Cost Implications of the Government's Housing Targets

Technical Report

Report

By

Building Cost Information Service

June 2009

Acknowledgement

BCIS gratefully acknowledges the support provided for this report by the department of Communities and Local Government and the Policy Department of the RICS.

The views presented in this report are those of the BCIS and not the other funders.

The cost implications of meeting the Government's housing targets

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1 Executive summary

- The objective of this study is to estimate the impact of the Government's targets, both quantitative and qualitative, for the supply of new homes on the cost of housebuilding in England.
- The impact has been estimated separately for public and private sector houses and flats.
- It is based on the targets set out in *Homes for the Future: more affordable, more sustainable* and *Building a Greener Future.* These set out targets for the numbers of completions and targets for the energy performance and other design criteria, in the public and private sector.
- It is not the objective of this study to forecast the housing market ie it does not attempt to comment on how likely it is that these targets will be met.
- Based on ONS statistics for housing output and completions the current cost of homes is estimated to be:

  Public Sector

Flats	£146,000
Houses	£181,000

  Private Sector

Flats	£107,000
Houses	£132,600

- Costs of complying with the Code for Sustainable Homes, Building Regulations and other regulatory requirements are, unless stated otherwise, are based on previous CLG reports.
- Where they are viable the use of large wind turbines will reduce the cost of compliance.
- Although the impact of the changes proposed to the Code to permit 'Allowable solutions' are not yet clear it has been assumed that, where they are viable, the will reduce the cost of compliance.
- Complying with the insulation and air-tightness requirements will require changes in the way homes are built, probably using off-site manufacture. The costs of the building fabric will remain unchanged and the cost of installation will tend rise until these forms of construction are the standard specification and decline thereafter.
- Complying with the energy requirements will require changes to the way homes are serviced and the use of different technologies. Because these technologies are generally not new, and have an established world market, the cost of the products will remain unchanged and the cost of installation will tend rise until these forms of construction are the standard specification and decline thereafter.
- Given the relatively short period to adopt these changes in construction there is a danger that delivery constraints and the availability of skilled labour may be a barrier to implementation and push up prices in the short term.
- The Code requirements will be reflected in completions two years after their introduction.
- Building Regulation requirements will be reflected in completions one year after their introduction.

- Based on the assumptions stated in this report the additional cost per unit in meeting the targets are as follows:

Cost per unit of implementing the targets (2007 prices)

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	12,970	9,093	7,106	5,734	7,928
2011/12	15,743	11,321	13,007	10,063	12,084
2012/13	23,437	16,337	14,396	11,266	14,971
2013/14	25,883	18,291	16,747	12,771	17,101
2014/15	28,404	20,308	22,856	16,762	21,191
2015/16	55,587	36,807	23,364	17,343	29,425
2016/17	55,618	36,964	23,823	17,714	29,926
2017/18	55,033	36,622	44,076	31,782	40,271
2018/19	54,460	36,286	43,552	31,430	39,836
2019/20	53,898	35,957	43,038	31,085	39,410
2020/21	53,898	35,957	42,534	30,746	39,152

- A simple model based on the assumptions has been derived that can be used to look at different sets of assumptions.
- Note: Generally costs in this report are presented as calculated this is not intended to imply a level of accuracy in the estimates beyond £,000 per unit.

2 Introduction

Objective

To estimate the impact of the Government's targets, both quantitative and qualitative, for the supply of new homes on the cost of housebuilding in England.

Background

The Government published *Homes for the Future: more affordable, more sustainable* in July 2007, which sets out a target for the supply of new homes – reaching 240,000 new houses a year by 2016. Much of this increased provision will be 'affordable housing', most of which will be delivered through Housing Corporation investment in the National Affordable Housing Programme.

The Government has also set targets for the sustainable design of the homes to be built in *Building a Greener Future: policy statement* in July 2007.

The targets are therefore for more homes to a higher standard.

This report models the impact on the cost of housing that results from these targets.

The crisis in the money markets that has occurred since this project was first proposed has brought about a significant downturn in the housing market, the construction industry and the economy as a whole. However, as it is the objective of the project to forecast the marginal impact on the building cost of homes of the Government's targets, it as been agreed that the forecast should be based on a steady state of demand.

It is not therefore the objective of this project to forecast the housing market ie it does not attempt to comment on how likely it is that these targets will be met.

The definition of the sustainability targets, and how they might be achieved is under review. This report uses overall estimates for achieving the targets it does not therefore address how they maybe achieved. However, because there is potentially a significant cost difference between achieving Code for Sustainable Homes level 6 with on-site micro-renewables and central on-site or off-site generation, or the implementation of the proposed 'allowable solutions', the model takes these into account.

The report examines the impact on building cost of increased house building and the additional costs that will result from meeting the higher quality requirements in the targets. It brings together estimates for the following:

- The current cost of a unit of housing
- The impact on the prices of general building work of increased demand inherent in the numbers targets
- The additional cost of achieving the sustainability targets as defined in the Code for Sustainable Homes
- A breakdown of the cost between the building fabric and 'new' technology
- The impact of central or off off-site power generation and 'allowable solutions'
- The impact of increased demand on the price of renewable technologies
- The impact of increased demand on the price of 'Modern Methods of Construction' for the building fabric.

The report makes the following basic assumptions:

- No change in government incentives to the adoption of the code or other measures.
- The sustainability targets will be met using currently available technology. We have not allowed for any breakthrough technology although this is a possibility.
- Unless otherwise stated, we have used the cost and mix assumptions from previous CLG published reports.

Methodology

- Establish government targets to 2016/17
    - Numbers
    - Sustainability performance levels
- Forecast pattern of completions to 2016/17
    - Numbers
    - Client: public/private
    - Type: houses/flats
    - Sustainability provisions
- Estimate the current cost per unit for houses and flats
- Estimate impact of increased housing demand on construction costs
- Estimate additional cost of meeting sustainability targets in the Code for Sustainable Homes
- Estimate impact of alternative solutions
- Estimate impact of increased demand on costs of meeting sustainability targets
- Estimate lag in implementation of regulations
- Estimate impact of adoption of new standards as they become the standard
- Combine estimates to estimate the cost per unit through to 220/21.

3 Government Targets

Base assumptions on targets

- England only
- Financial years
- Completions not starts
- Base 185,000 (2007-08)
- Public sector – Registered Social Landlords and Local Authorities are subject to the Code for Sustainable Housing
- Private Enterprise – Subject to Building Regulations only. Allow for some voluntary take up of code
- Targets are net additions allowing for 'other losses and gains (such as conversions and demolitions)'
- Forecasts are based on new homes
- 'Other losses and gains' will represent 10% of net additions targets.

Numbers from Homes targets

Taken from '*Homes for the Future: more affordable, more sustainable',* CLG in July 2007

- *All houses*
  - *By 2016: 240,000 per annum*
  - *By 2016: 2 million (2007/08 –2016/17)*
  - *2017 to 2020: 240,000 per annum (assumed the overall 1 million target for this period is a rounding from 960,000)*
- *Affordable*
  - *Assume these are all Public Sector*
  - *By 2010: 180,000*
  - *By 2010: 70,000 per year*
  - *Ambition to increase thereafter*
- *Social*
  - *Assume these are all Public Sector*
  - *By 2010: at least 45,000 a year. Included in target for affordable*
  - *A goal of 50,000 a year in next spending round*
  - *Included in target for Affordable*
- *Shared ownership*
  - *Assume these are all Public Sector*
  - *25,000 a year*
  - *'Thousands more' through local housing companies.*
  - *Included in target for Affordable*
- *Rural affordable*
  - *Assume that these are covered by other targets.*
- *Private Sector shared equity*
  - *Assume that these are private sector*

Sustainability performance levels

Targets supplied be CLG

	2008	2010	2013	2016
Public Sector				
Code For Sustainble Homes (public sector)	Code Level 3	Code Level 4	Code Level 6	Code Level 6
Lifetime Homes in CSH	Mandatory Code Level 6	Mandatory Code Level 4	Mandatory Code Level 3	Mandatory Code Level 3
Lifetime Homes CSH in public sector	Mandatory for new funding Hcorp	Mandatory for new funding Hcorp	All publicly funded homes to LHS from 2011	All publicly funded homes to LHS from 2011
Water Regulations (Building Regulations)*	New Part G 125 litres day (coming into force 2009)	No change proposed	No change proposed	No change proposed
Private sector				
Code For Sustainable Homes	All code building voluntary	All code building voluntary	All code building voluntary	All code building voluntary
Lifetime Homes (possible regulations)			**Possible** inclusion in Building Regulations (Oct 2013)	
Part L Changes (Building Regulations)		25% improvement over 2006 Part L[1]	44% improvement over 2006 Part L[2]	Zero carbon to be defined[3]
Water Regulations (Building Regulations)*	New Part G 125 litres day (coming into force 2009)	No change proposed	No change proposed	No change proposed

NOTES 1,2,3 - Building Regulations are not the same as the Code but rough compliance in performance terms is as follows:

1. Equivalent to Code Level 3 in energy performance
2. Equivalent to Code Level 4 in energy performance
3. Equivalent to Code Level 6 in energy performance

* Maximum water consumption in Code

- Code Level 1 - 120 litres per day
- Code Level 2 - 120 litres per day
- Code Level 3 – 105 litres per day
- Code Level 4 – 105 litres per day
- Code Level 5 – 80 litres per day
- Code Level 6 – 80 litres per day

Note: Code level water efficiency is mandatory where built to the code, e.g. public sector.

4 Pattern of future completions

The Government's targets are expressed in 'net additions'. The Code for Sustainable Housing applies mainly to new homes. The relationship between net additions and new completions over recent years is given in Figure 4.1. The relationship has varied but for the purposes of this exercise we have assumed that new completions will be 90% of net additions

Figure 4.1 - Housing completions: England

	New completions (1)	Net additions (2)	
2000/01	133260	132000	101%
2001/02	129870	130520	100%
2002/03	137740	143660	96%
2003/04	143960	154770	93%
2004/05	155890	169040	92%
2005/06	163400	185150	88%
2006/07	167680	199240	84%
2007/08	166990	185500	90%

(1) Housing Stats Sept 08
(2) www.communities.gov.uk/documents/housing/xls/118.xls

Based on the targets, and an assumption of steady year on year growth to 240,000 by 2016, Figure 4.2 shows the forecast net additions and new completions. The public sector completions are based on the Government's targets. The private sector numbers represent the difference between the overall target and the public sector target.

Figure 4.2 New completions to 2020-21implied in the targets

	New completions			Other Additions	Net Additions
	Public	Private	Total		
2000/01	16610	116640	133250	-1250	132000
2001/02	14160	115700	129860	660	130520
2002/03	13280	124460	137740	5920	143660
2003/04	13860	130100	143960	10810	154770
2004/05	16760	139130	155890	13150	169040
2005/06	18460	144940	163400	21750	185150
2006/07	22000	145680	167680	31560	199240
2007/08	23400	143600	166700	18500	185500
2008/09	50000	125500	175500	19500	195000
2009/10	60000	124500	184500	20500	205000
2010/11	70000	120800	190800	21200	212000
2011/12	70000	128900	198900	22100	221000
2012/13	70000	133400	203400	22600	226000
2013/14	75000	132000	207000	23000	230000
2014/15	77000	133600	210600	23400	234000
2015/16	83000	130300	213300	23700	237000
2016/17	86000	130000	216000	24000	240000
2017/18	86000	130000	216000	24000	240000
2018/19	86000	130000	216000	24000	240000
2019/20	86000	130000	216000	24000	240000
2020/21	86000	130000	216000	24000	240000

Figure 4.3 gives the proportion of houses and flats in completions over recent years.

Figure 4.3 Houses and flats

	Public		Private	
	Houses	Flats	Houses	Flats
2000/01	63%	37%	83%	17%
2001/02	64%	36%	78%	22%
2002/03	62%	39%	74%	26%
2003/04	54%	46%	67%	33%
2004/05	47%	53%	60%	40%
2005/06	42%	58%	55%	45%
2006/07	34%	66%	56%	44%
2007/08	34%	66%	55%	45%

There has been a general trend towards more flats in both sectors but the last three years have been relatively stable. The following relationships have been used in the base model:

- Public: 34% Houses, 66% Flats
- Private: 55% Houses, 45% Flats.

5. The Current Cost of House Building

To establish the current cost of building housing units we have looked at two sets of data, ONS data on output and completions and a database of information derived from the information BCIS collect to calculate the Tender Price Index of Social Housing (TPISH).

ONS data cost per unit estimates

The ONS data provides construction new work output for public and private housing, and housing completions. The completions in any one year do not relate directly to the output in the same year. However, as output is calendar year and completions are financial year they are lagged by one quarter. This is a simplistic assumption as the lag between output and completion will vary from period to period.

Output is all work done by contractors so includes the cost of the building, external works, site preparation and overheads and any fees that they pay.

Figure 5.1 Implied cost per unit from ONS statistics (England current prices)

	Private			Public			Cost per Unit Private as % of Public
Year[1]	Output £million	Completions	Cost per unit £	Output £million	Completions	Cost per unit £	
2002/03	8805	124460	70746	1366	13280	102861	69%
2003/04	11147	130100	85680	1670	13860	120491	71%
2004/05	13862	139130	99633	2249	16760	134189	74%
2005/06	15040	144940	103767	2322	18460	125785	82%
2006/07	16356	145680	112273	2980	22000	135455	83%
2007/08[2]	17023	143600	118545	3700	23400	158120	75%

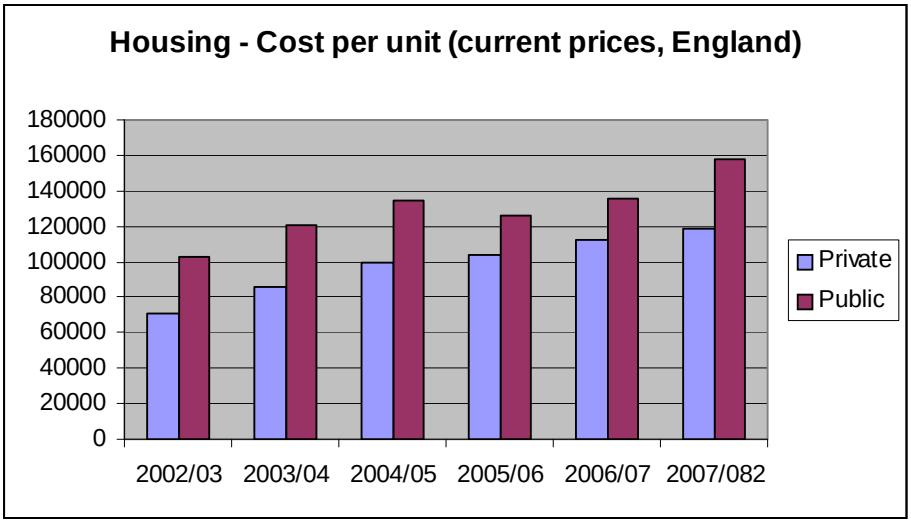
[1] Output calendar year e.g. 2002/03 = 2002, completions financial years April-March

The degree of variability in the public sector figures in 2004/2005 when there was a jump in output, suggests that the lag between output and completions should be longer. However, the figures do indicate a differential between costs per unit in the public and private sector of between 20% and 25% in the last four years.

There are a range of factors that influence the price per unit that may explain the differences between the public and private sector.

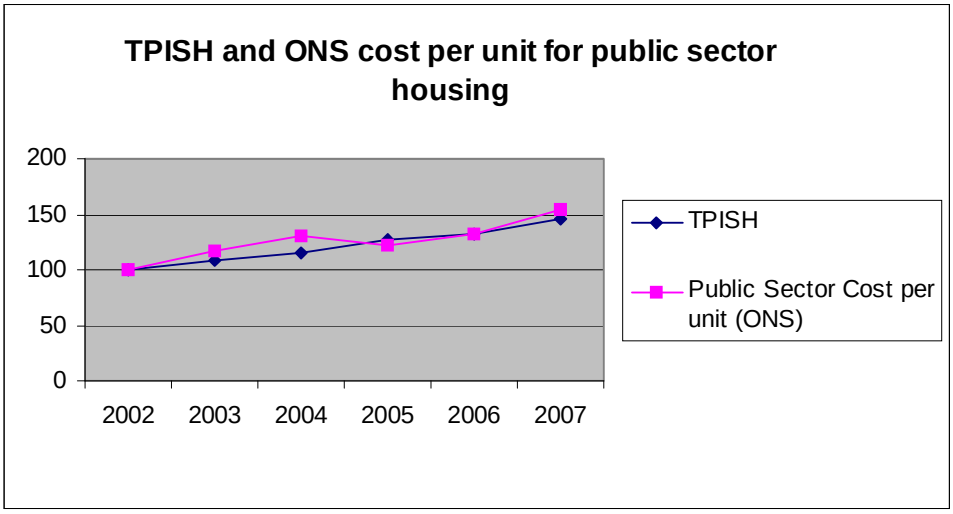
- Tending to make public sector more expensive:
  - Smaller schemes
  - More infill sites
  - Larger units on a like for like basis
  - Higher basic specification
- Tending to make private sector more expensive:
  - Greater proportion of houses to flats
  - Possibly more large units
  - Higher finishes and fittings specification.

Figure 5.2 Housing Cost per Unit based on output and completions



. Figure 5.3 shows the trend in Tender price levels (as measured by the Tender Price index of Social Housing)and the ONS data cost per unit figures for Public Sector housing.

