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# Energy Saving Trust - Housing Energy Model

## The full potential for CO<sub>2</sub> emission reductions in the housing stock

### Introduction

The Energy Saving Trust's Housing Energy Model is a powerful analytic tool allowing us to explore what happens when different energy efficiency and renewable energy measures are applied to homes in Great Britain. The model identifies how much energy and CO<sub>2</sub> could be saved in the domestic sector by applying different measures to homes in different combinations and with different uptake rates, looking at the period between 2010 and 2050.

The scenario we have modelled here is a very ambitious one of widespread installation of energy efficiency measures and microgeneration. It doesn't represent what we believe should be fitted to British homes; rather it is an indicative scenario of what is technically possible with today's technologies. We've assumed two grid decarbonisation scenarios: a high level of grid decarbonisation where CO<sub>2</sub> intensity of the grid reduces linearly to 20gCO<sub>2</sub>/kWh by 2050; and a median level of grid decarbonisation where the CO<sub>2</sub> intensity reduces linearly to half current levels to 287gCO<sub>2</sub>/kWh by 2050. Although the results are not comparable to Project Discovery scenarios it may be useful to see what the potential for CO<sub>2</sub> reduction is in the domestic sector.

### The model

The model is based on the English House Condition Survey which was analysed to produce over 96 existing house types about which we have detailed underlying data. These house types are characteristic of over 90% of the housing stock: the numbers for each house type are then scaled up to reflect their relative proportions and to reflect the real total number of homes in Great Britain.

There are 30 standardised house types to represent new build properties. The energy performance characteristics of these new homes are based on government plans for future changes to Part L of the building regulations.

The house types are differentiated according to the following criteria:

- Age
- Tenure
- Primary heating system
- Size
- Proportion of energy efficiency measures

The suitability of each potential energy saving measure is defined for each house type so that, for example, loft insulation is not applied to flats. Up to two groups of measures can be applied to the model, each with a different uptake rate. Using a building physics module based on the SAP 2005 methodology, the model then calculates the reduction in energy use and carbon emissions resulting from the measures applied. Interactions between the measures applied to each home are taken into account.

### Baseline assumptions



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A baseline was defined, against which the effect of implementing measures was assessed. We assumed:

- New build rates are based on CLG household projections with size being scaled to 2006 and 2007 statistics. A demolition rate of 20,400 per annum is assumed for pre-2007 homes which is uniform across all house types.
- There is no increase in demand in electricity from appliances and no increase in internal temperatures. This could be the result of improved standards for appliances and a behaviour change campaign, including smart meters, to reduce energy use in the home.
- Due to the impact of climate change we have assumed an increase of around 1.5°C by 2050 means a 20% reduction in heating degree days.
- There is no increase in the number of cooling degree days
- Grid decarbonisation is at two levels as stated above.
- Business as usual installations that would occur anyway through necessity (e.g. boiler replacement), current policies (e.g. CERT) and standard uptake.

*Measures applied to the housing stock:*

All homes to have these measures by 2050:

- Reduced flow hot water fittings
- Draught proofing
- Heating controls
- Foam insulation on hot water tank
- Insulation on primary hot water pipe-work
- Insulated doors
- Floor insulation
- Energy efficient appliances
- Lofts and cavities filled where possible (assumed 85% possible) by end of 2015
- Triple glazing on all single glazed properties
- External solid wall insulation on all terraced, semi-detached and detached homes
- Internal solid wall insulation on all flats
- Reduced infiltration (increased air tightness) and heat recovery on new homes built between 2007 and 2010. (It is assumed homes built from 2010 onwards will have this in line with zero carbon new build assumptions)

Microgeneration:

- Community biomass boilers installed in all flats without gas central heating up to 2019 (after which homes will be zero carbon)
- Community gas CHP installed in all flats with gas central heating up to 2019
- Solar thermal and solar PV installed on all 75% of all homes
- Ground source heat pumps installed in all terraced, semi-detached and detached homes that have basic energy efficiency measures
- Biomass boilers installed in all terraced, semi-detached and detached homes that don't have basic energy efficiency measures (but energy efficiency measures will gradually be installed in all homes by 2050)

All measures are applied to the housing stock with a flat uptake rate so that 100% saturation is reached by 2050 (unless otherwise stated).

