Carbon Dioxide emissions of West Midlands' Housing

A Scenario Analysis

A report commissioned by the West Midlands Regional Assembly

Carbon Dioxide emissions of West Midlands Housing – A Scenario Analysis	
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Executive summary

This study assessed the carbon dioxide emissions for the West Midlands taking into account the proposed RSS phase 2 revision until the year 2026.

Considering these three alternative housing growth options, and assuming that electricity mix, retrofit rates and efficiency rates develop as they have in the past, the initial results suggested that although the per capita carbon dioxide emissions will slightly decrease by around 4% under option 1, 3% under option 2, and 2% under option 3, the overall emissions for the region will increase. Under option 1, total carbon dioxide emissions for the West Midlands will grow by more than 4%, by almost 5% under option 2, and by around 7% under option 3.

This means that despite improved energy efficiencies on a per capita basis, the total net carbon dioxide emissions for the region will increase. In other words, all three housing options proposed in the West Midlands' strategy will not be met and, should this path continue, the region will also fail to contribute to the Government's targets on reducing carbon emissions by 60% by 2050.

Taking into account these baseline results, four possible different housing policy options were evaluated:

1. Introduction of Ecohomes (100% by 2015).
2. All new builds will have 25% of renewable on-site energy by 2015.
3. A "combined moderate" scenario including:
    - All new builds have 25% on-site renewables by 2015
    - By 2015, all new builds will be "Ecohomes excellent"
    - The demolition rate will be increased to 400% by 2026
    - Energy consumption through retrofit measures has been reduced to 58% by 2026
    - Better enforced building regulations achieve a 3% reduction in energy consumption in new build houses per year.
4. "Combined aspirational"scenario: As in number 3 but with an EU renewables target of 25% renewable energy by 2015 and 30% by 2026.

Although the per capita figures could decrease by 43% in the "combined aspirational" scenario, the total carbon dioxide emission reductions for the region are less dramatic. The results for the West Midlands demonstrated that single policy options only have a very limited or no effect on reducing the carbon dioxide emissions but that a combination of measures, as suggested in scenarios 3 and 4, are required to ensure significant emission reductions.

In 2026, total carbon dioxide emissions under RSS option 1, "combined aspirational" could be 26% lower than under the weakest scenario in RSS option 3 (25% renewables for new builds) and 30% lower than the baseline projections under RSS option 3. These reductions are equivalent to around 7,467,382 tonnes of carbon dioxide for the year 2026 or 105,649,597 tonnes for the accumulated emissions between the years 2002 and 2026.

While these measures are crucial for a policy framework towards more sustainable housing policies and for achieving UK and regional sustainability targets, these alone will not be sufficient to achieve a Factor 2 reduction in carbon dioxide emissions by 2026. Even the most aspirational scenario 4. under RSS option 1 falls 21% short of this target.

The evidence provided in this first report shows that additional planning strategies supporting the RSS are needed to reduce the West Midland's contributions to climate change. Because environmental impacts from housing and transport policies are inextricably linked, one suggestion would be to integrate the region's housing strategy into its transport strategy. Previous research by SEI has shown that the lion's share of the housing and transport Footprint can be explained by a region's transport policy.

SEI would propose an evidence package that will evaluate West Midland's transport strategies, and to explore how both housing and transport policies could be integrated so that regional and national targets to reduce carbon dioxide emissions can be achieved.

1. Purpose of this report

The purpose of this report is to test West Midlands' Regional Spatial Strategy (RSS) phase 2 revision and the Regional Housing Strategy for their impacts on carbon emissions within the region, focussing especially on housing. The report further provides a number of carbon reduction scenarios based on each of the spatial options within the phase 2 revision.

2. Background

The Government has set a number of targets for the reduction of carbon emissions. These require a reduction in carbon dioxide emissions from 1990 levels by 60% by 2050, with a number of interim targets.

At present, carbon dioxide emissions are still increasing. This means that the first requirement is to achieve a stabilisation of anthropogenic carbon emissions and following this, to reduce them. Clearly, the West Midlands will need to contribute to this process.

However, if a regional target is to be achieved, it is vital that new housing developments are built in ways which minimise or eliminate emissions. This will require significantly higher standards in design and construction methods, as well as careful consideration of where and in what form development takes place.

Earlier this year, Counting Consumption, a report on carbon emissions, material flows and Ecological Footprint for the West Midlands was published by WWF. The report provides a baseline, setting out the impacts that the region has had globally, and highlights the potential of the Carbon Footprint as an environmental assessment tool. A report for the Leeds City Region has demonstrated how the Carbon Footprint can be used to assess the impact of housing options at the regional level.

In particular, we need to bear in mind that the UK's Government policy PPS1: Delivering Sustainable Development requires that:

Regional planning bodies and local planning authorities should ensure that Development plans contribute to global sustainability by addressing the causes and potential impacts of climate change – through policies which reduce energy use, reduce emissions (for example, by encouraging patterns of development which reduce the need to travel by private car, or reduce the impact of moving freight), promote the development of renewable energy resources, and take climate change impacts into account in the location and design of development.