Figure 5.3 Trend in tender prices and ONS based estimate of public sector cost per unit



TPISH data cost per unit estimates

The Tender Price Index of Social housing (TPISH) database contains data on 1,327 social housing projects containing 19,208 units built over the past six years. Broken down as follows:

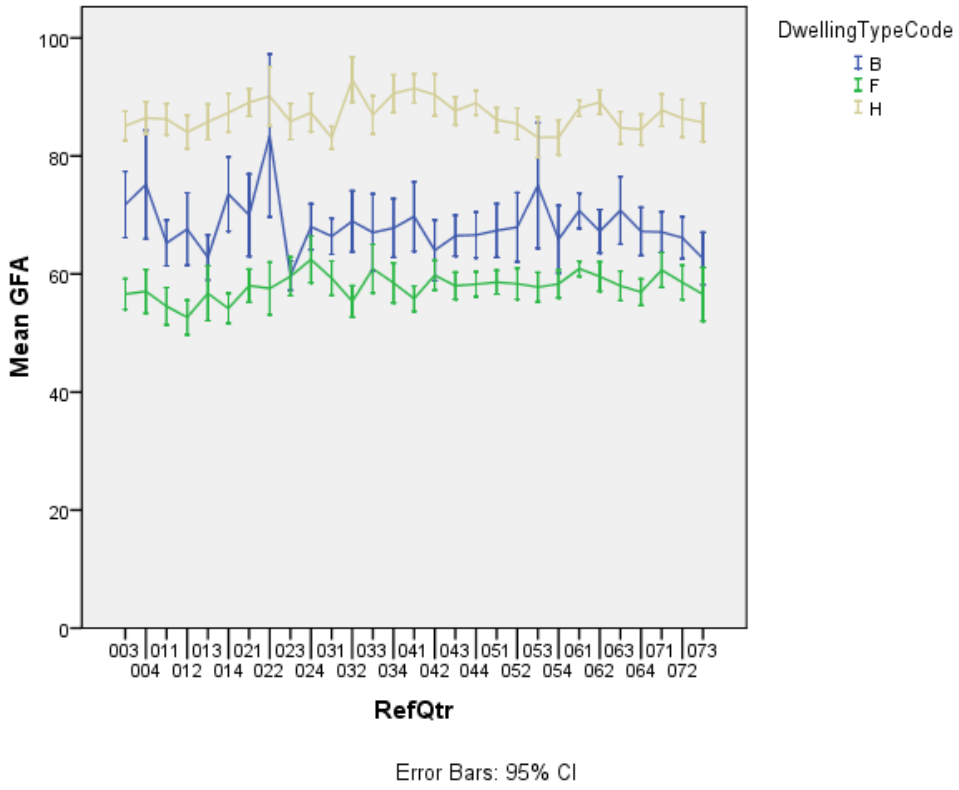
236 flats only
756 houses only
325 mixed houses and flats.

The average scheme sizes are:

Flats only – 13 units (range 2-64)
Houses only – 10 units (range 1-108)
Mixed houses and flats – 26 units (range 3-200).

The average size (gross internal floor area – GIFA) of houses and flats has been fairly consistent through the period. See Figure 5.4.

Figure 5.4 – Trend in average (mean) dwelling size



Key: B = Bungalows, F = Flats, H = houses

The cost per unit of the dwelling (excluding external works, etc) has also been fairly stable over the six years. See Figure 5.5.

Figure 5.5 average cost per unit (dwelling) at constant prices

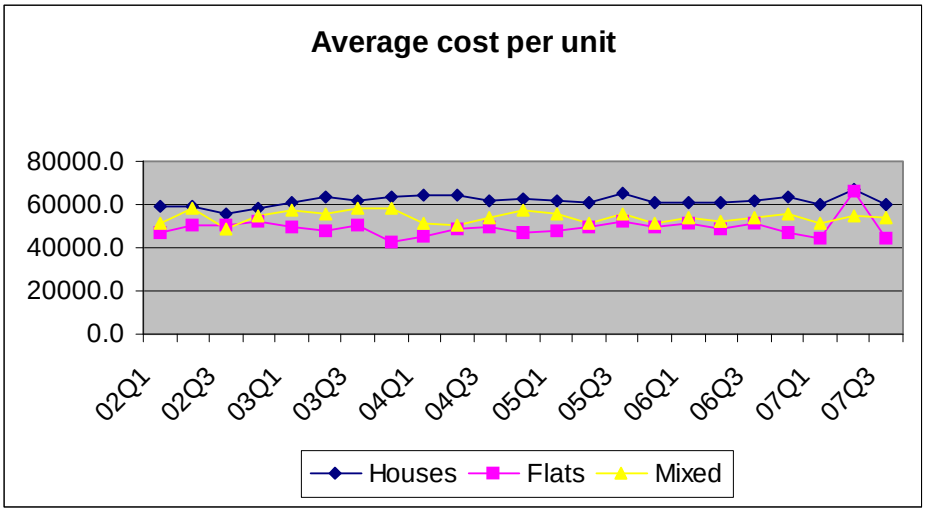


Figure 5.6 compares the trend in the TPISH index and the cost per unit estimates from the ONS public sector output and completions and the TPISH database. It is interesting that both the cost per unit estimates show a jump in 2004.

Figure 5.6 Trend in TPISH and cost per unit estimates

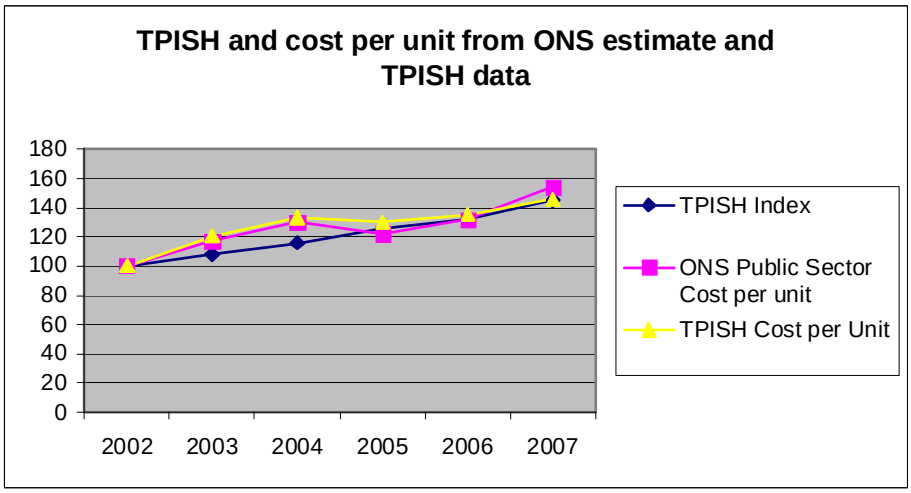


Figure 5.7 shows the average cost per unit from the TPISH data adjusted to 2007 prices, broken down to the greatest level of detail available.

Figure 5.7 Cost per unit 2007 prices

	Cost per unit			
DwellingType	Flats	Houses	Mixed	All projects
Substructure	8451	10386	8940	9673
Superstructure	52499	56340	51293	54392
External Works	10395	20415	15776	17421
Garages	183	397	527	389
Preliminaries	11103	14642	11213	13146
Contingencies	1273	2108	1403	1781
Design Fees	4357	4919	4507	4714
Other	3317	3890	5273	4122
Total	91579	113097	98933	105639
Sample	246	756	325	1327

'Other' is non-building or non-housing related work included in the contracts.

The costs imply a mix of 35% houses and 65% flats, which is very similar to the figures from housing completions in Section 4 (Figure 4.3). They also show houses costing 24% more than flats.

Cost per unit figures assumed in the model

There is a significant difference in the two estimates The ONS statistics suggest a cost per unit in the public sector of £158,000 compared to, £106,000 from the TPISH database. However, the TPISH data relates to the contracts for building the houses and would exclude the cost of any separate contracts for pre-construction infrastructure works. It also excludes schemes that have communal facilities such as social centres, local offices, etc which may well be included in output statistics for housing.

In order to make the forecast of output comparable with the current ONS output statistics the ONS based costs per unit have been used in Section 6 to model the impact of the targets for completions on construction output.

In Section 7 the breakdown of the costs per unit from the TPISH data have been used as the basis for allocating the costs of implementing the Code and Building regulations between building fabri, new technology and external works.

Therefore the cost per unit estimate of £158,000 has been used for the output predictions for the construction price impact assessment while the TPISH figures have been used as the basis for looking at the additional costs that relate to the building fabric and services.

Modelling construction output

For modelling construction output the following figures have been used.

Public Sector

Based on a cost per unit of £158,000, a ratio of the cost of flats to the cost of houses of 1.24, and a ratio of houses built to flats built of 0.34:0.66.

0.66y+1.24x0.34y = £158,000, where y = cost of a flat unit
Flats = £146,000 per unit
Houses = £181,000 per unit

Private Sector

Based on a cost per unit of £118,500, a ratio of flats to house costs of 1.24 and a ratio of houses to flats built of 0.55:0.45

0.55y + 1.24x0.45 = £118,500 where y = cost of a flat unit
Flats = £107,000 per unit
Houses = £132,600 per unit

These prices are at current 2007 prices, the output statistics in the price forecast model are required at constant 2000 prices. The available 2007 figures for constant and current GB output are given in Figure 5.8.

Figure 5.8 Constant (2000) price deflator

	Public £million	Private £million
Current 2007	4228	20059
Constant 2000	2576	11273
Deflator	0.61	0.56

The constant price figures per unit used in the price forecasting model are given in Table 5.9/

Figure 5.9 Constant (2000) price cost per unit

Public Sector	
Flats	£89,060
Houses	£110,410
Private Sector	
Flats	£59920
Houses	£74260

Modelling changes in design

For modelling the cost impact of changes in design required for the Code for Sustainable Houses, the costs are based on the TPISH figures.

The figures in Figure 5.10 have been rounded to provide the basis for the public sector estimates. The private sector figures in Figure 5.11 are based on the 20% reduction on the private sector derived from the figures in Table 5.1.

Figure 5.10 Cost of public sector houses and flats

	Cost per unit	
DwellingType	Flats	Houses
Substructure	8600	10650
Superstructure	55250	57700
External Works	10800	21300
Preliminaries	11100	14650
Design Fees	4350	4900
Total Building Work	90100	109200
Prelims %	15%	16%
Design fees	5%	5%

Figure 5.11 Cost of private sector houses and flats

	Cost per unit	
DwellingType	Flats	Houses
Substructure	6880	8520
Superstructure	44200	46160
External Works	8640	17040
Preliminaries	8880	11720
Design Fees	3480	3920
Total Building Work	72080	87360
Prelims %	15%	16%
Design fees	5%	5%

6 Impact of Increased Demand on Construction Prices

Modelling the impact of housing demand on construction pricing

The increase in housing supply will inevitably increase the demand for building work. There is a historic linkage between the demand for building work and the price for building work.

The Government's targets for housing completions have been converted into estimates for increased construction output in the housing sector. It is not the objective of this report to forecast the market for construction but to look at the likely impact on price of housing construction of the increases, at the margin, in demand implied by the Government's targets.

The linkages between increases in demand and increases in prices are as complex as the market and result from a multitude of individual experiences and perceptions of current and future demand. However, the trends in demand and the trends in prices can be measured. Looking at the linkages in historic trends can give an indication of possible future outcomes.

In this section, various models of this historic relationship have been constructed in order to help forecast the impact of the changes in housing demand (completions) on the price for building work.

We have looked at the following relationships:

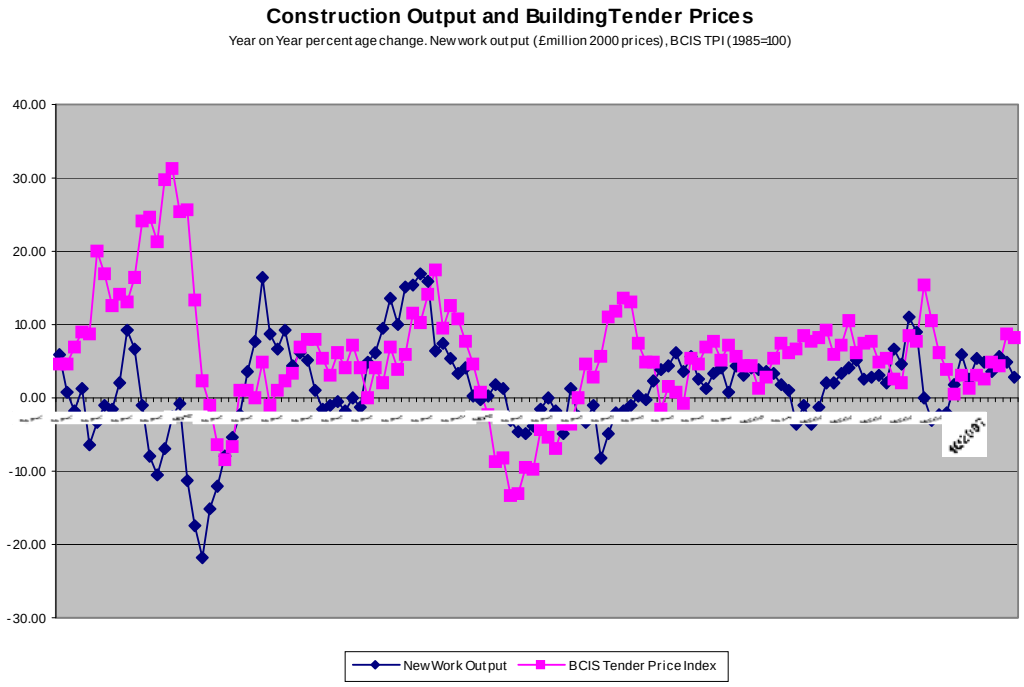
- Construction output v TPI
- Ditto differenced
    - quaterly annual change
    - quarter on quarter
    - year on year
- Various lags
- All output differenced and housing as a proportion v TPI
- Housing and all other output v TPI differenced.

'Construction output' is new work output at constant 2000 prices seasonally adjusted.
'Tender Price Index (TPI)' is the BCIS All-in Tender Price Index.
'Tender Price Index of Social Housing (TPISH)' is the BERR Tender Price Index of Social Housing.

Construction output and tender prices

Construction prices, i.e. the prices charged by contractors to clients for building work, are highly influenced by demand. Figure 6.1 shows the quarterly annual percentage change in construction new work, construction output and the BCIS All-in Tender Price Index quarterly from 1974 to 2007.

Figure 6.1: Construction output and tender prices



It shows how prices have generally shadowed changes in output. Since the downturn in the late 1970s, prices reacted within a quarter or two, in more recent years changes in prices have on occasion prefigured the changes in output. It is interesting to note the strong rise in prices when output stabilised in the mid 90s after the severe recession that preceded it and the continued rise in prices when output fell in 2001.

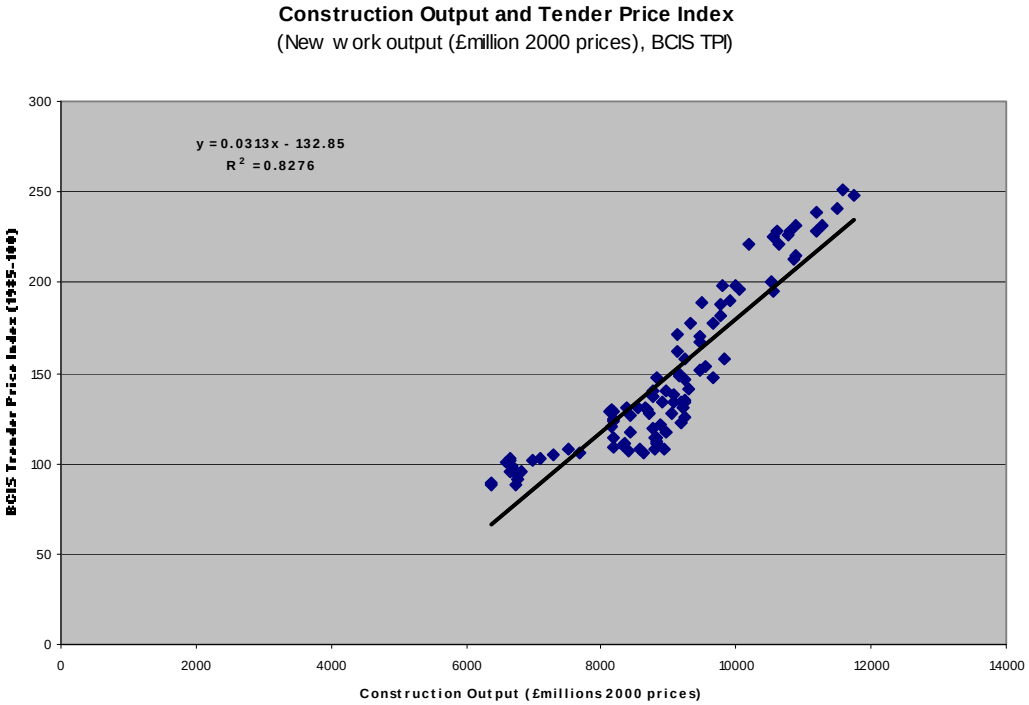
Prices are certainly driven by the perception of the current and future demand for work, rather than simply the amount of work currently being done as measured by output.

The period before the recovery in the early 1980s seems to be structurally different than subsequent periods as the lag between changes in output and changes in prices appear very much longer. The analysis has therefore looked at the period between 1983 and 2007.

A simple regression of output and the TPI over the period from 1983 shows the strong relationship between output and the TPI. Figure 6.2 compares output and the TPI for the same quarter.

