	Occurrence rises from existing levels to 100% of all windows by 2050
GS	Occurrence rises from existing levels to 100% of all windows by 2030 (50% u-values of 0.6, and rest average u-value by that period). Rising to 100% of all windows to 0.6 by 2050 (1. Current ownership ~ 50% of houses (Shorrock & Utley 2003), 2. 2030 is because of churn rate)
PE	Occurrence rises from existing levels to 100% of all windows by 2030 (based on 0.5m pa current churn)
LS	Occurrence rises from existing levels to 100% of all windows by 2020

The uptake of double glazing does not appear to be challenging, rather it is the u-values of the installed double glazing (which could also be triple or other efficient technology).

3.6 FLOORS

2005 building regulations are expected to take floor u-values to 0.2. The known technical potential of 0.09 has already been realised in the UK, so could be used in 2010 building regulations for sustainability scenario.

Table 11: New build floor u-values

	WM	GS	PE	LS

1997-2003	0.25	0.25	0.25	0.25
2004-2010	0.2	0.2	0.2	0.2
2011-2020	0.2	0.09	0.2	0.09
2021-2030	0.2	0.09	0.2	0.09
2031-2040	0.2	0.09	0.2	0.09
2041-2050	0.2	0.09	0.2	0.09

3.7 DOORS

Small part of energy loss – assumed to have u-value of 2 for all scenarios into the future, currently u-value is 2.5.

3.8 VENTILATION

There are very few reliable data on air changes per hour (ach). The BREDEM-8 algorithm assumes that occupants increase ventilation by opening windows when ach < 1. The following have been assumed for UKDCM.

Table 12: Air changes per hour (ach)

	WM	GS	PE	LS
1997-2003	1.5	1.5	1.5	1.5
2004-2010	1.2	1.2	1.2	1.2
2011-2020	1.2	0.9	1.2	0.9
2021-2030	1.2	0.6	1.2	0.6
2031-2040	1.2	0.3	1.2	0.3
2041-2050	1.2	0.3	1.2	0.3

3.9 APPLIANCES (INCLUDING COOKING)

At present the DECADE model produces average consumption per household. It is possible to make an estimate by household type, household size and other variables, using the EHCS and other UK housing conditions survey.

The appliances have been sub-divided into generic groups: consumer electronics, cooking, wet (washing machines, tumble dryers and washer-dryers), refrigeration, miscellaneous. Separate estimates of overall increased usage and improvements in efficiency have been made for each scenario.

Table 13: Average generic appliance end-change in usage and efficiency, 2050

End-use	Scenario	Usage change (%)	Efficiency change (%)	Comment
Cold	WM	200	EEI=0.3	
	GS	150	EEI=0.3	Reached by 2030
	PE	180	EEI=0.5	
	LS	120	EEI=0.4	
CE	WM	400	100% of TP	
	GS	400	100% of TP	By 2030
	PE	300	60% of TP	
	LS	200	40% of TP	
Wet	WM	220	30% of TP	
	GS	220	50% of TP	

	PE	180	30% of TP	
	LS	150	30% of TP	
Cooking	WM	80	+30%	
	GS	130	+40%	By 2030
	PE	120	+30%	
	LS	170	+20%	
Miscellaneous	WM	300		
	GS	150		
	PE	200		
	LS	150		

* EEI = Energy Efficiency Index; TP = technical potential

Since there are many different types of consumer electronics it has been assumed that TP means a 50% reduction in consumption (or a doubling in efficiency).

The sustainability scenarios have much less consumption by appliances. This will be achieved through a combination of strong policy and fewer appliances. For GS some Consumer Electronics, for instance, may well be more efficient but there will be many more of these appliances, so overall electricity consumption will be higher.

3.10 LIGHTING

A majority of lighting is created using GLS lamps. The last 20 years have seen the introduction of CFLs. The next technology which will substantially change consumption is LED lighting, which promises to be much cheaper, and significantly more energy efficient.