The consultation PPS on Planning and Climate Change was published in December last year and highlights that trajectories for carbon performance for new residential and commercial developments will be expected for inclusion in all RSS. One of the key objectives of the PSS is that "regional planning bodies and all planning authorities should prepare and deliver spatial strategies that make a full contribution to delivering

the Government's Climate Change Programme and energy policies, and in doing so contribute to global sustainability"[1]

This report develops an evidence package that will look at a number of environmental issues surrounding the RSS Phase 2 review. The evidence provided can be used to assess the housing growth policies in the West Midlands in relation to its carbon dioxide emissions.

2.1. Outline

The evidence provided by the Resources and Energy Analysis Programme (REAP) can inform the draft Phase 2 RSS review and will contribute to a clear and suitable framework to guide sustainable development over the next 15-20 years. It will help to inform key partners and ensure that carbon dioxide reduction strategies, informed by the evidence base within this piece of work, are considered during the phase 2 review of the RSS.

2.2. Outputs

- A summary of the carbon dioxide emissions for the West Midlands Region, broken down by Local Authority Area (to be published soon at: http://www.sei.se/reap/regional/r_casestudies.php.)
- A set of generated comparative housing scenarios within the region based on RSS Phase 2 growth figures and policies within the RHS. This will provide data for carbon dioxide emissions for each local authority area based on each of the three main housing options.
- A set of four policy scenarios for all three housing options within the region based on RSS Phase 2 growth figures and policies within the RHS:

    1. Introduction of Ecohomes (100% by 2015).
    2. All new builds will have 25% of renewable on-site energy by 2015.
    3. A "combined moderate" scenario including:

        - All new builds have 25% on-site renewables by 2015
        - By 2015, all new builds will be "Ecohomes excellent"
        - The demolition rate will be increased to 400% by 2026
        - Energy consumption through retrofit measures has been reduced to 58% by 2026
        - Better enforced building regulations achieve a 3% reduction in energy consumption in new build houses per year.

    4. A "combined aspirational" scenario: As in number 3 but with an EU renewables target of 25% renewable energy by 2015 and 30% by 2026.

[1] Consultation Planning Policy Statement:
Planning and Climate Change Supplement to Planning Policy Statement 1, p. 13.
http://www.communities.gov.uk/pub/142/ConsultationPlanningPolicyStatementPlanningandClimateChangeSupplementtoPlanning1_id1505142.pdf

3. Introduction of REAP

REAP (www.sei.se/reap) is a sophisticated model developed by SEI with CURE and WWF that measures the environmental pressures associated with human consumption. It and can be used at the local, regional and national level and assess the full life-cycle impacts of greenhouse gas emissions, air pollutants, energy consumption, heavy metals, Ecological Footprint, and material flows of products and services. REAP can also model the impacts of different policies and create plausible scenarios of the future. These can then be set against targets or compared to alternative futures based on selected trends or assumptions. All indicators take into account the direct and indirect pressures of consumption of products and services throughout the full economic supply chain.

4. Methodology

The basic methodology underpinning REAP combines existing Material Flow Accounts (MFA), National Environment Accounts and National Footprint Accounts (NFA) with input-output analysis. Environmental input-output analysis is a well established approach that makes it possible to track and assign intermediate resource flows to consumption categories. This is important because industries trade resources with each other in the process of producing goods and services and we need to be able to track these 'indirect' or 'offsite' impacts as well as those associated by the 'direct' or 'onsite' use of resources[2]. This impact can be expressed in carbon dioxide emissions or by using the Ecological Footprint.

In this study, REAP has been applied to measure the carbon dioxide emissions and Ecological Footprint associated with West Midlands' Regional Spatial Strategy (RSS) phase 2 revision (2006).

4.1. REAP support sheets

The REAP support sheets for the built environment has been developed to provide and prepare data for REAP, to facilitate data management, scenario modelling, and for analysing and testing very detailed policy assumptions. The outputs created from the support sheet can be directly put into REAP. Data that can be changed in the "Change Variables" sheet are:

- Demolition rates
- Demolition mix by housing type
- Number of new houses (building rates) in total and according to housing type
- Retrofit rate
- Electricity mix
- Effectiveness of building regulations
- Population projections

[2] The underlying methodology has been described in detail by Wiedmann et al. (Thomas Wiedmann, Jan Minx, John Barrett, Mathis Wackernagel (2006). Allocating ecological footprints to final consumption categories with input-output analysis. Ecological Economics 56 (2006) 28-48).

4.1.1. Variables in the REAP spreadsheet

The variables in the REAP spreadsheet for the West Midlands' RSS are based on the following assumptions:

4.1.1.1. Demolition rates

Based on information in the RSS it was assumed that demolition and the building of new dwellings occur independently, i.e. a new house does not automatically replace a demolished one.

4.1.1.2. New build houses

Newly built houses are expressed as the rate of houses that are built each year and are based on regional projections.