However, decisions on pricing will be based on actual and perceived demand reflected in construction orders in current and previous periods. Orders themselves will be reflected in future output. The TPI for a quarter has therefore been regressed against output in earlier and later quarters.

Figure 6.2: Regression Construction Output and Tender Price Index



The year on year percentages in Figure 6.1, appear to show the TPI reacting to changes in output in previous periods.. However, the fit of the regression line is slightly better when comparing the TPI to output up to four quarters later (-4) and deteriorates when compared to output in previous quarters.(+1 to +4) (see Figure 6.3).

Figure 6.3: Regression TPI to construction output: The effect of lagging TPI

Period of Lag in Quarters	R^2 of trend line
-4	0.8536
-3	0.8470
-2	0.8428
-1	0.8346
0	0.8276
+1	0.8121
+2	0.7936
+3	0.7656
+4	0.7404

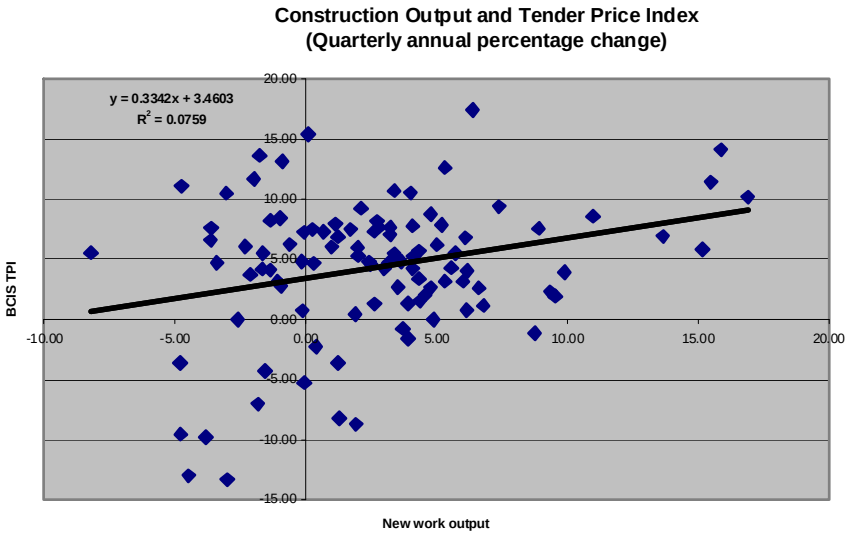
Construction output and tender prices 'differenced'

Because both output and prices have tended to rise over the period there is an inherent relationship, which is reflected in the regression.

A 'differenced' analysis that looks at the percentage change in output and the TPI between periods, rather than their absolute value, has been carried out.

Using the quarterly annual percentage changes, i.e. the change compared with the same quarter a year previously, produces the results in Figure 6.4

Figure 6.4: Regression quarterly annual percentage change in output and tender prices



Taking out the upward trend in both series in this way reduces the fit of the regression but still shows a relationship between changes in output and changes in demand.

Looking at prices against output in previous periods shows the strongest relationship with output two quarters previously. See Figure 6.5.

Figure 6.5: Regression quarterly annual percentage change TPI to construction output: The effect of lagging TPI

Period of Lag in Quarters	R^2 of trend line
-4	0.0653
-3	0.0367
-2	0.0321
-1	0.0514
0	0.0759
+1	0.1261
+2	0.1606
+3	0.1489
+4	0.1351

Quarter on quarter percentage change

Looking at the quarter on quarter percentage change shows very little as the quarterly figures for both series are very variable around the trend (see Figure 6.6) and a regression of the quarter on quarter percentage changes (Figure 6.7) does not produce a strong relationship between changes in output and prices.

Figure 6.6: Quarter on quarter percentage change in output and tender prices

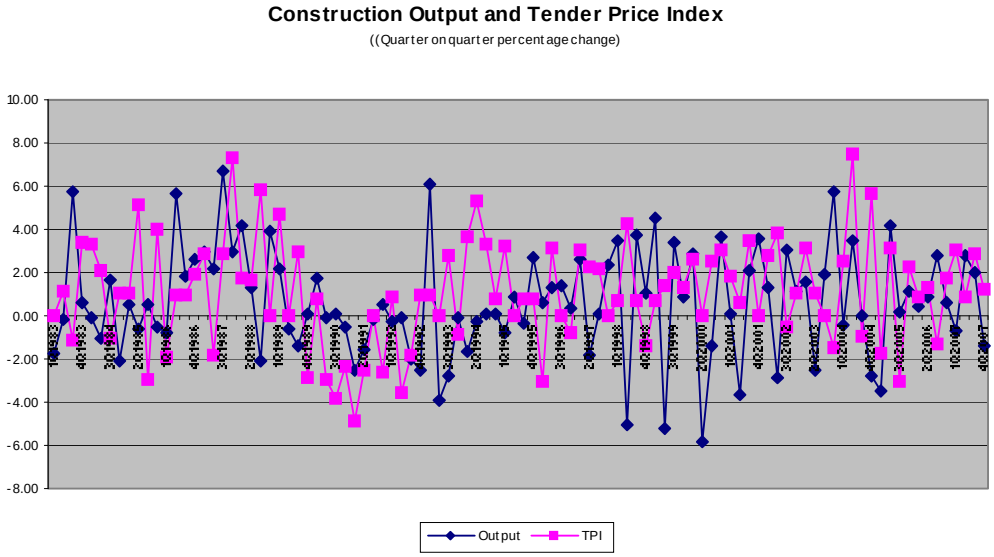
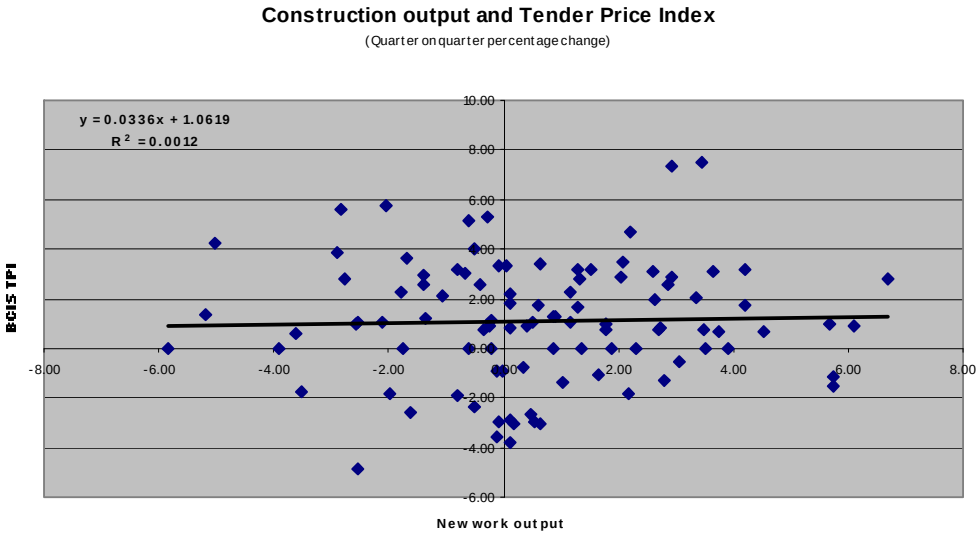


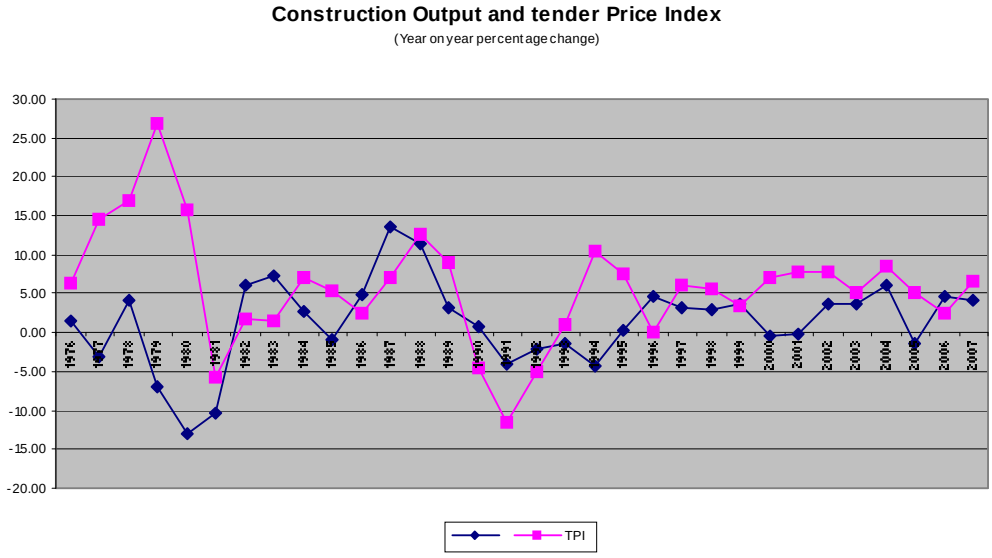
Figure 6.7: Regression quarter on quarter percentage change output and tender prices



Year on year percentage change

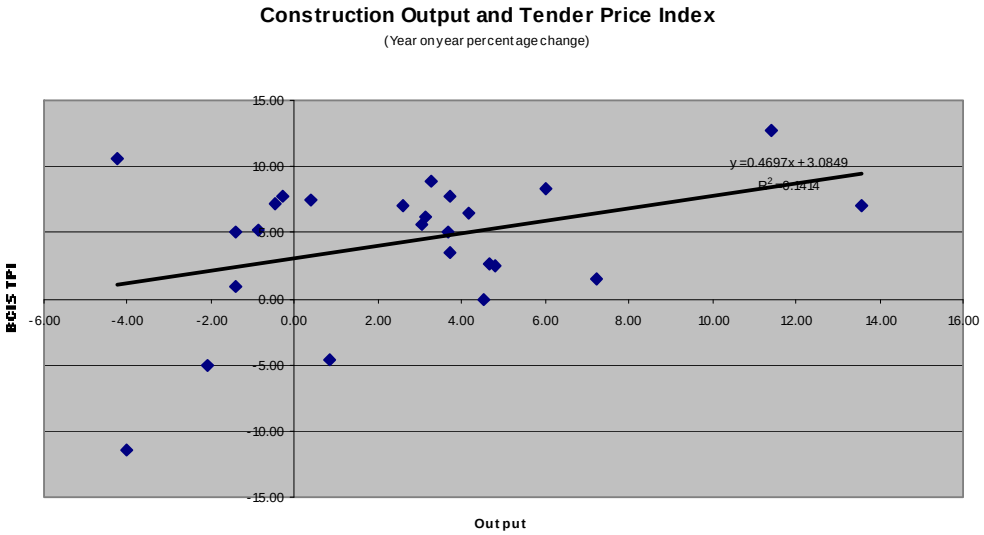
Looking at annual data from 1976, Figure 6.8 shows the year on year percentage change in annual figures for output and the TPI.

Figure 6.8: Year on year annual percentage change output and tender prices



A regression analysis shows a positive relationship between changes in output and prices in the same year, see Figure 6.9.

Figure 6.9: Regression year on year annual percentage change in output and tender prices



There is a slightly stronger relationship between output in one year and prices in the next (+1) but no relationship with output two years previously (+2) There is also a relationship between prices and output in previous years (-1,-2) see Figure 6.10.

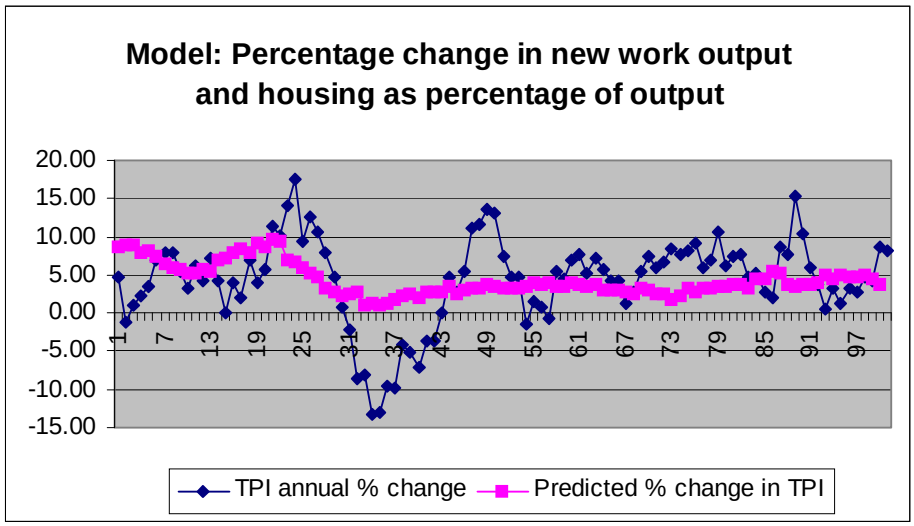
Figure 6.10: Regression TPI to construction output: The effect of lagging TPI

Period of Lag in years	R^2 of trend line
-2	0.1193
-1	0.1011
0	0.1414
+1	0.1768
+2	0.0012

Construction output, percentage of housing output and tender prices

To examine if the level of housing output within construction influenced construction prices, a regression based on quarterly annual percentage change in all new work output and housing as a percentage of output. Figure 6.11 shows the actual and predicted annual percentage change in the Tender Price Index.

Figure 6.11: Model based on regression percentage change in TPI to percentage change in output and housing output as a percentage of all new work



Lagging the TPI to the output did not improve the fit of the model. See Figure 6.12

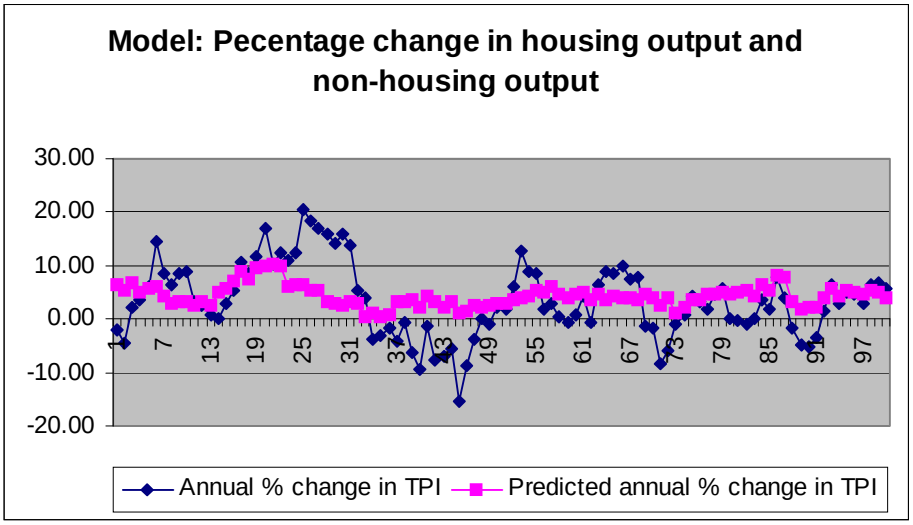
Figure 6.12: Regression percentage change in TPI to percentage change in output and housing output as a percentage of all new work

Period of Lag in years	R^2 of trend line
0	0.1286
+1	0.1076
+2	0.0958

Housing output, non-housing output and tender prices

The predicted change in the TPI based on comparing percentage change in tender prices with the percentage change in housing and non-housing output is shown in Figure 6.13.

Figure 6.13: Model based on regression percentage change in TPI to percentage change in housing and non-housing output



Again, lagging prices to output does not produce a better fit.

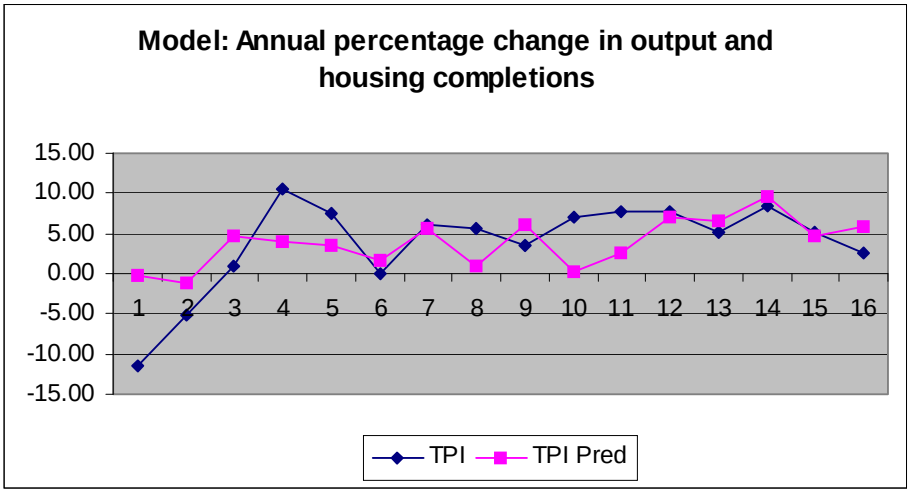
Figure 6.14: Regression percentage change in TPI to percentage change in housing output and non-housing output

Period of Lag in years	R^2 of trend line
0	0.1286
+1	0.1076
+2	0.0958

Construction annual output, housing completions and tender prices

Looking at housing completions and total output on a year-by-year basis over the period since 1990 and taking a differenced model of annual percentage change. The resultant model produces the predicted percentage changes shown in Figure 6.15.

Figure 6.15: Model based on regression annual percentage change in TPI to annual percentage change in construction output and housing completions



The fit of the regression line improved slightly lagging the TPI to the previous year's output and completions.