Table 14: Uptake of efficiency lighting

	Extra service (%)	**100% LED**	**Comment**
WM	40	2030	No further uptake of CFL. Rapid uptake (ownership) of LED post 2010 - 100% by 2030. 40% of lower energy benefit lost to increased use of lighting.
GS	20	2030	No further uptake of CFL. Rapid uptake (ownership) of LED post 2010 - 100% by 2030. 20% of lower energy benefit lost to increased use of lighting.
PE	20	2050	No further uptake of CFL. Slow uptake (ownership) of LED post 2010 - 100% by 2050. 20% of lower energy benefit lost to increased use of lighting.
LS	0	2050	No further uptake of CFL. Slow uptake to 2020 (40% ownership) rising to 100% by 2050. No takeback.

3.11 AIR CONDITIONING

A separate analysis of cooling degree days (CDD) is undertaken for each region – see background material E: Climate.

Fans and additional shading (and higher thermal mass, night time removal of heat) may be used instead of air conditioning units. These solutions are more common in the sustainability scenarios.

Table 15: Presence of air conditioner (AC) and fans

	AC present	Fans (kWh)	Comment
WM	Yes	0	Rising to 100% of CDD analysis
GS	No	10	50% of LS due to additional shading
PE	Yes	40	AC and fans 50% of CDD analysis
LS	No	20	Fans 20% of CDD analysis

The efficiency of air conditioners is assumed to improve linearly under all scenarios from a Coefficient of Performance (COP)=3 to COP=4 by 2050.

For LS scenario, the 20 KWh = 5 fans @ 100 W for 4 hrs for 6 weeks. For the GS scenario, additional shading means that only half of this energy is required.

3.12 SOLAR THERMAL AND SOLAR PHOTOVOLTAICS (PV)

Based on discussion at modelling meetings. A large increase in ownership of roof-based renewable generation is assumed in the two sustainability scenarios, and none in the PE/WM scenarios.

The average roof is assumed to be 17m^2 in the UK, which could take either PV or solar-thermal collectors.

The efficiency of PV is assumed to be 6%, constant over the period. This is a conservative estimate since crystalline technologies are already higher, however, this an acceptable figure for silicon-based PV which has the potential for dramatically lower production costs.

Table 16: PV and solar thermal (ST), ownership (%) and area (m^2)

	PV (%)	PV (m^2)	ST (%)	ST (m^2)	Comment
WM	0	-	-	-	None installed
GS	82	12	82	5	Have both systems
PE	0	-	-	-	None installed
LS	25	17	75	5	Have one or the other

3.13 HEAT GENERATORS

Once the building fabric and householders heating demand have been taken into account, the household heat generation systems and its fuel will decide the amount of emissions produced by heating in the domestic sector.

The main heating systems in use at present are shown below (for England), with gas-fuelled systems the most common.

Table 17: Main heating systems in England, 1996:

Heating system	Ownership (%)
Mains gas – single purpose boiler plus radiator	65
Mains gas – back boiler plus radiator	15
Electricity – off-peak storage heaters	8
Fuel oil	4
Mains gas – duct air	3

Solid fuel	3
Other (tanked gas, communal, etc)	2
Electricity floor/ceiling	1

Source: DETR 2000

New future technologies could include the following (limited to currently known technologies, but not necessarily ones that are market-ready):

- Community heating using Combined Heat and Power (CHP) and biomass
- Micro-CHP (stirling engine and fuel-cell)
- Heat pumps (ground source)
- Biomass boiler
- Solar photovoltaics
- Solar water heaters
- Micro wind

3.13.1 WM scenario

This is the conservative projection. The ownership projections can be summarised as:

- There are no dCHP, nor electric heat pumps introduced in the future.
- Households without a CH system are expected to be eliminated by 2020 (linear fill from 1996).
- The households without CH install gas/electric/communal at the same proportion as 1996.
- 'Other' CH category remains constant
- Average efficiency of gas increases from 68% to 94% by 2050.