Newly built houses add to the existing housing stock. The existing housing stock for a given year takes into account the building rates for new homes, existing homes, demolition rates, and five different housing types (detached, semi, terraced, flat, "Ecohomes excellent").

This study uses regional demolition rates taken from the RSS, and building rates provided by Staffordshire County Council.

4.1.1.3. Retrofit rate

The retrofit rate relates to the percentage of houses being retrofitted with energy conserving measures such as loft insulation, double glazing, cavity wall insulation, and condensing boilers. The retrofit rate directly affects the energy efficiency of the existing housing stock.

4.1.1.4. Electricity mix

As a default, the electricity mix over time assumes projections based on data compiled by the Department of Trade and Industry (DUKES, 2006)[3]. The mix can be changed manually and accounts for fuel-specific CO_2 emissions and Ecological Footprints.

4.1.1.5. Effectiveness of building regulations

Building regulations affect the energy efficiency of new houses. These regulations provide a design standard for new housing rather than an actual performance standard. This means that on average, currently only two thirds of new buildings comply with building regulations for energy efficiency (EST 2004)[4], resulting in only small improvements in the energy efficiency of new houses (less than 1% per year). A higher compliance of new building stock with energy efficiency regulations could lead to energy efficiency improvements in the housing stock between 3-5% a year.

[3] DUKES (2006). Digest of UK Energy Statistics
http://www.dti.gov.uk/energy/statistics/publications/dukes/page29812.html
[4] Energy Saving Trust (2004). Assessment of energy efficiency impact of building regulations compliance. Client report no 219683.

The overall housing stock efficiency is determined by the energy efficiency of the old and new housing stock, including "Ecohomes". It also includes average energy savings achieved through retrofit and from the effectiveness of building regulations.

The efficiency of the housing stock affects the energy consumption per household. The energy consumption per household includes the energy required for space and hot water heating, lighting, cooking, and also takes into account occupancy rates and different house building types. Energy efficiencies for different house types and retrofit options were based on BRE data[5] and Wiedmann et al. (2003)[6] .

4.1.1.6. Population projections

Population projections forecast the population numbers over 25 years. Population numbers are based on data from the UK Office of National Statistics (ONS)[7] using regional projections.

5. Assumptions for modelling baseline scenarios in REAP

The following section describes the data assumptions behind the scenarios that were modelled on West Midlands' RRS and RHS.

5.1. Assumptions for baseline data

For the model to work, a number of baseline values need to be entered for each specific region. For the West Midlands region, the following values were used:

- Number of 2001 household 2,153,672 (from the RSS)
- 2001 housing mix (from census table ks016)
    - detached 24%
    - semi detached 38%
    - terraced 24%
    - flat 14%
- Electricity consumption 1656 KWh/cap (REAP)
- Gas Consumption 6877 KWh/cap (REAP)
- Population 2001 5,251,338 (REAP CACI ACORN figures)
- Population 2026 5,748,700 (ONS population projections, 2004)

5.2. Data assumptions for key variables

Based on available evidence, assumptions on the future trends of a number of key variables were made:

5.2.1. Demolition rates

The RSS provides three housing options. Option 1 is based in a continuation of current RSS policies, option 2 has been derived from advice and further discussion with

[5] www.bre.co.uk
[6] Tommy Wiedmann, John Barrett and Nia Cherrett (2003). Sustainability rating for homes. Stockholm Environment Institute, 2003.
[7] http://www.statistics.gov.uk/

strategic authorities and option 3 meets the overall levels of housing demand associated with the Government's latest housing projections and the need to replace obsolete stock which will be demolished.

For each housing option, the gross and net numbers of new houses is given for the period 2001-2026. The difference between the gross and net figures is the number of total demolitions. Dividing this number over the period of 25 years gives an average demolition figure for each year. Assuming a constant annual demolition rate, we applied the following figures:

- Option 1: 3,504 demolitions per year
- Option 2: 4,580 demolitions per year
- Option 3: 4,580 demolitions per year.

5.2.2. Demolition mix

The RSS gives little detail on the exact proportions of houses of each type that are to be demolished. Regeneration programs concentrate on demolishing old terraced housing and flats. It was decided, to bias demolitions towards the terraced houses in the following profile:

- detached 10%
- semi detached 10%
- terraced 50%
- flat 30%

This means that if 1000 houses are to be demolished, 500 of these are terraces.

5.2.3. New build rate

The gross numbers from the RSS's three housing options are divided over 25years to give an annual figure for new houses.

- Option 1: 15,240 new houses per year
- Option 2: 20,000 new houses per year
- Option 3: 23,000 new houses per year

We have assumed the same rate of new build each year.

5.2.4. New build mix

Neither the RSS nor the RHS give specific detail on the types of houses that are to be built in the period 2001 to 2026. The Survey of English Housing provides some detail on the types of houses that are built each year and in 2001, 14% of the houses built in the West Midlands were flats and 86% were houses. Since the figure for flats is the same as the existing housing mix and no data has been found to advise on the new

housing mix, for the RSS scenario, the new build mix was assumed to be exactly the same as the existing housing mix:

- detached 24%
- semi detached 38%
- terraced 24%
- flat 14%

5.2.5. Retrofit

Neither the RSS nor the RHS make specific mention of the need to retrofit existing housing stock. For this scenario, it is assumed that there will be an annual "natural" decrease in energy use based on average retrofit rates. This would result in annual energy efficiency improvements of less than 1% per year, starting from 2001.