Figure 6.16: Regression percentage change in TPI to percentage change in construction output and housing completions

Period of Lag in years	R^2 of trend line
0	0.2903
+1	0.3052
+2	0.0078

However the standard error of the second variable, i.e. housing completions, does not seem to add anything to the model.

Construction annual output and tender prices.

Looking at output alone over a more recent period, since 1991, a model based on the relationship of prices to output in the following years gives a good fit, relating prices to output in the two subsequent years an even better fit.

Regression Statistics	
Multiple R	0.799035
R Square	0.638457
Adjusted R Square	0.578199
Standard Error	4.009074
Observations	15

The resultant model is:

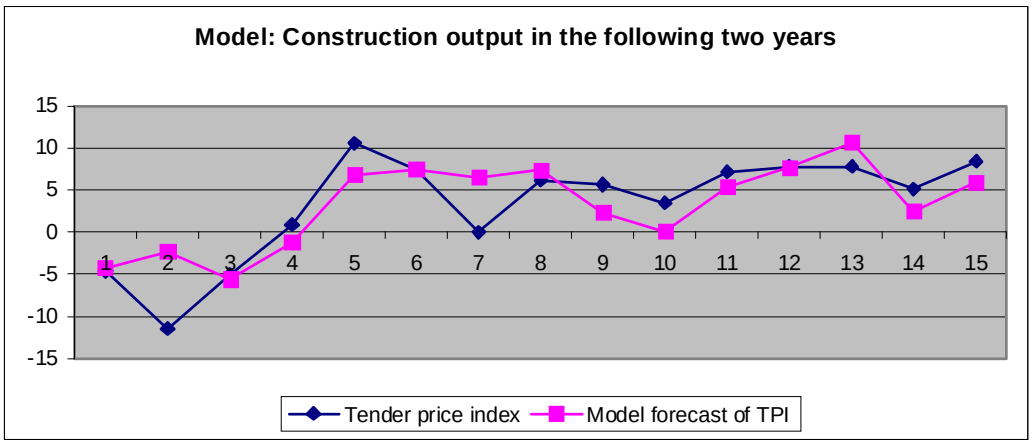
	Coefficients
Intercept	0.743074
X Variable 1	0.588089
X Variable 2	1.28845

Where:

- Intrecept is a constant
- X Variable 1 is the percentage change in output in the following year
- X Variable 2 is the percentage change in output in two year

A comparison of the model prediction with the actual TPI over the period is shown in Figure 6.17.

Figure 6.17: Model based on regression annual percentage change in TPI to annual percentage change in construction output in the following two years



This model has been used to calculate the impact of growth in construction output, resulting from the target housing growth, on building prices because:

- An annual model is prefereable as the Governments targets for numbers of houses are annual. The forecast of output is therefore annual. Converting this to quarterly figures would add unnecessary complications to the model.
- The results are intuitively believable. Contractors react to their perception of future demand when bidding for current work rather than their existing workload.
- There is a good fit of the regression.
- The model fits to the historical data

The model is used to estimate price changes from government targets is therefore:

P% = 0.743074 + O2%*0.588089 + O3%*1.28845

Where:
P% =Percentage annual change in construction prices in year 1
O2% = percentage change in output in year 2
O3% = percentage change in output in year 3

Forecast of output

Applying the cost per unit figures from Section 5 (Figure 5.9) to the completion figures in Section 4 (Figures 4.2 and Figures 4.3), gives the constant price output figures for housing in Figure 6.18.

Figure 6.18: Forecast of construction output (£ million constant 2000 prices)

	Public		Private		Output
	Houses	Flats	Houses	Flats	Total
Unit cost	£110410	£89060	£74260	£59920	£million
2006/07					11489
2007/08	878	1375	5863	3871	11988
2008/09	1877	2939	5126	3384	13326
2009/10	2252	3527	5085	3357	14221
2010/11	2628	4115	4934	3257	14933
2011/12	2628	4115	5265	3476	15483
2012/13	2628	4115	5448	3597	15788
2013/14	2815	4408	5391	3559	16174
2014/15	2891	4526	5457	3602	16476
2015/16	3116	4879	5322	3513	16830
2016/17	3228	5055	5310	3505	17098
2017/18	3228	5055	5310	3505	17098
2018/19	3228	5055	5310	3505	17098
2019/20	3228	5055	5310	3505	17098
2020/21	3228	5055	5310	3505	17098

Assuming that there are no other changes in output, i.e. the non-housing output does not change, the regression model produces the forecast of output changes in Figure 6.19.

Figure 6.19: Forecast of total output (£ million constant 2000 prices)

Output: housing target growth

Non housing growth = 0.00%

	Housing output	All new work output	
	£million	£million	% change
2006	11489	44167	
2007	11988	46001	4.2
2008	13326	47339	2.9
2009	14221	48235	1.9
2010	14933	48947	1.5
2011	15483	49496	1.1
2012	15788	49801	0.6
2013	16174	50188	0.8
2014	16476	50489	0.6
2015	16830	50843	0.7
2016	17098	51112	0.5
2017	17098	51112	0.0
2018	17098	51112	0.0
2019	17098	51112	0.0
2020	17098	51112	0.0
2021	17098	51112	0.0
2022	17098	51112	0.0

Forecast of the impact of output on construction price levels

The selected model from gives a steady state forecast of 0.74%, the growth in prices when output does not change. Comparing this with the price increases based on the output growth from meeting the housing targets gives the price increases shown in Figure 6.20

Figure 6.20: Growth in tender prices resulting from the targeted growth in housing output

	Percentage change in construction prices			
	Housing Target	Housing No growth	Difference	Cumulative
2008	3.76	0.74	2.99	2.99
2009	3.06	0.74	2.30	5.36
2010	2.20	0.74	1.44	6.88
2011	2.11	0.74	1.35	8.33
2012	1.97	0.74	1.22	9.65
2013	2.00	0.74	1.25	11.02
2014	1.84	0.74	1.09	12.22
2015	1.05	0.74	0.31	12.57
2016	0.74	0.74	0.00	12.57
2017	0.74	0.74	0.00	12.57
2018	0.74	0.74	0.00	12.57
2019	0.74	0.74	0.00	12.57
2020	0.74	0.74	0.00	12.57

Figure 6.21 shows the different impact on tender prices of target housing growth and a range of year on year changes in non-housing output. The results vary but are of the same order. The basic forecast is based on the assumption of zero percent annual growth in non-housing output.

Figure 6.21: Growth in tender prices resulting from the targeted growth in housing output and various increases in non-housing output

TPI % increase resulting from housing growth

	Non-housing growth				
	0	+2%	+5%	-2%	-5%
2008	2.99	2.74	2.39	3.27	3.71
2009	2.30	2.01	1.62	2.61	3.13
2010	1.44	1.16	0.79	1.75	2.28
2011	1.35	1.04	0.64	1.70	2.30
2012	1.22	0.89	0.48	1.59	2.23
2013	1.25	0.89	0.44	1.66	2.38
2014	1.09	0.72	0.28	1.51	2.25
2015	0.31	0.02	-0.30	0.65	1.25
2016	0.00	-0.25	-0.51	0.30	0.85
2017	0.00	-0.24	-0.49	0.31	0.85
2018	0.00	-0.24	-0.48	0.31	0.86
2019	0.00	-0.24	-0.46	0.31	0.86
2020	0.00	-0.24	-0.45	0.31	0.87

The forecasts in Figure 6.9 are for tender prices. It has been assumed that output prices lag tender prices by a year. Figure 6.11 therefore shows the impact on cost per unit of the price increases in Figure 6.9 lagged one year.

Figure 6.22: Cumulative increase in unit costs resulting from targeted output growth

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	9,699	7,824	7,106	5,734	7,212
2011/12	12,452	10,044	9,122	7,361	9,221
2012/13	15,069	12,155	11,040	8,908	11,135
2013/14	17,462	14,086	12,793	10,323	12,969
2014/15	19,938	16,083	14,606	11,786	14,820
2015/16	22,118	17,841	16,204	13,076	16,547
2016/17	22,745	18,347	16,663	13,446	17,057
2017/18	22,745	18,347	16,663	13,446	17,057
2018/19	22,745	18,347	16,663	13,446	17,057
2019/20	22,745	18,347	16,663	13,446	17,057
2020/21	22,745	18,347	16,663	13,446	17,057

This results in the unit costs shown in Figure 6.23

Figure 6.23: Unit costs including impact of increased demand

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	181,000	146,000	132,600	107,000	126,241
2009/10	186,417	150,369	136,568	110,202	130,223
2010/11	190,699	153,824	139,706	112,734	133,453
2011/12	193,452	156,044	141,722	114,361	135,462
2012/13	196,069	158,155	143,640	115,908	137,376
2013/14	198,462	160,086	145,393	117,323	139,209
2014/15	200,938	162,083	147,206	118,786	141,061
2015/16	203,118	163,841	148,804	120,076	142,788
2016/17	203,745	164,347	149,263	120,446	143,298
2017/18	203,745	164,347	149,263	120,446	143,298
2018/19	203,745	164,347	149,263	120,446	143,298
2019/20	203,745	164,347	149,263	120,446	143,298
2020/21	203,745	164,347	149,263	120,446	143,298

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7. Additional Cost of Code and Building Regulations

The starting point for the estimates are the two reports published by DCLG in 2008:

- *Cost Analysis of The Code for Sustainable Homes* - (Report 1)
- *Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development* – (Report 2).

Note where reference is made to tables in these DCLG reports they are given in italics and reproduced in the Appendix.

Cost analysis of the Code for Sustainable Homes - (Report 1)

The '*Cost Analysis of The Code for Sustainable Homes*' Report (Communities and Local Government) published in July 2008 provides cost benchmarks for achieving different performance levels under the Code for Sustainable Homes.

The report includes a range of development scenarios and dwelling types and the technical strategies to be employed to achieve compliance with the 6 levels of the Code.

Estimated costs are represented in comparison to the baseline home (Building Regulations compliance) at Q4 2007.

Based on the costs provided in Report 1, and using the design solutions stated, we have allocated the costs to three categories for the basis of identifying future cost trends. The categories for cost movements are as follows:

1. General Construction: including building fabric and typical currently incorporated services (i.e.: gas central heating systems, plumbing and ventilation)
2. Technology: New or innovative services (i.e.: renewable technologies, rainwater harvesting/grey water technologies)
3. External works.

Energy requirements

Table 2.3 from the report has been used to identify the design solutions for meeting the energy requirements (assuming that no wind power can be used). For example the technology for achieving Code level 3 for each dwelling type is:

- Detached and Terraced Houses: solar hot water system (Market Town & Small Scale developments)
- Flats: PV system and Best Practice Energy Efficiency measures (Urban Regeneration & City Infill development types).

Report 1 represents additional costs to baseline (Building Regulations compliance) the baseline cost including the cost of a gas-fired central heating system. It should be noted that *Table 2.3* indicates the technology for achieving minimum energy requirements at each level and shows where technology replaces, or is in addition to a traditional central heating system. For example, solar hot water will be an additional cost for the solar technology whereas Biomass will be a substitution and the cost of a gas central heating boiler should be omitted from the 'General Construction' category and added to the 'Technology' category. As the costs of these traditional services are included in the Building Regulations baseline, adjustment has not been made to the split for *Table 2.3* Costs for General Construction and Technology.

Water requirements
Table 2.8 in Report 1 has been used to identify the design solutions for reducing water consumption within homes, with Code levels 5 and 6 requiring rainwater harvesting systems.

Other requirements
Tables 4.1-4.3 in Report 1 have been used to provide the overall costs for Code compliance with *Table 2.11* providing the costs for individual categories other than the mandatory standards for energy and water.

We have also taken the full cost of Lifetime Homes, as shown in *Table 2.11* in the report, as £550 per house or £75 per flat, comprising additional supports, fixings and drainage (generally fabric costs) although we have allocated 20% £110 to external works for houses to compensate for larger parking spaces, improved access.

In the base model we have allowed for the cost of Lifetime Homes in 2010 when it forms part of Code level 4 and adjusted the Code level 6 costs in 2016.

The Code for Sustainable Homes still retains an element of flexibility and therefore assumptions have been made with regard to at what level of the Code credits must be implemented. For example, it is assumed that from Code level 3 water butts will be required to all schemes, in addition at Code level 4 the maximum storage for cycles will be provided and at Code level 5 composting facilities will be provided and a surface water attenuation will be designed into the scheme.

Management requirements (Preliminaries)
It should be noted that The Code for Sustainable Homes includes a number of Preliminaries or Management related items. Report 1 includes the following such items:

- Enhanced Construction Site Waste Management (Was2): £100/property
- Home User Guide: £100/house; £50/flat (Man1)
- Enhanced Site Management Practices: £100/house; £75/flat (Man3).

For the purposes of the current modelling exercise these have been grouped with the General Construction costs.

Exclusions
The costs make no allowance for Engineers and Code Assessors consultancy fees. The impact of these on the housebuilding industry may be significant given the complexity of design solutions and the two-stage assessment process (Design Stage and Post Construction).

Research to assess the costs and benefits of the Government's proposals to reduce the carbon footprint of new housing development (Report 2)

The 'Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development' modelled costs for a combination of measures required to achieve specific carbon reductions against a baseline of Building Regulations Part L1a 2006. This research considered various policy options for the phased implementation of carbon reductions, the permitting of contributions from offsite renewables and the setting of mandatory minimum levels of energy efficiency prior to the selection of renewable technologies. The report concludes that permitting off-site renewable technologies would have a fundamental impact on the cost of delivering carbon reductions.

Cost of Code of Sustainable Homes

Figure 7.1 is an estimate of the cost of meeting various levels of the Code for houses and flats based on the costs from *Cost Analysis of the Code for Sustainable Homes* set out in the Appendix,

The costs have been combined from estimates for Best, Medium and Worst case scenarios from *Table 1.2* Report 1 as follows:

Houses		
End of terrace		63%
worst case	20%	
medium	40%	
best	40%	
Detached		37%
worst case	28%	
medium	36%	
best	36%	
Flats		
worst case	10%	
medium	60%	
best	30%	

Figure 7.1 shows the cost impact on houses and flats based on the figures in the report and the weightings given above.

Figure 7.1 Cost of implementing Code for Sustainable Homes

Level	General Construction	Technology	External Works	Total Costs
Estimated Costs Q4/2007: Houses				
1	793	0	0	793
2	2486	0	0	2486
3	2766	2155	200	5121
4	2626	6403	1200	10228
5	2926	15934	1680	20540
6	17637	15934	2172	35743
Estimated Costs Q4/2007: Flats				
1	359	0	0	359
2	1772	0	0	1772
3	1934	974	30	2938
4	2179	3392	330	5901
5	2486	8764	660	11910
6	11449	8573	709	20730

Other estimates of the cost of sustainable housing tend to support these estimates for the higher level of the Code. For example, EC Harris and Knight Frank report *'Eco-Homes, economically sustainable?'* May 2008 gave the following costs

Figure 7.2: Additional cost of construction associated with meeting Code levels at Q4 2007 south east England prices

Code level	Housing	Low rise flats	High rise flats
1	1000	1000	3000
2	2500	2500	4000
3	5000	3500	6500
4	15000	8500	17000
5	26000	34000	36000
6	Unknown	Unknown	Unknown

Source: EC Harris

Anecdotal evidence from the 'Carbon Challenge' Schemes suggests a cost of £37,000 for Code level 6 over current Building Regulations.

'Cost Impact analysis for low carbon and EcoHomes' a report for the Scottish Government by Davis Langdon in 2008, states the cost for EcoHomes ratings as follows:

- 'Very Good' (approximates to Code level 3) - £210 to £6,400
- 'Excellent' (approximates to Code level 4) - £1,710 to £16,121

Estimates of the cost of the Code used in the model

The estimates for the public sector are based on the CLG figures in Figure 7.1.

The targets for the private sector are based on the following assumptions:

- Part L requirements are the Code level targets for energy as follows:
  - 25% = level 3
  - 44% = level 4
  - Zero = level 6
- Part G requirements in 2009 will have no discernible cost impact as its requirements are already becoming the standard specification
- Life Time Homes will become part of Building Regulations in 2013. We have taken the figure of £550 per house and £75 per flat from Report 1 for consistency.

Figure 7.3: Cost of code requirements in the Public sector

Level	General Construction	Technology	External Works	Total Costs
Estimated Costs Q4/2007: Houses				
1	793	0	0	793
2	2486	0	0	2486
3	2766	2155	200	5121
4	2626	6403	1200	10228
5	2926	15934	1680	20540
6	17637	15934	2172	35743
Estimated Costs Q4/2007: Flats				
1	359	0	0	359
2	1772	0	0	1772
3	1934	974	30	2938
4	2179	3392	330	5901
5	2486	8764	660	11910
6	11449	8573	709	20730

Figure 7.4: Cost of Building Regulations in the Private sector

Building Regs	General Construction	Technology	External Works	Total Costs
Estimated Costs Q4/2007: Houses				
(25% Reduction)	1648	2127		3775
(44% Reduction)	1463	6423		7886
(zero)	15109	12636		27745
Estimated Costs Q4/2007: Flats				
(25% Reduction)	1648	974		2622
(44% Reduction)	1626	3414		5040
(zero)	10375	8453		18828

Cost - Public sector

For the Public sector the costs in the model are based on the following assumptions:

- Houses built prior to 2008/09 are built to EcoHomes 'Very Good' standard
- The difference in cost between Code level 3 and EcoHomes 'Very Good' is equivalent to the difference between Code levels 2 and 3 to reflect the likely need for renewables to meet the mandatory requirements
- That changes in mandatory implementation of the Code levels will be implemented in projects completed two years later.
-

Figure 7.5: Year on year cost public sector **(additional costs relative to 2008/09 costs in each year)**

Public						
	Houses			Flats		
	Building	Technology	Ext works	Building	Technology	Ext works
2008/09						
2009/10						
2010/11	280	2155	200	162	974	30
2011/12	280	2155	200	162	974	30
2012/13	140	6403	1200	407	3392	330
2013/14	140	6403	1200	407	3392	330
2014/15	140	6403	1200	407	3392	330
2015/16	15151	15934	2172	9677	8573	709
2016/17	15151	15934	2172	9677	8573	709
2017/18	15151	15934	2172	9677	8573	709
2018/19	15151	15934	2172	9677	8573	709
2019/20	15151	15934	2172	9677	8573	709
2020/21	15151	15934	2172	9677	8573	709

Cost - Private sector

For the Private sector the costs in the model are based on the following assumptions:

- Houses built prior to 2008/09 are built to current Building Regulations
- That changes in Building Regulations will be implemented in projects completed one year later.