Average electric efficiency remains at 100% (ie assumes resistive heating and no ground-source or air-sourced heat pumps).

The efficiency values for each technology are shown in the Figure below.

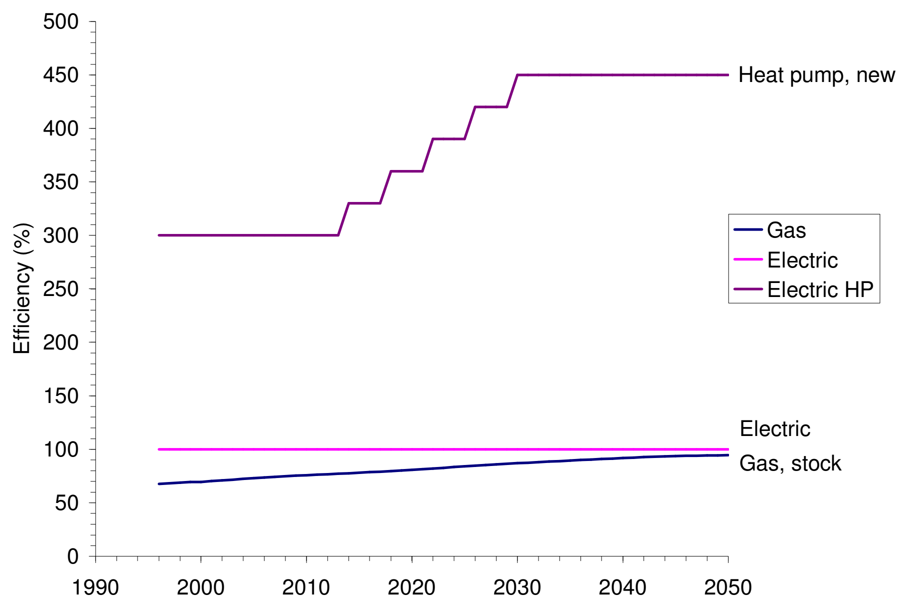


Figure 2: Efficiency of heating systems for WM scenario, 1996-2050

3.13.2 PE scenario

Same as the WM scenario in terms of heating systems.

3.13.3 LS scenario

There is an assumed uptake of dCHP and heat pumps in this scenario.

The dCHP is for stirling engine based technology (85-10 ratio for heat to electricity efficiency). It is assumed that some fuel cell technology will be introduced as dCHP, which has a ratio of 55-40.

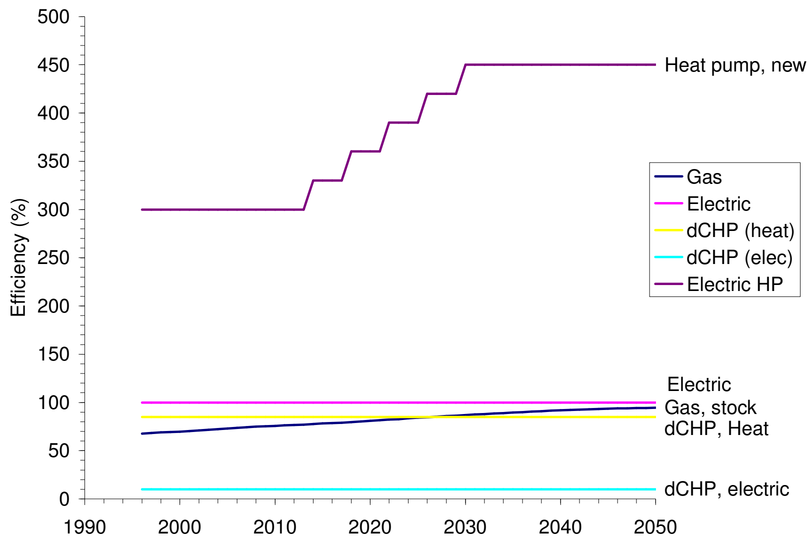


Figure 3: Average efficiency of gas heating systems, 1970-2050
Note: dCHP is for a stirling engine

3.13.4 GS scenario

Similar to LS scenario except that the uptake of fuel cells for dCHP is 50% of that in the LS scenario.