5.2.6. Electricity mix

The electricity mix was based on the national projections based on DTI (2006)[8], with 14% of electricity supplied by renewable sources by 2026.

5.2.7. Effectiveness of building regulation for new houses

National building regulations will improve the energy efficiency of new houses over time. Overall we assume a 9% improvement by 2026.

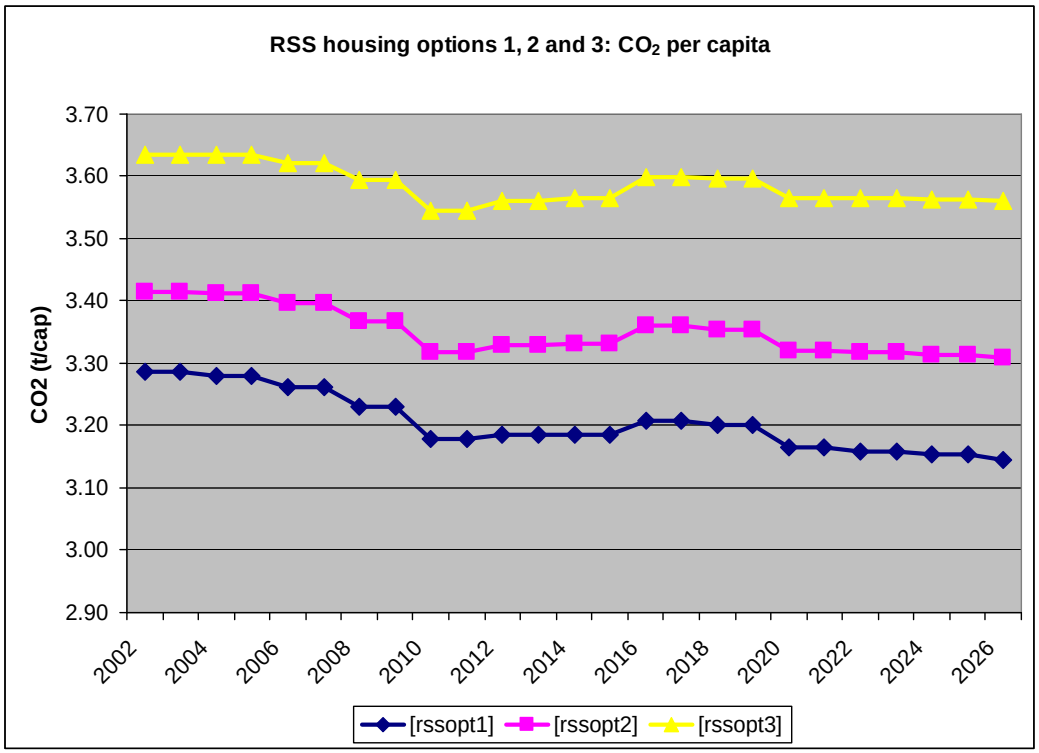
6. Results

Considering RSS options 1, 2 and 3, the following section shows how carbon dioxide emissions and Ecological Footprint could develop over the 2001 – 2026 period.

6.1. Carbon dioxide emissions per capita

Under the RSS scenario, carbon dioxide levels will decrease per person in the West Midlands region (Figure 1). Option 1 results in each person having a lower carbon footprint in both 2001 and 2026. With a 4.3% decrease, option 1 also shows the greatest reduction in carbon dioxide emissions per capita. Option 2 will reduce carbon dioxide emissions by around 3%, and option 3 by 2% per person. However, the results are less encouraging when considering the total carbon dioxide figures rather than the per capita values.

[8] DUKES (2006). Digest of UK Energy Statistics.