Figure 7.6: Year on year costs Private sector

Private						
	Houses			Flats		
	Building	Technology	Ext works	Building	Technology	Ext works
2008/09						
2009/10						
2010/11						
2011/12	1648	2127	0	1648	974	0
2012/13	1648	2127	0	1648	974	0
2013/14	1648	2127	0	1648	974	0
2014/15	1463	6423	0	1626	3414	0
2015/16	1463	6423	0	1626	3414	0
2016/17	1463	6423	0	1626	3414	0
2017/18	15109	12636	0	10375	8453	0
2018/19	15109	12636	0	10375	8453	0
2019/20	15109	12636	0	10375	8453	0
2020/21	15109	12636	0	10375	8453	0

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8 Wind Turbines and Allowable Solutions

CLG reports identify that the cost of the code can be reduced by the use of wind turbines and other 'allowable solutions'.

Wind turbines

All costs in Section 7 assume that it is not possible to use wind turbines (micro, medium or large scale) on any developments. *Table 2.4* of Report1 indicates that costs are reduced markedly where wind technologies can be used effectively. Figure 8.1 shows the savings where wind generation can be utilised.

Figure 8.1: Savings from use of wind energy

Code	Table 2.3 (without wind)	Table 2.4 (with wind)	% reduction for wind	Table 2.3 (without wind)	Table 2.4 (with wind)	% reduction for wind
Detached Houses	**Small Scale**			**Market Town**		
1	275	275	0.00%	275	275	0.00%
2	1,648	1,648	0.00%	1,648	1,127	31.61%
3	3,916	3,407	13.00%	3,916	1,566	60.01%
4	10,914	7,458	31.67%	9,868	2,600	73.65%
5	22,367	18,722	16.30%	17,132	3,053	82.18%
6	40,228	36,583	9.06%	32,752	13,065	60.11%
Flats	**Small Scale**			**Market Town**		
1	n/a	n/a		275	275	0.00%
2	n/a	n/a		1,648	720	56.31%
3	n/a	n/a		2,622	1,000	61.86%
4	n/a	n/a		5,054	1,593	68.48%
5	n/a	n/a		9,962	2,600	73.90%
6	n/a	n/a		18,996	8,685	54.28%
End of Terrace	**Small Scale**			**Market Town**		
1	275	275	0.00%	275	275	0.00%
2	1,648	1,648	0.00%	1,648	818	50.36%
3	3,916	3,407	13.00%	3,692	1,137	69.20%
4	5,880	5,586	5.00%	7,115	2,001	71.88%
5	13,292	10,687	19.60%	12,353	2,600	78.95%
6	29,393	24,721	15.89%	24,822	8,771	64.66%

Combining the examples in Figure 8.1 using the weightings given belowgives the average saving for houses and flats shown in Figure 8.2 for Code levels 4 and 6.

Houses		
	Public	Private
Market town	90%	90%
Small scale rural	10%	10%
Detached	30%	30%
End Terrace	70%	70%
Flats		
Market town	85%	85%
Small scale rural	10%	10%

Figure 8.2: Impact on cost of using wind turbines

Code or Building Regs	**Without wind**	**With wind**	**Reduction for wind**
Houses			
4 (44%)	7,886	2,577	-5,308
6 (zero)	27,745	11,881	-15,864
Flats			
4 (44%)	5,054	1,593	-3,461
6 (zero)	18,996	8,685	-10,311

Report 1 indicates that wind turbines will be viable on 'at least some…small scale rural and Market town developments'. The estimates of 'Small scale rural' and 'Market town' dwellings from *Table 2.4* in Report 2 are as follows:

Development type	Social	All projects
Small scale rural	25%	15%
City infill	25%	3%
Market town	25%	72%
Urban regeneration	25%	10%

Based on a 30:70 Social:Private mix, this implies that in the Private sector 10% are small scale rural and 90% are market town schemes.

The base model assumes the 10% of small scale and 10% of market town schemes have wind turbines and that this represents the proportion of units shown in Figure 8.3. This assumption is included in the base model.

Figure 8.3: Proportion of units with wind energy solutions

Public		Private	
Houses	Flats	Houses	Flats
5%	5%	10%	10%

Other allowable solutions

The cost of a development may well also be reduced if the energy or heating is generated off-site either by a private wire agreement, by using some wider renewable energy source, by carrying out off-setting works elsewhere or other 'Allowable Solution'.

The Code for Sustainable Homes defines a Private Wire arrangement, in the context of Low or Zero Carbon Technology, as an arrangement where, any electricity generated on or in the vicinity of the site is fed directly, to the dwellings being assessed, by dedicated power supplies.

The CLG Report *Definition of Zero Carbon Homes and Non-Domestic Buildings - Consultation Document*, December 2008, refers to 'Allowable Solutions' as a way of achieving a net 100% reduction in energy demand for a development.

The report states that 'The Government has an ambitious programme to increase housing supply. It would be unacceptable if our zero carbon policy were defined so rigidly that it would be technically infeasible for a substantial proportion of housing developments. It was understood, from the analysis for *Building A Greener Future,* that some homes would not be able to meet the zero carbon standard through on site energy solutions alone. Over the past year, the UK GBC Zero Carbon Definition Task Group has investigated this further. By changing two assumptions in the modelling of zero carbon homes, they found that the percentage of homes unable to meet the definition through onsite energy solutions could be higher than previously understood.'

The Task Group considered that Government should press ahead with its zero carbon target for 2016. However, it recommended that greater flexibility in the use of off site solutions should be introduced, with a hierarchy of measures for meeting the zero carbon standard based on:

- Strict energy efficiency parameters – building design and appliances
- Meeting at least a minimum level of carbon mitigation onsite or near-site
- Demonstrably additional offsite low and zero carbon energy solutions; and, if needed
- Contributions to a Community Energy Fund, whose proceeds would be used to fund investment in additional low and zero carbon energy.

Examples of 'Allowable Solutions':

- Where, as a result of the development, low carbon or renewable heat (or cooling) is exported from the development itself, or from an installation that is connected to the development, to existing properties that were previously heated (or cooled) by fossil fuels, then credit will be given for the resulting carbon savings
- A credit for S106 Planning Obligations paid by the developer towards local Low and Zero Carbon (LZC) energy infrastructure
- Retrofitting works undertaken by the developer to transform the energy efficiency of existing buildings in the vicinity of the development
- Any investment by the developer in LZC energy infrastructure (limited to the UK and UK waters) where the benefits of ownership of that investment are passed to the purchaser of the home.

The Report considers varying levels of 'Carbon compliance' (ie on-site renewables): 44%, 70% and 100%. It estimates the total savings from reducing the carbon compliance as set out in Figure 8.4.

Figure 8.4: Impact of reducing level of on-site renewables for carbon compliance

Carbon compliance	Cost of compliance £millions	Percentage reduction
100%	22,274	
70%	15,319	31%
44%	6,689	70%

These figures are based on the Net Present Value of a range of 'Allowable Solutions'

An estimate produced by the Zero Carbon Hub showing the additional costs over Building Regulations Part L 2006 for the same levels of carbon compliance is given in Figure 8.5.

Figure 8.5: Impact of increasing the levels of on-site renewables for Carbon compliance

	Additional Costs over Part L 2006 Carbon Compliance		
	44%	**70%**	**100%**
Flats	11%	15-18%	17-25%
Houses	12%	17%	19-31%

The exact nature of allowable solutions will vary from project to project. They may be implemented where they are the only means of reaching zero carbon even if they have an additional cost but in most circumstances it is reasonable to assume that they will be implemented as a cost effective measure.

In the base model we have made the following allowance for implementing allowable solutions.

- Reduction in cost of technology at code level 6 for Allowable Solutions of:
  - 10% reduction for 70% compliance
  - 15% reduction for 44% compliance
  - Allowable solutions occur on 5 % of dwellings
  - Half of dwellings at 70% half at 44%.

These have been applied to cost of technology on 5% of dwellings in both the public and private sector.

9 Impact of Demand on the Cost of Implementing Sustainability Targets

Meeting the specification and completion targets will dramatically increase the demand for the products and technologies required.

Section 6 shows that increased demand for construction work tends to push up the price of construction. This section discusses the likely impact on technologies required to meet the sustainability targets. These are:

- Those required to produce highly insulated air tight homes, mainly off-site construction
- Those required to reduce energy in heating and lighting, mainly substitute technologies
- Those required to generate energy from renewable sources, mainly new technologies.

Off-site construction

Most of the examples of zero carbon houses under construction use off-site manufactured panellised systems. While traditional on-site built solutions are possible, it is likely that, in order to meet the insulation and air tightness requirements of the Code most of the homes will be built using off-site panellised construction.

A study carried out by BCIS for the National Audit Office (NAO) in 2005, as part of their research for the NAO report *Using modern methods of construction to build homes more quickly and efficiently*, surveyed panel system suppliers on the impact of demand on price.

Volume was seen as one of the key issues for the viability of off-site manufacture but the size of contract also impacts on pricing of on-site work. Suppliers were asked to comment on the impact of greater volume on their pricing from:

- Different size of framework agreement
- Larger scheme size
- Increase in overall demand for their system.

The results are summarised in Figure 9.1. The figures for the site operations are based on the BCIS Tender Price Study.

Figure 9.1 Impact of volume on pricing of framed panels

Increase in demand due to:	Site operations	Off-site manufactured elements
Framework		
200 units pa		
20 units	5%	+3% to +10%
1000 units	-3%	-1% to -5%
Scheme size		
22 units		
50 units	-4%	0
100 units	-7%	0
200 units	-10%	0
Overall demand		
Current levels		
Double current levels	N/A	Up to -15%

The report concluded that:

- Manufacturers stated that project size did not impact directly on the manufacturing, delivery and erection process but on the cost of design and investment overheads.
- Within a certain range, the factory processes are not price sensitive to volume. The volume savings will only be made if standard designs are used. The design costs for a one off off-site manufactured house can be as much as £5000. This cost will be spread as the number of similar units is produced. Standardisation will also have an impact on manufacturing and erection costs.
- Any savings to scheme size will be negated if there are many different dwelling types on the site.
- Site construction rates will impact on erection costs.
- The savings from overall demand reflect the spare capacity in system manufacturers. Most could easily cope with a doubling of demand and the increased throughput would reduce their overheads significantly. However, eventually growth in demand would require an increase in capacity and at that stage any excess of demand over supply would result in price rises.
- Increased demand would also strengthen the sustainability of supply.

Since this report was prepared there has been a significant growth in the numbers of panel suppliers both in the UK and selling in to the UK market from abroad.

The NAO report estimated that there was scope for a 15% price reduction in off-site manufactured elements of houses as a consequence of a maturing and expanding market. In the report, BCIS estimated that most suppliers could cope with a doubling of demand by using spare capacity but that further increases in demand would lead to temporary price increases until more capacity became available, when prices would start to reduce again.

Given the rapid rise in the use of off-site manufacture that will be required by the Targets we feel that in the short term, demand pressures and appropriate skills shortages are likely to push up prices but that they may start to fall when off-site manufacture becomes the norm after 2015/16

New technologies

To estimate the effect of increased demand on new technologies required to deliver the Government's sustainability targets we looked at a range of information:

- Survey of suppliers
- Building Services Research and Information Association (BSRIA)
- DCLG published research
- Historic producer prices

Survey of suppliers

A list of suppliers, manufacturers, consultants and trade associations were contacted to see how the price of carbon saving technologies and rainwater harvesting/greywater recycling systems would be affected by increased demand.

The following carbon savings technologies were considered:

- Solar Water Heating
- Heat Recovery Ventilation
- Photovoltaic
- Biomass Heating
- Ground Source Heat Pumps
- Air-Source Heat pumps
- Heat Recovery Heat Pumps
- Biomass Combined Heat & Power – scaled for biomass CHP capacities (large sites)
- Biomass Combined Heat & Power – scaled for biomass CHP capacities (small city infill sites)
- Gas-Fired Combined Heat & Power – scaled on CHP capacities from 8kWe to 40kWe
- Gas-Fired Combined Heat & Power – scaled on CHP capacities over 400kWe
- Micro Wind
- Medium Wind
- Large Wind.

The following water saving technologies were considered:

- Rainwater Harvesting
- Greywater Recycling.

The suppliers were first asked how many units they currently supply/install. Then they were askedasked what would be the affect on their supply/installation price, if any, if they were to increase their current output by 50% and 100%, and also their comments.

The manufacturers, consultants and trade associations were asked how manufacturing cost or consumer price would be affected by a 50% and 100% increase in consumer demand.

However, as the manufacturing process for these technologies is almost exclusively outside of the UK, in China and Europe, most respondents were re-sellers and therefore the costs of the underlying products were largely outside their control and subject to world market forces.

The largest Solar PV (and Solar hot water) provider in the UK, indicates that they anticipate the cost of PV to fall by 10% next year as some overcapacity has built up, and for it to return to 5% year-on-year deflation thereafter. This,reflects normal industry scale growth and ignores any breakthrough technological changes. They suggest that while a step change in the UK market will help to drive lower prices, module prices are dictated by the global market and the UK is only a small part of that.

Reductions on installed prices from the limited responses were in the region of 5% for a 50% or 10% for a 100% increase in current demand.

BSRIA review

The Building Services Research and Information Association (BSRIA) was asked how the price of carbon saving technologies would be affected if the Government's target for new housing output of 240,000 per annum by 2016 is achieved and each carbon saving technology was installed to the following percentages of new housing: 25% (60,000 new dwellings), 50% (120,000) and 100% (240,000).

Figure 9.1: Impact on demand on cost of carbon saving technologies

Carbon Saving Technology	**Specification**	**Percentage change in demand**		
		25% (60,000)	**50% (120,000)**	**100% (240,000)**
		Percentage change in cost		
Solar Water Heating	Generally 2.8bm2 of flat panel collector per dwelling	0	0	0
Heat Recovery Ventilation	Scaled from 180 to 500m3/hour	-2	-4	-6
Photovoltaic	Scaled from 0.25kWp to 4kWp per dwelling	0	0	0
Biomass Heating	Scaled on biomass boiler capacities from 25kW to 1000kW	0	0	0
Ground Source Heat Pumps	Scaled on GSHP capacities from 250kW to 500kW	-2	-4	-6
Air-Source Heat Pumps	Scaled on ASHP capacities from 5kW to 15kW per dwelling	0	0	0
Heat Recovery Heat pumps	Scaled on HRHP capacities from 2kW per dwelling	-2	-4	-6
Biomass Combined Heat & Power	Scaled for biomass CHP capacities (large sites)	No info	No info	No info
Biomass Combined Heat & Power	Scaled for biomass CHP capacities (small city infill sites)	No info	No info	No info

Carbon Saving Technology	Specification	Percentage change in demand		
		25% (60,000)	50% (120,000)	100% (240,000)
		Percentage change in cost		
Gas-Fired Combined Heat & Power	Scaled on CHP capacities from 8kWe to 40kWe	-5	-10	-15
Gas-Fired Combined Heat & Power	Scaled on CHP capacities over 400kWe	0	0	0
Micro Wind	Generally 1.5kW unit per dwelling	No info	No info	No info
Medium Wind	Scaled on units of 150kW to 600kW size	-2	-4	-6
Large Wind	Scaled on units of 600kW to 1,200kW size	-2	-4	-6
Rainwater Harvesting	4,700ltr tank per dwelling	-2	-4	-6
Greywater Recycling	2,400ltr maximum water treatment capacity per day per dwelling	-3	-6	-9

Source: BISRIA

Reductions on installed prices were in the region of 0-5% for 60,000 units per annum, 0-10% for 120,000 units per annum and 0-15% for 240,000 units per annum.

The BCIS survey and the BISRIA table excludes the following factors:

- Changes in oil prices. The cost of crude oil has a huge bearing on the manufacturing processes of carbon saving technologies, and predicting the price of oil over a short timescale is a difficult exercise, let alone over a long timescale. Currently, most carbon saving technologies are manufactured in China and mainland Europe, and then imported into the UK. Suppliers have expressed concerns over predicting costs due to the volatility in the price of oil. Price rises as experienced during 2007-2008 would negate any cost savings through economies of scale.
- New technology, technical improvements and future options; as demand for carbon saving technology increases and the consumer becomes more 'learned', so will the mechanical and engineering design industry seek to improve existing technology, i.e. smaller units producing greater efficiencies, options to the consumer may increase and/or one or more of the carbon saving technologies above may become obsolete. In addition, the costs of technical improvement and design research have not been included for.
- Fluctuations in value of sterling in comparison to other currencies.