## Results

### Low grid decarbonisation

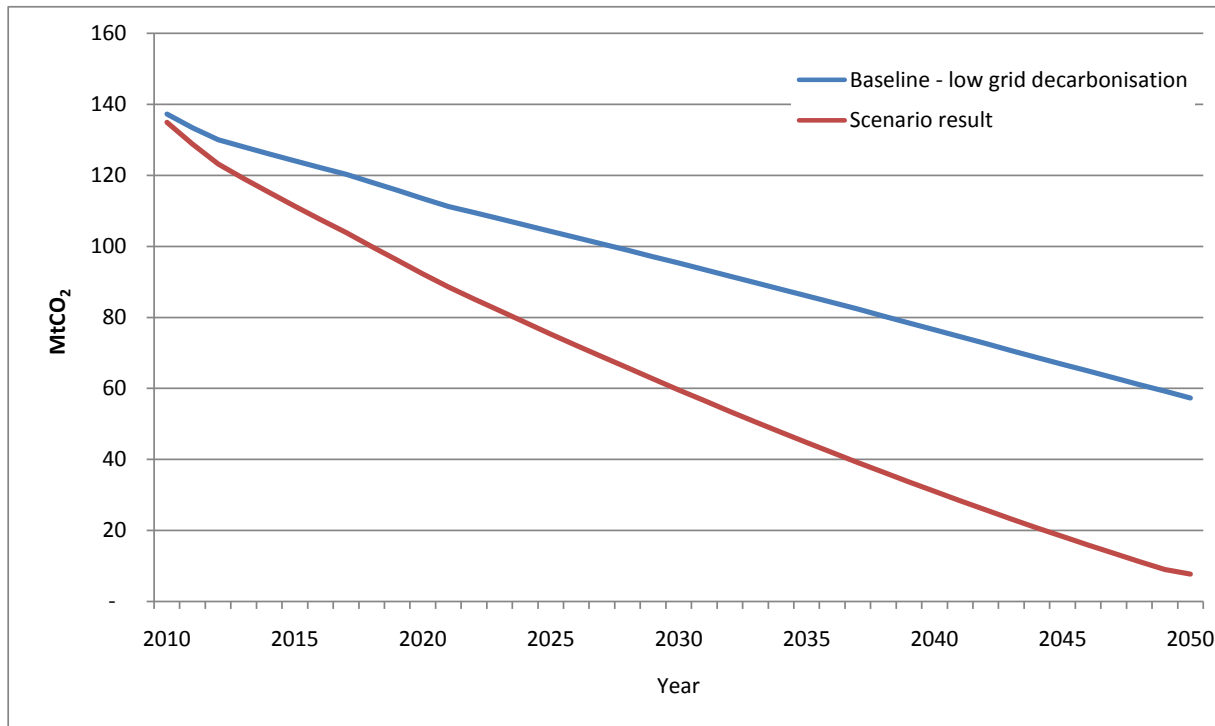


Figure 1

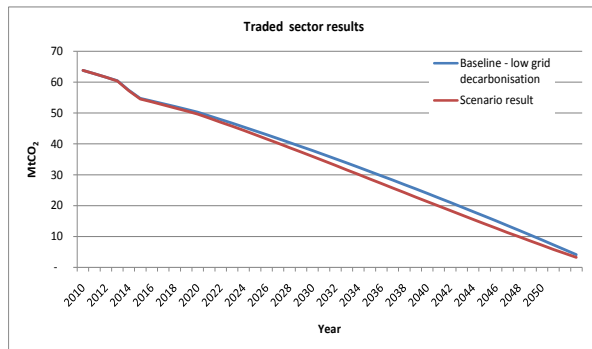


Figure 2

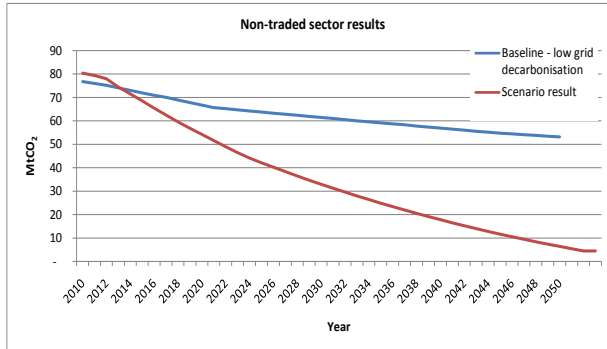


Figure 3

Figure 1 shows the result of installing the measures outlined above, against the specified baseline. The fall of CO<sub>2</sub> emissions in the baseline (blue line) is primarily because of grid decarbonisation which can be seen in the traded results (figure 2), and a lack of increasing emissions from existing homes. Savings from the scenario (red line) relative to the baseline are therefore mainly coming from the non-traded sector as heat demand reduces. Non traded reductions are due to reducing heat demand and the increasing number of homes not using oil or gas central heating.

In the non-traded results it appears that scenario emissions start above baseline emissions, this is because scenarios are modelled from 2007 when the model was originally built, where scenario and baseline emissions are equal, but only data from 2010 is show here.