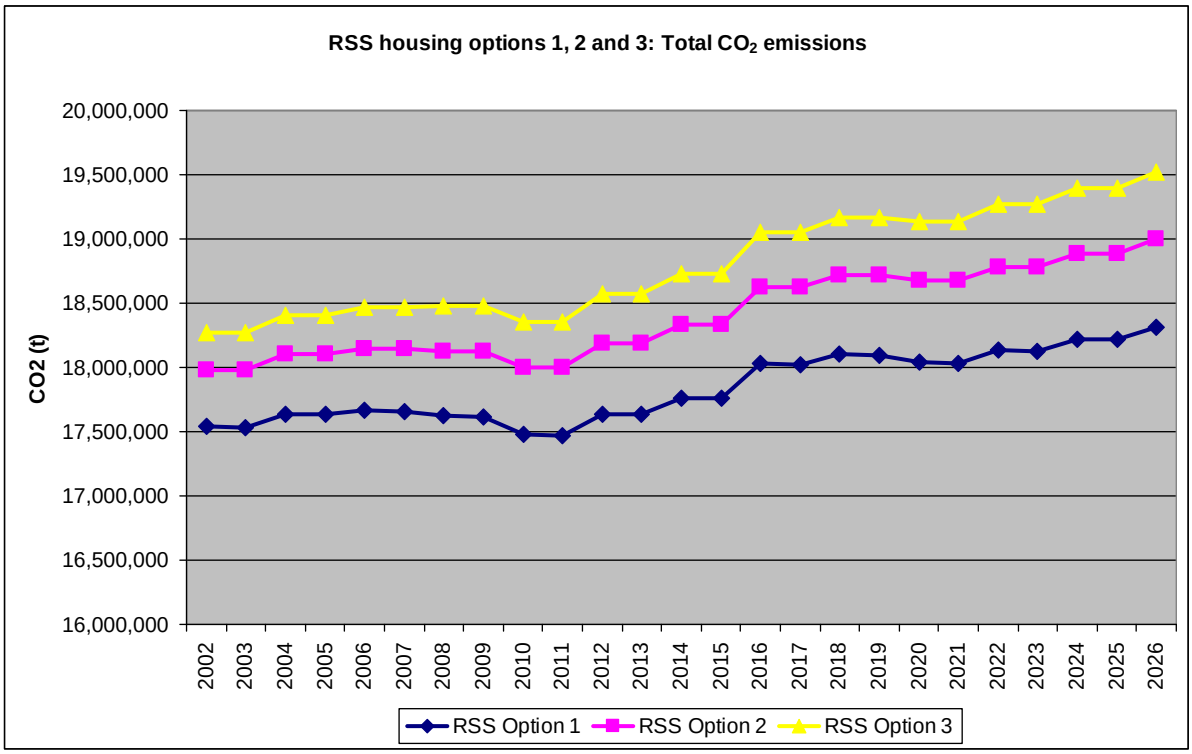
	2002 (tonnes CO_2/cap)	2026 (tonnes CO_2/cap)	Percentage Change
Option 1	3.29	3.15	-4.3%
Option 2	3.41	3.31	-3.1%
Option 3	3.63	3.56	-2.0%

Figure 1. West Midland's CO_2 emissions per person and different housing options

6.2. Total carbon dioxide emissions for the region

The total emission results (Figure 2)[9] show that all three options produce increases in carbon dioxide ranging from an increase of 4.4% to 6.9%. Option three suggests that the housing plan in 2026 will result in a total increase 1,253,128 tonnes of carbon dioxide in the West Midlands compared to 2002. Therefore, none of the options outlined in the current phase 2 review of the RSS will contribute to regional or national targets to reduce carbon dioxide emissions.

[9] Note that for display purposes, Figures 1 and 2 start with the year 2002 although they have the same baseline values in 2001.



	2002 (tonnes CO_2)	2026 (tonnes CO_2)	Percentage Change
Option 1	17,539,269	18,307,599	4.4%
Option 2	17,978,471	18,997,055	5.7%
Option 3	18,267,681	19,520,809	6.9%

Figure 2. West Midlands housing options and CO_2 emissions

7. Policy scenarios

Four different policy scenarios were modelled in REAP based on the following assumptions:

1. Ecohomes: Assuming that by 2015, all newly built houses will be developed according to the "Ecohomes excellent" standard.
2. All new built renewable energy 25% by 2015: Assuming all new homes will have around 25% on-site renewable energy
3. Combined moderate scenario including:
   - All new built 25% on-site renewables by 2015
   - By 2015, all new built homes will be "Ecohomes excellent"
   - The demolition rate will be increased to 400% by 2026
   - Energy consumption through retrofit measures has been reduced to 58% by 2026
   - Better enforced building regulations achieve a 3% reduction in energy consumption per year
4. Combined aspirational scenario: As in scenario 3 but with a gas-favoured EU electricity mix of 25% renewables by 2015 and 30% by 2026 for the national grid.

7.1. Examples from the Leeds City Region

A study for the Leeds City Region explored different energy efficiency measures for buildings. One of the key findings was that although most scenarios will achieve a certain degree of energy efficiency on a per household or per person basis, only those which focus on retrofit or a combination of measures (regulatory efficiency improvements, increase of renewables, faster transformation with Ecohomes and implementation of retrofit measures) will achieve long-term energy conservation and subsequent CO_2 reductions[10] (Figure 3).