The recent global economic crisis has certainly impacted on oil prices, the value of Sterling and global demand since this survey was carried out.

CLG reports

Recent CLG reports discuss 'learning rates' as follows:

- A measure of the extent to which costs are likely to change in proportion to the amount of experience (measured by the growth in installed capacity of a technology) gained by producers and installers (Report 1*)
- The rate at which the cost of a technology is predicted to fall each time the global market for a new technology doubles (Report 2*)
- Derived from empirical studies of ongoing trends in cost of a technology arising from technological advance, production efficiencies, improved design, supply chain management etc (Report 2*).

The Cost Analysis of The Code for Sustainable Homes Report (Report 1) includes a table (*Table 2.5*), which indicates the likely reduction in costs over time for energy compliance brought about by learning rates. For a detached house built in a Market Town location a 3% reduction on 2008 base is shown for Code levels 4 and 5 by 2010 and a 15% reduction for Code level 6. Reductions for 2016 are shown to be 10% for Code level 4, 14% for level 5 and 26% for level 6. The reduction for Code level 6 by 2025 is shown to be 35%.

Overall Report*1 concludes that the cost for Code compliance (all elements) could reduce by between 16% - 25% by 2016 depending upon the Code level, see Figure 9.2.

Figure 9.2: Reduction in energy compliance costs over time based on a market town development

Year	Code level		
	4	5	6
2008	-	-	-
2010	3%	3%	15%
2013	6%	8%	21%
2016	10%	14%	26%
2025	19%	27%	35%

Source: Cost Analysis of the Code for Sustainable Homes, CLG, 2008

The 'Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development' (Report 2*) concludes:

- That the technologies expected to predominate after 2016 are photovoltaic (PV), biomass CHP and wind
- A major spike in demand for PV and biomass CHP is predicted after 2016 placing a strain on the industry's ability to respond

Table 2.14 of Report 2 gives a range of global and local learning rates (percentage reduction in costs that occurs with each doubling of the market) for each technology. Figure 9.3 is a summaries the results and gives an indication of the likely learning rates for a number of the technologies as follows:

Figure 9.3: reduction in cost for each doubling in demand of carbon saving technologies

Carbon Saving Technology	**Global**	**UK local**
EST Best Practice	1%-5%	1%-5%
EST Advanced Practice	3%-21%	1%-5%
Solar Hot Water	1%-18%	1%-5%
PV	18%-25%	3%-5%
Biomass Community Heating	15%-20%	1%-5%
Biomass CHP	20%-25%	1%-5%
Micro wind	5%-18%	1%-5%
Large scale wind	4%-10%	1%-5%

As indicated above the reduction in cost for learning rates (technological advance, production efficiencies etc) for the UK market is generally between 1-5%.

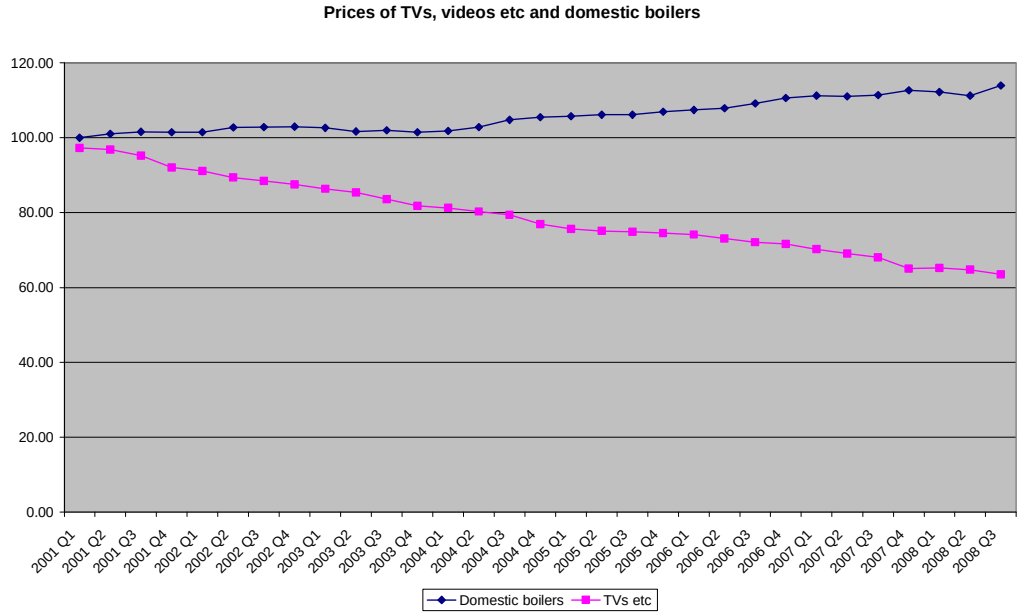
Producer price indices.

The Producer Price Indices track the factory gate prices of products.

The prices of high technology products, such as TVs, have fallen steadily over the years. However, none of the carbon saving technologies are of this level of sophistication. A closer comparison is the developments in domestic boilers. The last change in Part L of the Building Regulations in April 2006 made the use of condensing boilers mandatory.

Figure 9.1 shows the recent trends in prices of TVs, videos etc and domestic boilers.

Figure 9.1 Price of TVs and domestic boilers



The Figure shows a slight acceleration in prices for boilers in the run up to 2006, when the use of condensing boilers became mandatory, peaking at 3.9% in 4Q 2004. There has been no perceptible fall in prices as they have become the standard.

***Conclusion**:*

While the values in the surveys and reports differ there is a clear perception that, as new technology with a price premium is adopted as the norm, the price should fall. However, the underlying technologies, both for panellised construction for the fabric and for the renewable energy generation and hot water products, are not new and have sizable markets in the rest of the world. It is not clear therefore that their wide adoption in the UK would significantly impact on the product prices. Indeed, in the short term there maybe delivery constraints that push up prices.

The other factor to be considered is the installation cost. At the moment these products tend to be installed by specialist contractors, often the product supplier. If they are to be widely adopted there are likely to be shortages of suitably trained operatives. It is not clear whether the specialist contractors will expand to meet the demand or the existing trade contractors will take on the new technologies to defend their market. Historically the UK construction industry has not done the later particularly well.

In the base model therefore we have assumed that:

- Product prices will remain unchanged until the Code and Regulation changes are fully implemented and will fall 10% over the subsequent five years (ie 1.92% per annum.
- Installation prices will rise in line with construction prices until the Code and Regulation changes are fully implemented and will fall 10% in the following five years (ie 1.92% per annum)
- Product prices 60%, Installation prices 40%
- External works will rise in line with construction prices.

Figure 9.2 inflation rates for Code and Building Regs costs used in the model

Public			
	Houses and Flats		
	Building	Technology	Ext works
2007/08			
2008/09	1.20	1.20	2.99
2009/10	0.92	0.92	2.30
2010/11	0.58	0.58	1.44
2011/12	0.54	0.54	1.35
2012/13	0.49	0.49	1.22
2013/14	0.50	0.50	1.25
2014/15	0.43	0.43	1.09
2015/16	-1.92	-1.92	0.31
2016/17	-1.92	-1.92	0.00
2017/18	-1.92	-1.92	0.00
2018/19	-1.92	-1.92	0.00
2019/20	-1.92	-1.92	0.00
2020/21	0.00	0.00	0.00

Private			
	Houses and Flats		
	Building	Technology	Ext works
2008/09	1.20	1.20	2.99
2009/10	0.92	0.92	2.30
2010/11	0.58	0.58	1.44
2011/12	0.54	0.54	1.35
2012/13	0.49	0.49	1.22
2013/14	0.50	0.50	1.25
2014/15	0.43	0.43	1.09
2015/16	0.12	0.12	0.31
2016/17	0.00	0.00	0.00
2017/18	-1.92	-1.92	0.00
2018/19	-1.92	-1.92	0.00
2019/20	-1.92	-1.92	0.00
2020/21	-1.92	-1.92	0.00

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10. Implementation of standards and regulatory change

There are two issues here:

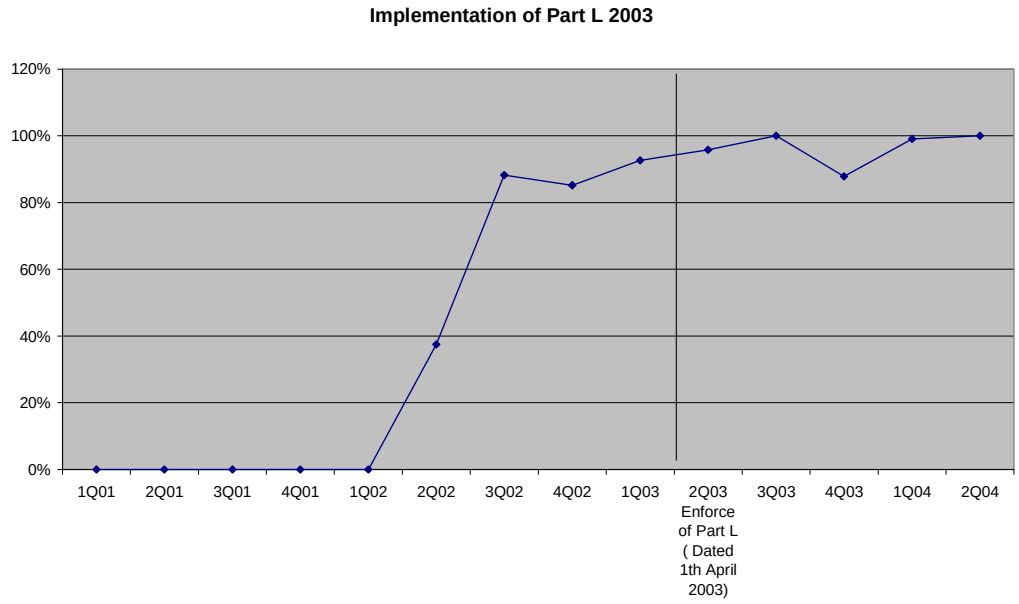
- Implementation - when are Building Regulations and Code changes likely to be implemented by builders and reflected in the cost of completed houses?
- Impact - will the changes in Building Regulations and the Code be fully reflected in building costs?

Implementation of Building Regulations

It is assumed that the private sector will implement changes when required to do so while Housing Associations may implement them in advance once they are published.

There is some support for the latter assumption from the data collected by BCIS in calculating the Tender Price Index of Social Housing. The information identified when projects include the changes to Part L in April 2003. Figure 10.1 shows the results.

Figure 10.1 Implementation of Part L 2003 in social housing schemes



The dates relate to the tender date. Assuming a start on site within a couple of months of tender over 80% of schemes had taken the regulations into account nine months prior to their implementation in schemes. This of course relies on the details of the change being available well in advance of its implementation - which is not always true. The average length of the schemes in TPISH is about 12 months, which suggests that completions would reflect changes in Building Regulation changes six to 15 months after they come into force.

We have no data on the take up of regulations in the private sector but the perception is that they are likely to implement later. Projects are also on average larger and tend to be built out in stages. It has been assumed therefore that changes in Regulations will be reflected in completions 12 to 24 months after they come into force.

The changes to the Code are mandatory for schemes seeking funding in the year of implementation. Anecdotal evidence suggests that Code 3, which became a requirement in 2008, is only now becoming the norm in schemes that are being assessed ie schemes that will be completed in 2010.

In the model the following assumptions have been made:

- Building Regulations will be reflected in houses completed one year after they become a requirement.
- Code requirements for the public sector will be reflected in completions two years after they become a requirement.
- No allowance has been made for early voluntary adoption of Regulations or the Code.

Impact of cost changes

Changes to the Building Regulations always require changes to the way buildings are constructed and generally require more material input and more work. These changes can be costed and they will have a cost. However it is not clear that the impact of these changes is reflected in the overall prices charged by contractors particularly once they have become standard practice.

The only evidence we have comes from the TPISH data relating to the April 2003 and April 2006 changes to changes to Part L. Within the TPISH indexing process BCIS estimated that the changes added around 2% to the cost of the building. There was a further significant change to Part L in April 2006 we do not have an estimate of its effect made at the time. However analysing the cost per m2 of projects through this period does not show any significant change in either date.

The cost per m2 figure are based on the cost of the building (substructure, superstructure, finishes, fittings and services) divided by the gross internal floor area. The quarterly averages were calculated for schemes that contained only houses, schemes that contained only flats and mixed schemes containing houses and flats.

The sample sizes for the flats only schemes are quiet small the results are therefore more volatile. The results are shown in Figure.10.2

Figure 10.2: Cost per m2 costs for social housing

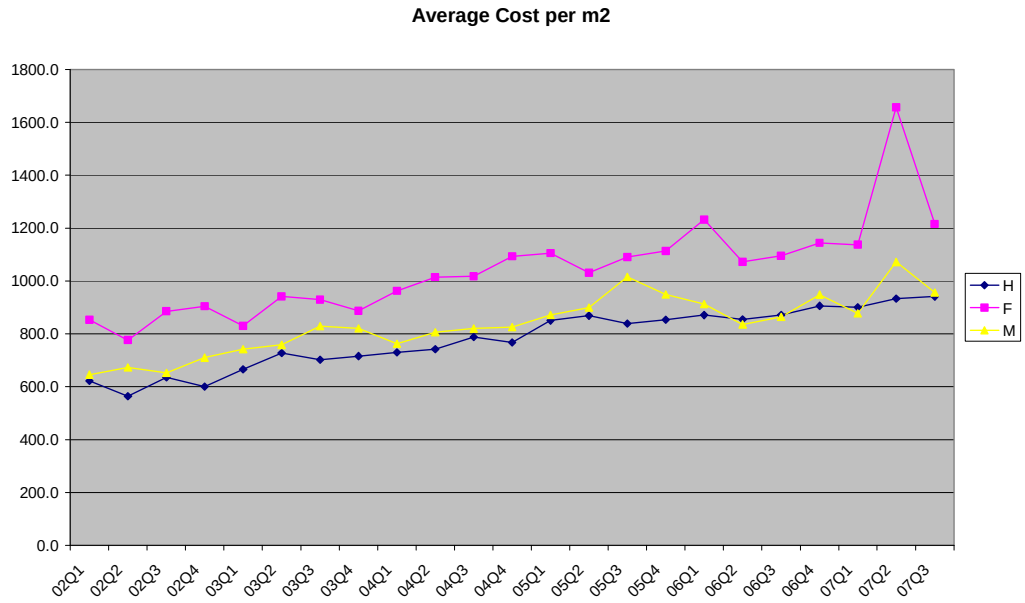
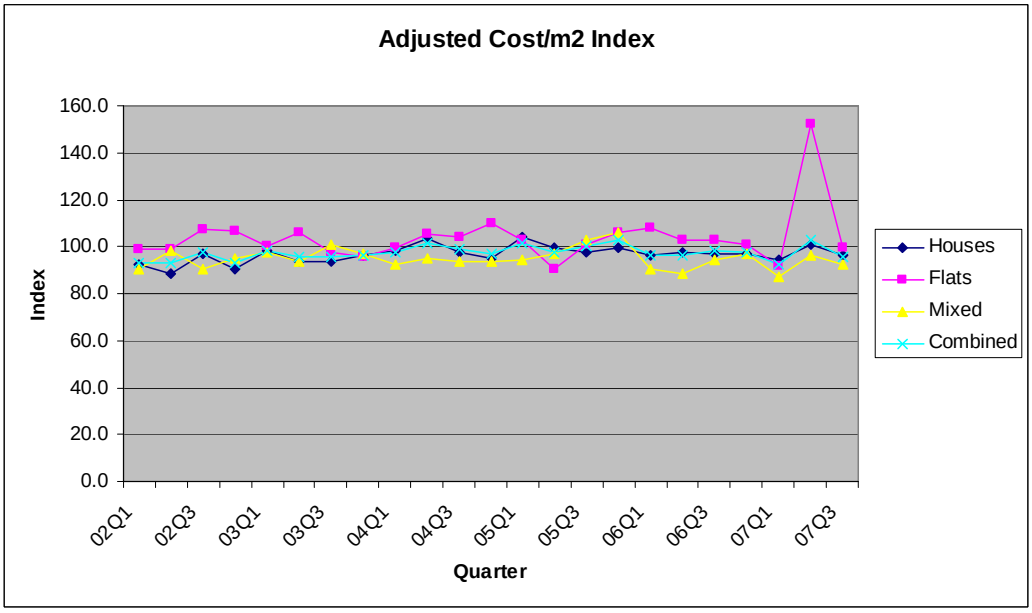


Figure 10.3 shows indices of the cost per m2 for houses, flat, mixed schemes and a combined index of all schemes adjusted for inflation and the variation in pricing due to location.

Figure 10.3: Indices of cost per m2 of social houses at constant prices



There is no discernable movement in costs in either 2003 or 2006.

It is reasonable to conclude that for changes in standard design costs are to some extent 'lost' in the overall cost of the complete house.

While this does not mean that the cost of changes that will be required to meet the Code that will impact on how houses are constructed, eg a move to Off-Site construction, and additions to what is to be provided, eg micro-generation, will not be passed on in full.

While there may be a 'damping' affect that reduces the cost increases no allowance has been made in the base model.

11 Details of model

BCIS has constructed a simple model of linked spreadsheets that allows assumptions to be changed to test different assumption scenarios.

The base assumptions are as set out in this report for:

- Numbers of homes in public and private sector by year
- Mix of houses and flats
- Current cost per unit of public and private houses and flats
- Impact of increases in construction output on construction prices.
- Additional costs of various levels of Code for Sustainable Homes
- Additional costs for proposed Building Regulations changes
- Impact on the above of the use of large wind turbines
- Impact on the above of the use of 'Allowable solutions'
- Impact of increases in demand for new technologies on prices.
- Lag between implementation of Code or Regulation and impact of costs on completions.