3.14 EMISSION FACTORS

Table 18: Assumed emission factors by 2050 under ForeSight scenarios

	Electricity	Elec (kgC/kWh)	Gas (kgC/kWh)
WM	Same as current, or higher – 0.5	0.14	0.05
GS	Lower than present, -30%	0.096	0.05
PE	Same as current – 0.4	0.11	0.05
LS	30% less than 1996	0.096	0.05

These are relatively conservative assumptions for electricity.

3.15 DEMOLITION RATES

Current demolition rates are very low, at around 12,000 per annum, with a historic high of 130,000 in the 1970s.

Table 19: Assumed annual demolition rates under ForeSight scenarios

	Annual demolition rate	Comment
WM	Current to 90,000 in 2030	lower building lifespan (new build)
GS	Current to 130,000 in 2030	Historic maximum
PE	Current levels to 15,000 in 2020	Similar to today's levels
LS	Current to 35,000 in 2030.	1. Higher than today 2. Based on making long-term investment choice for a higher efficient house 3. Migration away from cities

3.16 NEW BUILD TYPES

For new houses, both demolition replacement and stock additions, an estimate is needed for the type of housing built. Numbers for each scenario are summarised in the table below.

Table 20: Assumed mix of new-build home types under Foresight scenarios

	Semi	Detached	Flat	Terrace	Comment
WM	20	20	20	Negative	
GS	10	10	10	Negative	
PE	20	20	Same	Negative	
LS	10	10	Negative	Same	

Average window size for new dwellings is modelled as being 15% smaller than existing over the period 1997-2003, then same size current average to 2007, then increasing to 15% larger from 2008 onwards.

Average floor size for new dwellings is modelled to be the same as existing to 2007, then 5% larger after that.

3.17 EXTERNAL TEMPERATURES

A mapping is made between Foresight scenarios and future emissions scenarios, using data from the Inter-governmental Panel on Climate Change and the UK Climate Impacts Programme (IPCC 2001, UKCIP 2002). This mapping is summarised in the following table.

Table 21: Scenarios and average temperature rise

Scenario	IPCC	Emissions	Temp rise 2020 (oC)	Temp rise 2050 (oC)
WM	A1F1	high	0.94	2.24
GS	B1	Low	0.79	1.41
PE	A2	Medium high	0.88	1.87
LS	B2	Medium low	0.88	1.64

3.18 INTERNAL TEMPERATURES

All temperatures will reach the standard heating pattern as a minimum by 2020, in line with fuel poverty (FP) reduction targets. Some scenarios are likely to demand a higher level of heating.

Table 22: Assumed average demanded winter temperatures (required heating)

	Temp	Comment
WM	+4	No FP
GS	+2	No FP
PE	+3	50% of current FP
LS	Same	No FP

Table 23: Assumed average demanded summer temperatures (required cooling)

	Temp	Comment
Now	26	Example
WM	24	Constant internal temperature
GS	27	Winter temp +3
PE	-	No AC
LS	-	No AC

3.19 DEMOGRAPHIC CHANGES

Assumptions about the total size of the population and the number of people per household are given by Foresight (DTI 2002) and summarised in the following four tables.