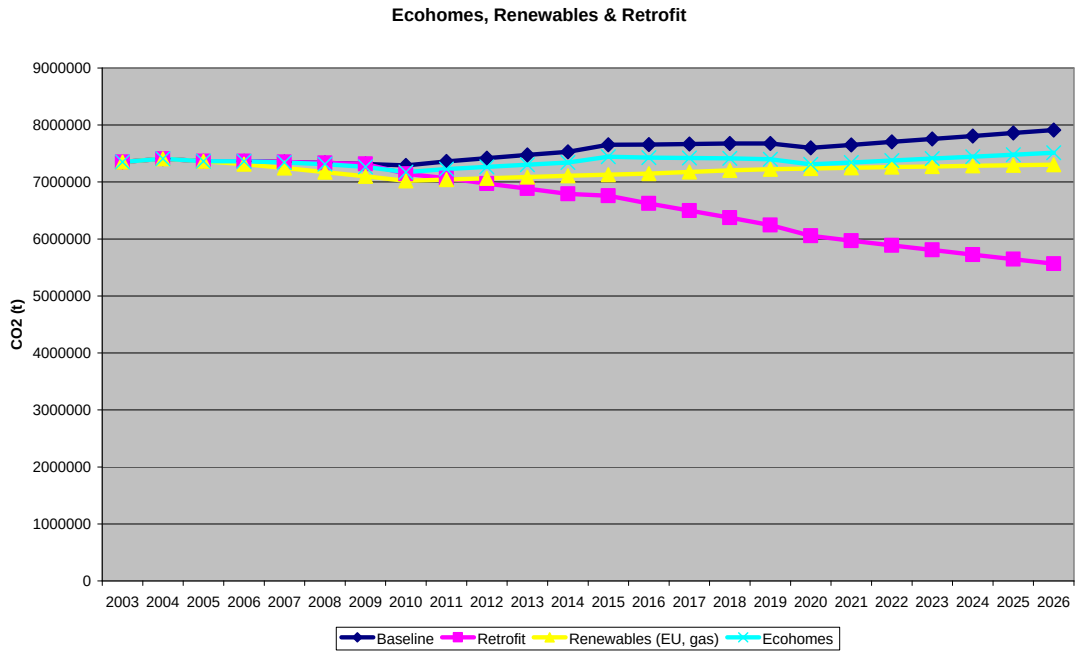


Figure 3. Reduction of carbon dioxide emissions from different energy efficiency measures.

7.2. Example energy consumption of different house types for new housing stock

Figure 4 and Figure 5 show examples for two different housing policies, the first one assuming that traditional building practices in the UK will continue and the second one where all new houses are "Ecohomes excellent " standard as of 2015. For the typical UK building practice, assuming that 62% of new houses being detached and semi-detached types, carbon dioxide emissions from these house types could account for 77% of emissions by 2026. In the Ecohomes example, 11% of the accumulated emissions are from Ecohomes. Although 69% of the carbon dioxide emissions by 2026 are still from detached and semi detached houses, overall emissions by 2026 have been reduced by 52% due to the introduction of Ecohomes. Based on data by BRE[11], a typical detached

[10] Frey, S., Paul, A., and Barrett, J. (2006). Using REAP for an environmental assessment of the Leeds City Region RSS Housing Policy. Stockholm Environment Institute, 2006.
[11] BRE 2001 data. Building Research Establishment Limited. http://www.bre.co.uk/index.jsp.

house in the UK consumes 16 times more energy than an Ecohomes excellent house. Semi-detached houses and terraces use around 11 and 7 times more energy than an Ecohome.

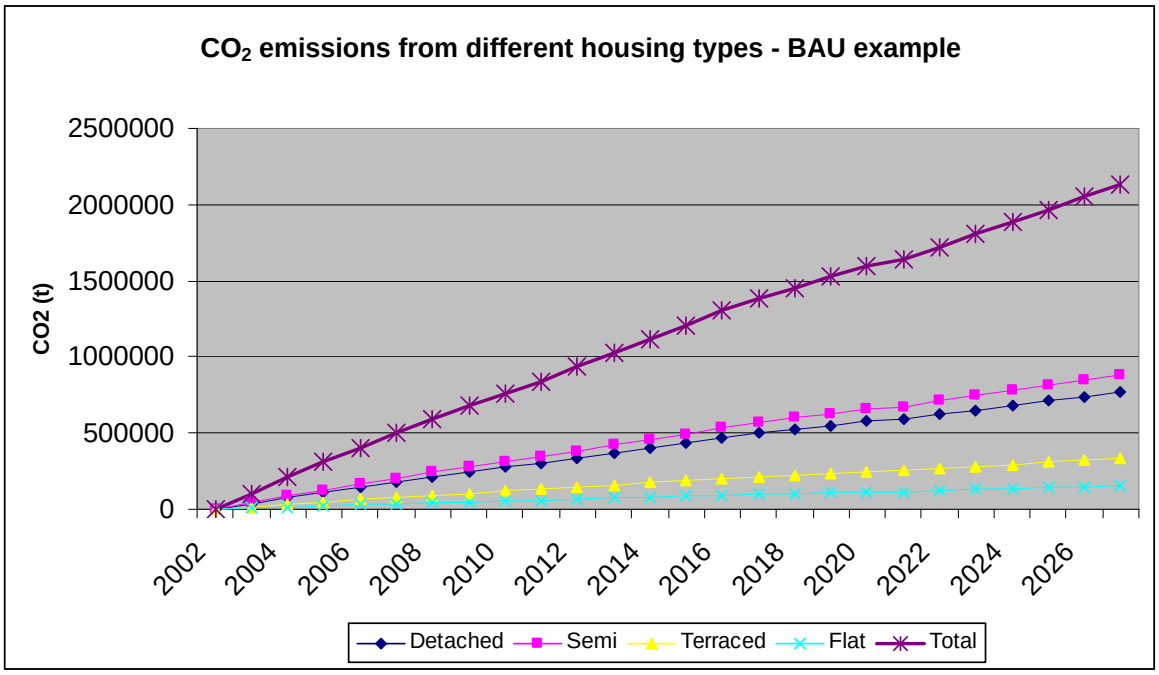


Figure 4. CO_2 emissions from different housing types, typical UK policy

Note that these CO2 values cannot be directly compared with REAP data.