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12 Results from model

Based on the assumptions in this report the changes in the costs per unit from meeting the Governments targets are given in Figure 12.1

Figure 12.1: Changes in costs per unit resulting from meeting the Government's targets

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	12,970	9,093	7,106	5,734	7,928
2011/12	15,743	11,321	13,007	10,063	12,084
2012/13	23,437	16,337	14,396	11,266	14,971
2013/14	25,883	18,291	16,747	12,771	17,101
2014/15	28,404	20,308	22,856	16,762	21,191
2015/16	55,587	36,807	23,364	17,343	29,425
2016/17	55,618	36,964	23,823	17,714	29,926
2017/18	55,033	36,622	44,076	31,782	40,271
2018/19	54,460	36,286	43,552	31,430	39,836
2019/20	53,898	35,957	43,038	31,085	39,410
2020/21	53,898	35,957	42,534	30,746	39,152

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Appendix

Tables from: *Cost Analysis of The Code for Sustainable Homes*, July 2008, published by Communities and Local Government

Table 1.2: Summary of development scenarios

Scenario	Approximate percentage of annual completions	Density (dwell/ha)	Site Area (ha)	Dwelling Types	Nos.	Dwelling Mix	Percentage of Social housing
Small scale	15%	30	0.3	Detached	4	45%	20%
				Terrace	3	33%	
				End-t/semi	2	22%	
				Flat	0	0%	
				Total	**9**	**100%**	
City infill	3%	180	0.1	Detached	0	0%	20%
				Terrace	0	0%	
				End-t/semi	0	0%	
				Flat	18	100%	
				Total	**18**	**100%**	
Market town	72%	50	2	Detached	25	25%	20%
				Terrace	27	27%	
				End-t/semi	21	21%	
				Flat	27	27%	
				Total	**100**	**100%**	
Urban Regeneration	10%	160	4.7	Detached	30	4%	20%
				Terrace	15	2%	
				End-t/semi	8	1%	
				Flat	697	93%	
				Total	**750**	**100%**	

Table 2.3: Achieving minimum energy requirements for Code levels 1 to 6 (assuming that no wind power can be used)

Code level	Carbon Saving (%)	Development scenario											
		Small			City Infill			Market town			Urban Regen		
		Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits
Detached House													
1	10	Improved controls	£275	1	N/A	N/A	N/A	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	N/A	N/A	N/A	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4
3	25	4m2 flat panel SHW	£3,916	7	N/A	N/A	N/A	4m2 flat panel SHW	£3,916	7	PV	£5,536	7
4	44	Best practice energy efficiency and PV	£10,914	11	N/A	N/A	N/A	Biomass heating	£9,868	10	Biomass heating	£8,223	10
5	100	Biomass heating and PV	£22,367	17	N/A	N/A	N/A	Biomass CHP	£17,132	16	Biomass CHP	£14,254	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£40,228	19	N/A	N/A	N/A	Advance practice energy efficiency, PV and biomass CHP	£32,752	19	Advance practice energy efficiency, PV and biomass CHP	£31,125	19
End Terraced													
1	10	Improved controls	£275	1	N/A	N/A	N/A	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	N/A	N/A	N/A	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,778	4
3	25	4m2 flat panel SHW	£3,916	7	N/A	N/A	N/A	4m2 flat panel SHW	£3,692	7	PV	£4,020	7
4	44	Biomass heating	£5,880	11	N/A	N/A	N/A	Biomass heating	£7,115	10	Biomass heating	£5,930	10
5	100	Biomass heating and PV	£13,292	17	N/A	N/A	N/A	Biomass CHP	£12,353	16	Biomass CHP	£10,278	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£29,393	19	N/A	N/A	N/A	Advance practice energy efficiency, PV and biomass CHP	£24,822	19	Advance practice energy efficiency, PV and biomass CHP	£23,631	19

Table 2.3: Achieving minimum energy requirements for Code levels 1 to 6 (assuming that no wind power can be used)

Code level	Carbon Saving (%)	Development scenario: Small			City Infill			Market town			Urban Regen		
		Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits
Mid Terraced													
1	10	Improved controls	£275	1	N/A	N/A	N/A	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	N/A	N/A	N/A	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,778	4
3	25	4m2 flat panel SHW	£3,916	7	N/A	N/A	N/A	4m2 flat panel SHW	£3,692	7	PV	£3,581	7
4	44	Biomass heating	£5,133	11	N/A	N/A	N/A	Biomass heating	£6,187	10	Biomass heating	£5,156	10
5	100	Biomass heating and PV	£11,933	17	N/A	N/A	N/A	Biomass CHP	£10,742	16	Biomass CHP	£8,938	16
6	Zero Carbon	Advance practice energy efficiency, PV and biomass heating	£29,172	19	N/A	N/A	N/A	Advance practice energy efficiency, PV and biomass CHP	£24,696	19	Advance practice energy efficiency, PV and biomass CHP	£23,569	19
Flat													
1	10	N/A	N/A	N/A	Improved controls	£460	1	Improved controls	£275	1	Improved controls	£460	1
2	18	N/A	N/A	N/A	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4	Improved air tightness and insulation levels	£1,648	4
3	25	N/A	N/A	N/A	PV and Best Practice energy efficiency	£2,622	7	PV and Best Practice energy efficiency	£2,622	8	PV and Best Practice energy efficiency	£2,622	7
4	44	N/A	N/A	N/A	PV and Best Practice energy efficiency	£5,054	11	Biomass heating	£5,054	10	Biomass heating	£4,782	10
5	100	N/A	N/A	N/A	Best practice energy efficiency and Biomass	£12,055	17	Biomass CHP	£9,962	16	Biomass CHP	£8,289	16
6	Zero Carbon	N/A	N/A	N/A	Advance practice energy efficiency, PV and biomass CHP	£18,430	19	Advance practice energy efficiency, PV and biomass CHP	£18,996	19	Advance practice energy efficiency, PV and biomass CHP	£16,775	19

Table 2.4: Technology mix and costs for Small Scale and Market Town developments where wind energy can be utilised

Code level	Carbon Saving (%)	Development scenario					
		Small			Market Town		
		Technology	Cumm capital cost	Cumm code credits	Technology	Cumm capital cost	Cumm code credits
Detached House							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,648	4	Wind turbine	£1,127	4
3	25	Micro wind	£3,407	7	Wind turbine	£1,566	7
4	44	PV and micro wind	£7,458	11	Wind turbine	£2,600	10
5	100	PV, Biomass heating and micro wind	£18,722	17	Wind turbine	£3,053	16
6	Zero Carbon	Advanced practice energy efficiency, PV, biomass heating and micro wind	£36,583	19	Advanced practice energy efficiency and wind turbine	£13,065	19
End Terraced							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,778	4	Wind turbine	£818	4
3	25	Micro wind	£3,407	7	Wind turbine	£1,137	7
4	44	Best practice energy efficiency and micro wind	£5,586	10	Wind turbine	£2,001	10
5	100	Best Practice Energy Efficiency, Biomass heating and micro wind	£10,687	17	Wind turbine	£2,600	16
6	Zero Carbon	Advanced practice energy efficiency, PV, biomass heating and micro wind	£24,721	19	Advanced practice energy efficiency and wind turbine	£8,771	19
Mid Terraced							
1	10	Improved controls	£275	1	Improved controls	£275	1
2	18	Improved air tightness and insulation levels	£1,778	4	Wind turbine	£729	4
3	25	Micro wind	£3,407	7	Wind turbine	£1,013	7
4	44	Best practice energy efficiency and micro wind	£5,500	10	Wind turbine	£1,782	10
5	100	Biomass heating and micro wind	£8,539	17	Wind turbine	£2,600	16
6	Zero Carbon	Advanced practice energy efficiency, PV, biomass heating and micro wind	£24,756	19	Advanced practice energy efficiency and wind turbine	£8,950	19
Flat							
1	10	N/A	N/A	N/A	Improved controls	£275	1
2	18	N/A	N/A	N/A	Wind turbine	£720	4
3	25	N/A	N/A	N/A	Wind turbine	£1,000	7
4	44	N/A	N/A	N/A	Wind turbine	£1,593	10
5	100	N/A	N/A	N/A	Wind turbine	£2,600	16
6	Zero Carbon	N/A	N/A	N/A	Advanced practice energy efficiency and wind turbine	£8,685	19

Table 2.5: Change in energy compliance costs over time for Market Town development

Year	Detached House	End Terrace	Mid Terrace	Flat	Percentage reduction on 2008 base
Code Level 4					
2008	£5,880	£5,133	£5,054	£2,600	–
2010	£5,551	£4,845	£4,371	£2,530	3%
2013	£5,392	£4,707	£3,761	£2,445	6%
2016	£4,883	£4,350	£3,355	£2,371	10%
2025	£3,533	£3,147	£2,670	£2,193	19%
Code Level 5					
2008	£17,132	£12,353	£10,742	£9,962	–
2010	£16,621	£11,985	£10,422	£9,665	3%
2013	£15,960	£11,508	£10,008	£9,202	8%
2016	£15,274	£11,083	£9,637	£8,530	14%
2025	£12,699	£9,973	£8,672	£7,271	27%
Code Level 6					
2008	£32,752	£24,850	£24,742	£18,996	–
2010	£27,701	£21,059	£20,900	£16,183	15%
2013	£25,284	£19,072	£18,920	£14,968	21%
2016	£23,560	£17,651	£17,509	£14,100	26%
2025	£20,223	£14,919	£14,807	£12,386	35%

Table 2.8: Revised specification and cost of water appliances

Code level	Estimated water usage (l/person/ day)	Initial Specification	Revised specification		Code Credits	Cost	Change from previous estimate
1 and 2	120	2 x 6/4 litre flush toilets 4 x taps with flow regulators 1 x shower 6 to 9 litres/min 1 x standard bath (80 litres per use) 1 x standard washing machine* 1 x standard dishwasher*	2 x 6/4 litre flush toilets 4 x taps with flow regulators (2.5 l/m) 1 x shower 6 litres/min 1 x standard bath (90 litres per use) 1 x standard washing machine* 1 x standard dishwasher*		1.5	£0	£0
3 and 4	105	As above, except: 2x4/2.5 litre flush toilets 1x 8 l/min shower 1x smaller shaped bath	As above, except: 2x4/2.5 litre flush toilets 1x smaller shaped bath		4.5	£125	£0
5 and 6	80	**Houses** As above, except: add grey water recycling or rainwater harvesting system (30% reuse)	Houses either:	As level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	7.5	£2,650	£0
		Apartments As above, except: add communal grey water recycling or rainwater harvesting system (30% reuse)	Apartments either:	As level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	7.5	£800	£0

Notes: *Additional cost of washing machine and dishwasher is assumed to be zero as these fittings are 'standard' industry performance. Therefore, if they are typically installed by house builder there would be no additional cost over their current specifications.

Table 2.11: Summary of cost estimates for Code credits (excluding minimum standards for energy and water)

Category	Credit Name	Performance	Credits available	Value of one credit	Credits achieved		Cost per unit		Comments
					House	Flat	House	Flat	
Energy	Low energy lighting	>40%	1	1.26	1	1	£10	£10	Allowance for additional cost of low energy light fittings.
Energy	Low energy lighting	>75%	1	1.26	1	1	£40	£30	Allowance for additional cost of low energy light fittings.
Energy	Drying Space	Providing	1	1.26	1	1	£20	£20	Cost allowance for internal clothes drying fittings in bathroom
Energy	Ecolabelled White Goods	Information or A+ rated fridges and freezers	1	1.26	1	1	£0	£0	No cost for provision of information on these goods.
Energy	Ecolabelled White Goods	Washing machines and dishwashers	1	1.26	1	1	£540	£540	Cost of providing energy and water efficient washing machine and dishwasher (providing these appliances also results in a benefit for overall water consumption calculations, see Section 4).
Energy	External Lighting	Space lighting	1	1.26	1	1	£0	£0	Costs for provision of space lighting included in base construction (additional cost is for energy efficient fittings).
Energy	External Lighting	Security lighting	2	1.26	2	2	£0	£0	If no security lighting is fitted then points are awarded by default (and if lighting is provided the additional cost of Code compliant specifications is negligible).
Energy	Cycle storage	Provision for full cycle requirement	2	1.26	2	2	£1,000	£300	Costs based on provision of full requirement (see Section 2.3)
Energy	Home office	Providing	1	1.26	1	1	£210	£210	Cost allowance for provision of telephone/data points in second bedroom (cost includes points and wiring work).
Potable water	External potable water consumption	Rainwater butt	1	1.50	1	1	£200	£30	Costs based on provision of 1 water butt for housing and communal butts for apartments. Costs include, butt, footings, downpipes and overflow. Actual costs for apartments will depend on storey number and layout.
Surface water runoff	Reduction in surface water runoff	Hard surfaces	1	0.55	1	1	£0	£0	Use of permeable surfacing.
Surface water runoff	Reduction in surface water runoff	Roofs	1	0.55	1	1	£450	£300	Cost of one swale for every 2 dwellings.
Surface water runoff	Flood risk	Low risk	2	0.55	2	2	£0	£0	No cost (provided development is in low flood risk area).
Surface water runoff	Flood risk	Medium/high risk	1	0.55	1	1	£16,635	£4,159	Costs based on use of flood resilient materials on the ground floor, costs for flat based on a 4 storey block (i.e. costs are a quarter of those for housing). Sources detailed in report

Table 2.11: Summary of cost estimates for Code credits (excluding minimum standards for energy and water)

Category	Credit Name	Performance	Credits available	Value of one credit	Credits achieved		Cost per unit		Comments
					House	Flat	House	Flat	
Materials	Environmental impact of materials	3 points (roof)	3	0.30	3	3	£0	£0	Standard specifications achieve an A rating (not A+) in the draft GGS, an A+ rated specification can be achieved at no cost by the use of interlocking concrete tiles.
Materials	Environmental impact of materials	6 points (external walls)	3	0.30	2	2	£0	£0	Standard specifications achieve an A rating (not A+) in the draft GGS,
Materials	Environmental impact of materials	9 points (internal walls)	3	0.30	2	2	£0	£0	Standard specifications achieve an A rating (not A+) in the draft GGS,
Materials	Environmental impact of materials	12 points (floors)	3	0.30	2	0.25	£0	£0	Ratings for floors based on 50% of housing floors being A+ (upper floors) and 50% being B (ground floors), for flats it is assumed that both upper and lower floors would average D. There is no cost uplift as these are standard specifications.
Materials	Environmental impact of materials	15 points (windows)	3	0.30	3	3	£140	£140	No Green Guide information is available on window specifications however it is assumed that a softwood timber window would still achieve the highest (A+) rating.
Materials	Responsible sourcing of basic materials	2 points	2	0.30	2	2	£0	£0	No additional cost, should be readily achievable with some analysis of supply chain, could require significant internal/consultant time in product analysis.
Materials	Responsible sourcing of basic materials	3 points	1	0.30	1	1	£0	£0	As above.
Materials	Responsible sourcing of basic materials	4 points	1	0.30	1	1	£300	£300	Additional cost associated with achieving higher supply chain performance (notional value based on potential restrictions on supply chain
Materials	Responsible sourcing of basic materials	6 points	2	0.30	2	2	£300	£300	Additional cost associated with achieving higher supply chain performance (notional value based on potential restrictions on supply chain
Materials	Responsible sourcing of finishing elements	1 point	1	0.30	1	1	£0	£0	No additional cost. Should be readily achievable with some analysis of supply chain; could require significant internal/consultant time in product analysis.
Materials	Responsible sourcing of finishing elements	2 points	1	0.30	1	1	£0	£0	As above
Materials	Responsible sourcing of finishing elements	3 points	1	0.30	1	1	£300	£300	Additional cost associated with achieving higher supply chain performance (notional value based on potential restrictions on supply chain
Waste	Construction Waste	Monitor, sort and recycle construction waste	2	0.91	2	2	£100	£100	No cost, routinely implemented by several large housebuilders.

Table 2.11: Summary of cost estimates for Code credits (excluding minimum standards for energy and water)

Category	Credit Name	Performance	Credits available	Value of one credit	Credits achieved		Cost per unit		Comments
					House	Flat	House	Flat	
Waste	Household Recycling Facilities	2 points	2	0.91	2	2	£160	£160	Cost allowance for provision of internal bins
Waste	Household Recycling Facilities	4 points	2	0.91	2	2	£0	£0	Assumed that local authority will provide kerbside collection service.
Waste	Composting facilities	home composting facilities	1	0.91	1	1	£30	£30	Cost based on 220l composter
Health and wellbeing	Daylighting	Kitchen	1	1.17	1	1	£140	£140	Cost allowance for additional glazing (based on needs of typical house); costs for specific houses will vary according to design and size of glazed area.
Health and wellbeing	Daylighting	Living room	1	1.17	1	1	£150	£150	Cost allowance for additional glazing (based on needs of typical house); costs for specific houses will vary according to design and size of glazed area.
Health and wellbeing	Daylighting	View of sky	1	1.17	1	1	£0	£0	No additional cost, although achieving a view of the sky from all homes requires careful layout.
Health and wellbeing	Sound insulation	3dB	1	1.17	1	1	£0	£330	No cost for detached properties, costs for terraced properties and flats based on costs of testing activities.
Health and wellbeing	Sound insulation	5dB	2	1.17	2	2	£0 (£160 for terraced properties)	£330	No cost for detached properties, costs for terraced properties and flats based on costs of testing activities.
Health and wellbeing	Sound insulation	8dB	1	1.17	1	0	£0	£0	No cost for detached properties, at present it is not clear how this performance standard will be achieved (and if it can be achieved with the construction methods used here.
Health and wellbeing	Private space	Provide	1	1.17	1	1	£0	£0	Housing has private space, can be designed into apartment blocks.
Health and wellbeing	Lifetime Homes	all features	4	1.17	4	4	£550	£75	Allowance for additional supports/fixing points within partitions and drainage point in first floor toilets.
Management	Home user guide	Provide for home	2	1.11	2	2	£20	£10	Assuming that housing is relatively standard.
Management	Home user guide	Provide for surroundings	1	1.11	1	1	£80	£40	Cost estimate for commissioning consultant to provide necessary location information (costs lower for larger sites).
Management	Considerate constructors	1 point	1	1.11	1	1	£0	£0	No cost for compliance (other than nominal site registration fee).
Management	Considerate constructors	2 points	1	1.11	1	1	£0	£0	No cost for compliance (other than nominal site registration fee).
Management	Construction site impacts	1 point	1	1.11	1	1	£0	£0	No cost for compliance, already implemented by several large house builders.