### Median grid decarbonisation

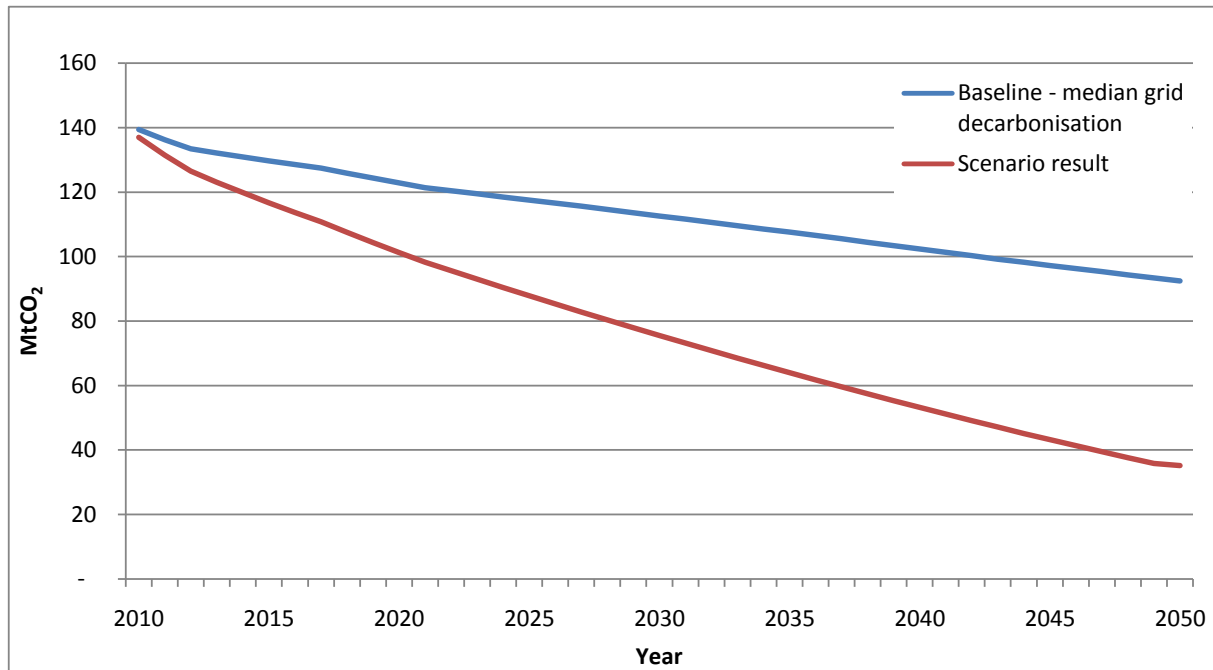


Figure 4

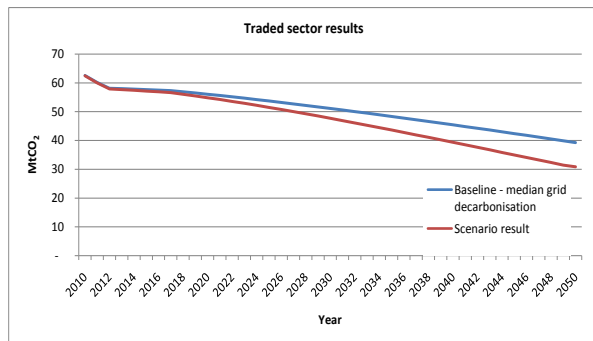


Figure 5

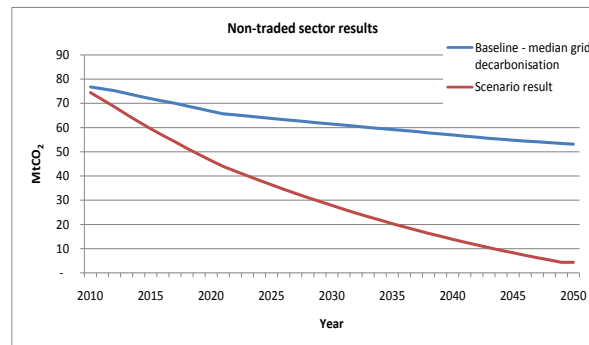


Figure 6

This is the same scenario but modelled with a median decarbonised grid (down to 287gCO<sub>2</sub>/kWh by 2050). CO<sub>2</sub> reductions within the baseline are still primarily from the traded sector but to a lesser degree. Electricity use in the baseline actually increases slightly towards 2050 as more new homes are built and heat pumps are installed, but traded sector emissions decrease because of grid decarbonisation.

These results may be useful for Ofgem in relation to the domestic reductions necessary for each energy scenario in Project Discovery. We make no policy recommendations as to how measures are implemented and who will pay. There is a cost benefit analysis module included with the model to examine the cost of implementing the scenario (but not the baseline business as usual measures) which is currently being finalised.

If you would like more information on these scenarios please contact Frances Downy [frances.downy@est.org.uk](mailto:frances.downy@est.org.uk) or David Weatherall [david.weatherall@est.org.uk](mailto:david.weatherall@est.org.uk)