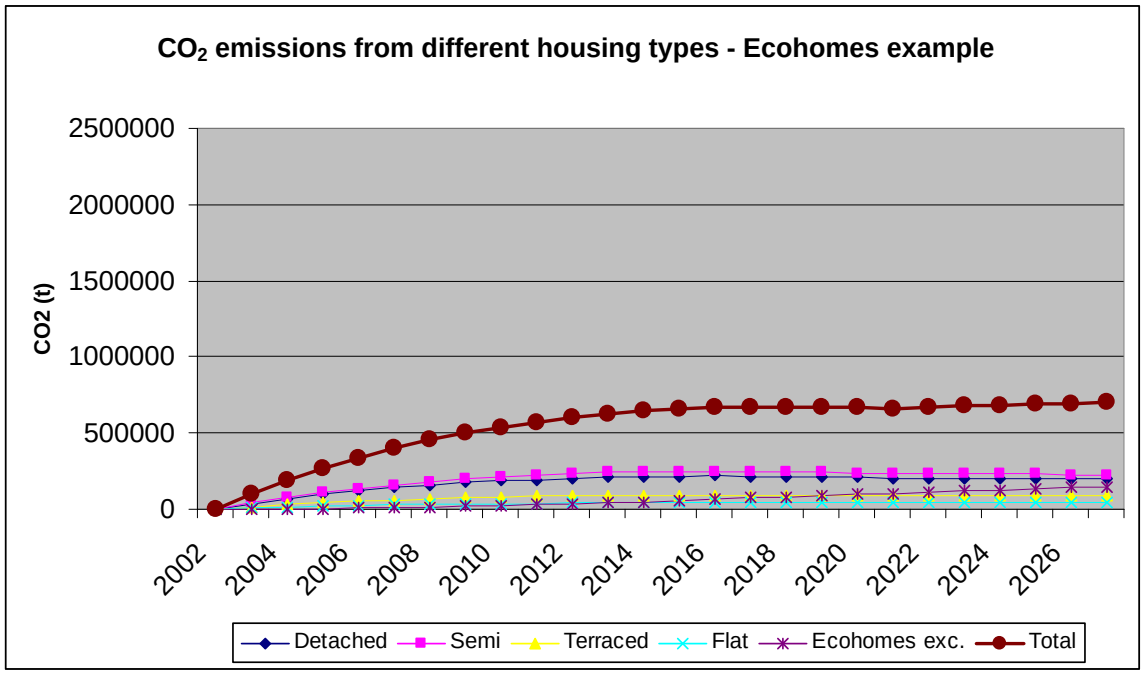


Figure 5. CO_2 emissions different housing types for new housing, Ecohomes example

8. Scenario results

All policy scenarios were modelled considering the RSS options 1, 2 and 3 for housing projections.

8.1. Per capita carbon dioxide emissions

The scenario summary shows that on a per capita basis, the RSS option 1 "combined aspirational" achieved the greatest per capita reduction in CO_2 emissions compared to 2002, with -36% compared to the renewable scenario in RSS option 3 or -43% compared to the baseline in RSS option 3 . Only relying on fuelling new homes with a 25% on-site renewables mix by 2015 in options 2 and 3 reduced per capita emissions by just 2% and 3% (Table 1 and Figure 6).

Scenarios	CO_2 (t/cap)	Percentage change 2026 / 2002
[rssopt3_Allnew EU energy target]	3.55	98%
[rssopt2_Allnew EU energy target]	3.30	97%
[rssopt3_ecohomes]	3.20	94%
[rss opt1_Allnew EU energy target]	3.14	95%
[rssopt2_ecohomes]	3.12	93%
[rssopt1_ecohomes]	2.99	91%
[rssopt3_combined moderate]	2.34	68%
[rssopt2_combined moderate]	2.27	68%
[rssopt3_combined aspirational_eco]	2.25	66%
[rssopt2_combined aspiratonal_eco]	2.19	65%
[rss opt1_combined moderate]	2.18	66%
[rss opt1_combined aspirational_eco]	2.10	64%