Table 2.11: Summary of cost estimates for Code credits (excluding minimum standards for energy and water)

Category	Credit Name	Performance	Credits available	Value of one credit	Credits achieved		Cost per unit		Comments
					House	Flat	House	Flat	
Management	Construction site impacts	2 points	1	1.11	1	1	£100	£75	Estimated cost for monitoring.
Management	Security	Secure by Design	2	1.11	2	2	£0	£0	No cost (although there may be an impact on site layout).
Pollution	Insulant GWP	Use	1	0.70	1	1	£0	£0	No cost, mineral wool, air blown and several types of rigid insulation comply.
Pollution	NOx emissions	<40 mg kWh	3	0.70	3	3	£0	£0	No cost; high efficiency boilers meet highest performance standards.

Table 4.1: Detached house							
CSH Level	**Mandatory (£)**	**Energy (£)**	**Water (£)**	**Flexible (£)**	**Total cost (£)**	**Cost £ per m²**	**Percentage increase on 2006 Building Regs**
Best Case (Market town scenario with low ecological value and low flood risk)							
1	£490	£275	£0	£0	**£765**	£7	1%
2	£490	£1,648	£0	£50	**£2,188**	£19	2%
3	£490	£3,916	£125	£220	**£4,751**	£41	5%
4	£490	£9,868	£125	£1,110	**£11,593**	£100	13%
5	£490	£17,132	£2,625	£1,600	**£21,847**	£188	24%
6	£490	£32,752	£2,625	£1,950	**£37,817**	£326	41%
Medium Case (Market town scenario with medium ecological value and low flood risk)							
1	£490	£275	£0	£0	**£765**	£7	1%
2	£490	£1,648	£0	£120	**£2,258**	£19	2%
3	£490	£3,916	£125	£460	**£4,991**	£43	5%
4	£490	£9,868	£125	£1,250	**£11,733**	£101	13%
5	£490	£17,132	£2,625	£1,950	**£22,197**	£191	24%
6	£490	£32,752	£2,625	£2,950	**£38,817**	£335	43%
Worst Case (Small scale scenario with high ecological value and medium/high flood risk)							
1	£490	£275	£0	£30	**£795**	£7	1%
2	£490	£1,648	£0	£585	**£2,723**	£23	3%
3	£490	£3,916	£125	£1,110	**£5,641**	£49	6%
4	£490	£10,914	£125	£2,000	**£13,529**	£117	15%
5	£490	£22,367	£2,625	£3,350	**£28,832**	£249	32%
6	£490	£40,228	£2,625	£4,190	**£47,533**	£410	52%

Table 4.2: End terraced house							
CSH Level	**Mandatory (£)**	**Energy (£)**	**Water (£)**	**Flexible (£)**	**Total cost (£)**	**Cost £ per m^2**	**Percentage increase on 2006 Building Regs**
Best Case (Market Town scenario with low ecological value and low flood risk)							
1	£490	£275	£0	£10	**£775**	£8	1%
2	£490	£1,648	£0	£220	**£2,358**	£23	3%
3	£490	£3,692	£125	£620	**£4,927**	£49	7%
4	£490	£7,115	£125	£1,270	**£9,000**	£89	12%
5	£490	£12,353	£2,625	£2,060	**£17,528**	£174	23%
6	£490	£24,822	£2,625	£3,270	**£31,207**	£309	41%
Medium Case (Market town scenario with medium ecological value and low flood risk)							
1	£490	£275	£0	£30	**£795**	£8	1%
2	£490	£1,648	£0	£460	**£2,598**	£26	3%
3	£490	£3,692	£125	£720	**£5,027**	£50	7%
4	£490	£7,115	£125	£1,760	**£9,490**	£94	13%
5	£490	£12,353	£2,625	£3,270	**£18,738**	£186	25%
6	£490	£24,822	£2,625	£3,810	**£31,747**	£314	42%
Worst Case (Small scale scenario with high ecological value and medium/high flood risk)							
1	£490	£275	£0	£120	**£885**	£9	1%
2	£490	£1,648	£0	£745	**£2,883**	£29	4%
3	£490	£3,916	£125	£1,270	**£5,801**	£57	8%
4	£490	£5,880	£125	£1,920	**£8,415**	£83	11%
5	£490	£13,292	£2,625	£3,810	**£20,217**	£200	27%
6	£490	£29,393	£2,625	£5,160	**£37,668**	£373.0	50.07%

Table 4.3: Flat

CSH Level	Mandatory (£)	Energy (£)	Water (£)	Flexible (£)	Total cost (£)	Cost £ per m2	Percentage increase on 2006 Building Regs
Best Case (Urban regeneration scenario with low ecological value and low flood risk)							
1	£0	£460	£0	£0	**£460**	£8	1%
2	£0	£1,648	£0	£115	**£1,763**	£30	2%
3	£0	£2,622	£125	£145	**£2,892**	£49	4%
4	£0	£4,782	£125	£580	**£5,487**	£93	7%
5	£0	£8,289	£805	£1,170	**£10,264**	£174	13%
6	£0	£16,775	£805	£1,500	**£19,080**	£323	24%
Medium Case (Market town scenario with medium ecological value and low flood risk)							
1	£0	£275	£0	£10	**£285**	£5	0%
2	£0	£1,648	£0	£115	**£1,763**	£30	2%
3	£0	£2,622	£125	£175	**£2,922**	£50	4%
4	£0	£5,054	£125	£880	**£6,059**	£103	8%
5	£0	£9,962	£805	£1,500	**£12,267**	£208	15%
6	£0	£18,596	£805	£1,850	**£21,251**	£360	27%
Worst Case (City infill scenario with high ecological value and medium/high flood risk)							
1	£0	£460	£0	£40	**£500**	£8	1%
2	£0	£1,648	£0	£205	**£1,853**	£31	2%
3	£0	£2,622	£125	£420	**£3,167**	£54	4%
4	£0	£5,054	£125	£1,020	**£6,199**	£105	8%
5	£0	£12,055	£805	£1,850	**£14,710**	£249	19%
6	£0	£18,430	£805	£3,320	**£22,555**	£382	28%

Tables from: *Research to Assess the Costs and Benefits of the Government's Proposals to Reduce the Carbon Footprint of New Housing Development,* September 2008, published by Communities and Local Government

Table 2.14: Learning rates

Carbon Saving Technology Option	Global Learning Rate			UK Learning Rate		
	High	Medium	Low	High	Medium	Low
EST Best practice	1%	3%	5%	1%	3%	5%
EST Advanced practice	3%	15%	21%	1%	3%	5%
Solar Water Heating	1%	10%	18%	1%	3%	5%
PV	18%	18%	25%	1%	3%	5%
Biomass Community Heating	15%	15%	20%	1%	3%	5%
Ground Source Heat Pumps	5%	9%	15%	1%	3%	5%
Biomass CHP	20%	20%	25%	1%	3%	5%
Gas CHP	5%	9%	4%	1%	3%	5%
Micro Wind	5%	5%	18%	1%	3%	5%
Medium scale Wind	4%	10%	10%	1%	3%	5%
Large scale Wind	4%	10%	10%	1%	3%	5%

Scenarios

The Governments targets can be summaries as building 216,000 new dwellings a year all to zero carbon design by 2016.

The report 'Cost Implications of the Governments Housing Targets' estimated that these would add £39,000 to the average cost current of £126,000 per dwelling by 2020.

The current cost and the impact is different for the public and private sector and for houses and flats as follows:

Figure S.1 Cost per unit, constant (2007) prices

	Public		Private		Average
	Houses	Flats	Houses	Flats	unit
Current	£181,000	£146,000	£132,600	£107,000	£126,000
2020 additional cost	£53,898	£35,957	£42,534	£30,746	£39,152
2020 total cost	£234,898	£181,957	£175,134	£137,746	£165,152

The additional cost result from the impact of increased demand on construction prices and the requirements for zero carbon as defined in the Code for Sustainable Homes (public sector) and Building Regulations (private sector) as follows.

Figure S.2 Additional cost per unit impact of Government targets, constant (2007) prices

	Public		Private		Average
	Houses	Flats	Houses	Flats	unit
Increased demand	£22,745	£18,347	£16,663	£13,446	£17,057
Code and Bldg Regs	£31,153	£17,610	£25,871	£17,300	£22,094
2020 additional cost	£53,898	£35,957	£42,534	£30,746	£39,152

This paper looks at some different scenarios for the delivery of houses and their impact on the cost of housing in 2020. The Scenarios are:

1. Housing output at half the current targets ie 108,000 per year from 2016.
2. Change in the mix of houses and flats towards more houses.
3. Impact of more projects using wind power for energy source.
4. Impact of more projects using 'allowable solutions' to meet sustainability targets

Each target has been assessed independently against the base model.

Figure S.3 gives the results for the additional cost per dwellings from the model.

Figure S.3: Additional cost per unit results in basic model

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	12,970	9,093	7,106	5,734	7,928
2011/12	15,743	11,321	13,007	10,063	12,084
2012/13	23,437	16,337	14,396	11,266	14,971
2013/14	25,883	18,291	16,747	12,771	17,101
2014/15	28,404	20,308	22,856	16,762	21,191
2015/16	55,587	36,807	23,364	17,343	29,425
2016/17	55,618	36,964	23,823	17,714	29,926
2017/18	55,033	36,622	44,076	31,782	40,271
2018/19	54,460	36,286	43,552	31,430	39,836
2019/20	53,898	35,957	43,038	31,085	39,410
2020/21	53,898	35,957	42,534	30,746	39,152

Scenario 1: Reduced housing output

This scenario assumes that housing completions fall through to 2011 to 100,000 per year and only recover slightly to 108,000 by 2020.

As a result of the falling construction demand the average cost per unit falls and is still £1,000 lower (at constant 2007 prices) in 2010.

The fall in demand also impacts on some of the assumptions made about inflation in the cost of meeting the sustainability targets so the overall average cost per unit rises by £19,500 by 2020.

Figure S.4 shows the completions and S.5 the impact on average costs per unit.

Figure S.4: Housing completions assumed in scenario 1

	New completions		
	Public	Private	Total
2006/07	22000	145680	167680
2007/08	23400	143550	166950
2008/09	25000	110000	135000
2009/10	30000	80000	110000
2010/11	35000	70000	105000
2011/12	35000	65000	100000
2012/13	35000	65000	100000
2013/14	37500	66000	103500
2014/15	38500	66800	105300
2015/16	41500	65150	106650
2016/17	43000	65000	108000
2017/18	43000	65000	108000
2018/19	43000	65000	108000
2019/20	43000	65000	108000
2020/21	43000	65000	108000

Figure S.5: Additional cost per unit results in Scenario 1

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	-4,813	-3,882	-3,526	-2,845	-3,487
2010/11	-3,996	-4,518	-5,204	-4,199	-4,615
2011/12	-4,800	-5,172	-2,093	-2,103	-3,129
2012/13	1,599	-1,107	-1,405	-1,468	-997
2013/14	3,181	159	287	-469	396
2014/15	4,519	1,229	5,323	2,705	3,488
2015/16	29,354	16,132	5,129	2,712	10,495
2016/17	29,118	16,067	5,371	2,907	10,729
2017/18	28,563	15,742	24,602	16,266	20,552
2018/19	28,019	15,423	24,104	15,931	20,140
2019/20	27,485	15,111	23,616	15,604	19,735
2020/21	27,485	15,111	23,138	15,282	19,489

Scenario 2: More houses less flats

The model is based on the following mix of houses and flats:

Public
- Houses 34%
- Flats 66%

Private
- Houses 55%
- Flats 45%

Scenario is based on the following mix.

Public
- Houses 60%
- Flats 40%

Private
- Houses 60%
- Flats 40%

This scenario increases the construction demand, which impacts on pricing levels, and increases the overall average cost per unit to £42,000 in 2020.

Figure S.6 gives the cost per unit based on the 60:40 houses:flats mix throughout the forecast period.

Figure S.6: Additional cost per unit results in Scenario 2

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	128,617
2008/09	0	0	0	0	0
2009/10	5,773	4,656	4,229	3,413	4,365
2010/11	13,465	9,491	7,466	6,024	8,719
2011/12	16,262	11,737	13,389	10,370	12,980
2012/13	24,101	16,867	14,876	11,653	16,209
2013/14	26,668	18,917	17,315	13,228	18,538
2014/15	29,372	21,080	23,566	17,331	22,894
2015/16	56,764	37,735	24,183	18,001	32,389
2016/17	56,831	37,922	24,670	18,393	32,952
2017/18	56,246	37,579	44,968	32,493	43,482
2018/19	55,671	37,242	44,443	32,141	43,017
2019/20	55,108	36,913	43,928	31,794	42,561
2020/21	55,108	36,913	43,423	31,455	42,296

Scenario 3: More schemes with wind power

The model is based on 5% of public and 10% of private dwellings being supplied with energy from dedicated wind power.

This scenario looks at the impact of increasing this to 10% of public and 20% of private dwellings.

This decreases the impact of the sustainability targets by £1,000 per unit in 2020.

Figure S.7 gives the cost per unit based on wind power being used 10% of public, and 20% of private dwellings.

Figure S.7: Additional cost per unit results in Scenario 3

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	12,970	9,093	7,106	5,734	7,928
2011/12	15,743	11,321	13,007	10,063	12,084
2012/13	23,163	16,158	13,848	10,909	14,596
2013/14	25,608	18,112	16,197	12,412	16,728
2014/15	28,128	20,128	22,304	16,402	20,818
2015/16	54,777	36,281	21,711	16,269	28,331
2016/17	54,823	36,448	22,170	16,639	28,844
2017/18	54,254	36,115	42,454	30,728	39,210
2018/19	53,696	35,790	41,961	30,396	38,796
2019/20	53,149	35,470	41,478	30,071	38,390
2020/21	53,149	35,470	41,004	29,752	38,146

Scenario 4: More schemes using 'allowable solutions'

The model is based on 5% of public and of private dwellings achieving zero carbon by carrying out offsetting works or applying some other 'allowable solution' and this resulting in a 10 % to 15% reduction in the cost of 'technology'.

Scenario 4.1 looks at the effect of increasing this to 20% of dwellings achieving zero carbon using allowable solutions and Scenario 4.2 looks at, additionally, increasing the saving from allowable solutions in the model from to 50%.

Increasing the number of dwellings affected from 5% to 20% only has a marginal effect of reducing the overall cost by £200 in 2020.

Figure S.8 gives the cost per unit based on allowable solutions being applied in 20% of dwellings.

Figure S.8: Additional cost per unit results in Scenario 4.1

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181,000	146,000	132,600	107,000	126,241
2008/09	0	0	0	0	0
2009/10	5,417	4,369	3,968	3,202	3,982
2010/11	12,928	9,075	7,106	5,734	7,918
2011/12	15,701	11,302	12,966	10,044	12,055
2012/13	23,318	16,274	14,365	11,254	14,928
2013/14	25,763	18,228	16,716	12,759	17,056
2014/15	28,284	20,245	22,741	16,702	21,104
2015/16	55,295	36,652	23,269	17,297	29,301
2016/17	55,331	36,812	23,728	17,667	29,803
2017/18	54,753	36,472	43,863	31,639	40,084
2018/19	54,185	36,140	43,343	31,290	39,653
2019/20	53,628	35,813	42,833	30,947	39,231
2020/21	53,628	35,813	42,333	30,611	38,974

The saving from allowable solutions in the model are 10% -15% if these are increased to 50% the reduction in the cost per unit in 2020 goes up to nearly £900. see figure S.9.

Figure S.8: Additional cost per unit results in Scenario 4.2

	Public		Private		Avg cost per unit
	Houses	Flats	Houses	Flats	
	181000	146000	132600	107000	126241
2008/09					
2009/10	5417	4369	3968	3202	3982
2010/11	12762	9000	7106	5734	7879
2011/12	15534	11227	12801	9968	11936
2012/13	22840	16024	14241	11205	14756
2013/14	25283	17976	16591	12709	16879
2014/15	27802	19992	22278	16461	20752
2015/16	54128	36031	22889	17109	28808
2016/17	54187	36203	23347	17479	29311
2017/18	53630	35875	43010	31066	39338
2018/19	53084	35554	42507	30728	38922
2019/20	52549	35239	42013	30396	38513
2020/21	52549	35239	41529	30071	38264