Table 24. Assumed demographic change: World markets

	Mid-1990s	2020s (linear)	2050
Household numbers	24.5 m	28 m	31 m
Household size	2.4 pph	2.2 pph	2.0 pph
population	58.5 m	61 m	62 m

Table 25. Assumed demographic change: National enterprise

	Mid-1990s	2020s (linear)	2050
Household numbers	24.5 m	28 m	25.5 m
Household size	2.4 pph	2.2 pph	2.4 pph
population	58.5 m	61 m	61 m

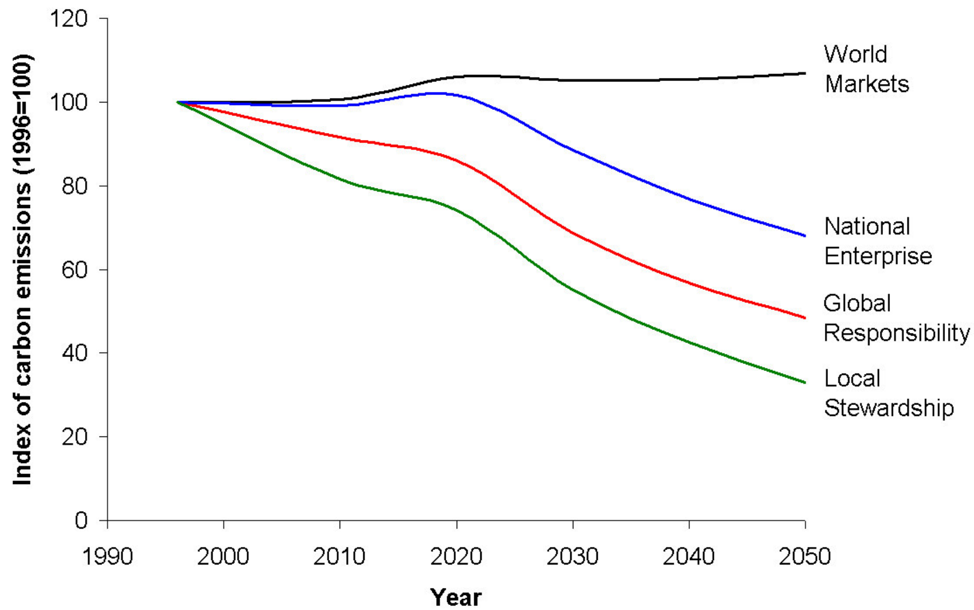
Table 26. Assumed demographic change: Global sustainability

	Mid-1990s	2020s (linear)	2050
Household numbers	24.5 m	28 m	27.5 m
Household size	2.4 pph	2.2 pph	2.2 pph
population	58.5 m	61 m	61 m

Table 27. Assumed demographic change: Local Stewardship

	Mid-1990s	2020s (linear)	2050
Household numbers	24.5 m	28 m	23 m
Household size	2.4 pph	2.2 pph	2.6 pph
population	58.5 m	61 m	60 m

4 RESULTS - SCENARIO COMPARISON



Results from UKDCM using input variables developed for Foresight scenarios

The results from the four runs of the UKDCM using the input data for the four Foresight scenarios are shown in the graph above. The World Markets scenario shows an increase in carbon emissions, while the other three show a decrease. Local Stewardship is the one scenario to achieve 60% carbon reductions by 2050, although Global Responsibility is not far behind.

5 CONCLUSIONS, DISCUSSION

Modelling to 2050 is difficult, when a large number of parameters have to be decided upon. The 40% House team has developed a detailed stock model (UKDCM), and made provisional estimates for input parameters that are self-consistent within a 'Foresight' framework. The model includes changes to climate and service levels into the future. The base values for 1996 have been cross-checked with values from Domestic Energy Fact File (which uses BREHOMES) for GB.

The Foresight approach was taken to allow comparison with other sectors using the same approach. Each ForeSight scenario has an associated climate scenario.

The scenarios show that a wide range of futures is possible. The World market scenario shows that consumption and importantly emissions will rise into the future. However, in a Local Stewardship world emissions will fall, close to sustainable levels by 2050.

One key distinguishing feature of the Local Stewardship scenario is the assumed demographic change: a larger household size leading to fewer homes in 2050 than in

1996. Such demographic shifts are relatively insensitive to policy, and there is clearly a possibility that the future world might share some of the other values of the LS scenario, but that the assumptions about demographics could be wrong.

A key challenge for developing a more robust scenario would be to accommodate a significant growth in the number of homes needed.

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