Table 1. Per capita CO_2 emissions for different housing scenarios

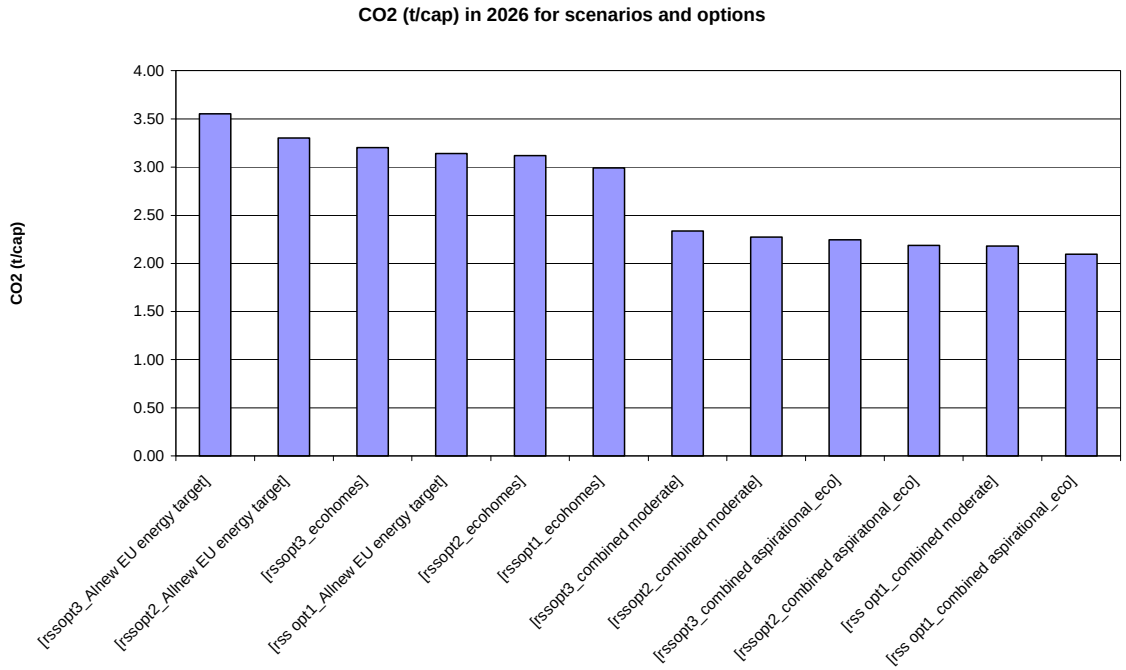


Figure 6. Per capita CO_2 emissions from different scenarios

8.2. Total carbon dioxide emissions

The accumulated carbon dioxide emissions until the year 2026 show that RSS option 3, even if all new built homes were fuelled by on-site renewable energy at a 25% rate in 2015, would accumulate the highest emissions compared to the other scenarios. The

"combined aspirational" scenario under RSS option 1 would be the lowest emitter (Table 2). This difference between the highest and lowest scenario is 26%, equivalent to around 99,593,355 tonnes of carbon dioxide.

Scenarios	**Cumulative overall ranking CO_2 (t)**	**overall difference highest - lowest**
[rssopt3_Allnew EU energy target]	490,033,128	
[rssopt3_ecohomes]	475,430,220	
[rssopt2_AlLnew EU energy target]	475,057,500	
[rssopt2_ecohomes]	465,776,069	
[rss opt1_Allnew EU energy target]	454,854,248	
[rssopt1_ecohomes]	451,223,600	
[rssopt3_combined moderate]	420,370,820	
[rssopt2_combined moderate]	412,303,739	
[rssopt3_combined aspirational_eco]	410,637,463	
[rssopt2_combined aspiratonal_eco]	402,491,742	
[rss opt1_combined moderate]	400,303,893	**26%**
[rss opt1_combined aspirational_eco]	390,439,774	99,593,355 t CO_2

Table 2. Cumulative CO_2 results for all scenarios without baselines

A ranking of all scenarios for the year 2026 shows that only option1 Ecohomes and the combined moderate and aspirational scenarios lead to reductions in carbon dioxide. All other scenarios will lead to increases in emissions (Table 3).

Scenarios	**Value in 2026 CO_2 (t)**	**Percentage change 2002/2026**
[rssopt3_Allnew EU energy target]	19,520,809	104%
[rssopt2_Allnew EU energy target]	18,464,058	102%
[rssopt3_ecohomes]	18,409,271	102%
[rssopt2_ecohomes]	17,927,315	101%
[rss opt1_Allnew EU energy target]	17,555,595	101%
[rssopt1_ecohomes]	17,195,657	99%
[rssopt3_combined moderate]	13,433,128	74%
[rssopt2_combined moderate]	13,070,208	74%
[rssopt3_combined aspirational_eco]	12,912,181	72%
[rssopt2_combined aspiratonal_eco]	12,568,593	71%
[rss opt1_combined moderate]	12,526,614	72%
[rss opt1_combined aspirational_eco]	12,053,427	70%

Table 3. Comparison of annual CO_2 emissions in 2026 and 2002

For the West Midlands, housing and energy efficiency measures within a housing option account for a spread of 18 to 21% between the most effective and the least effective scenario whereas the suggested RSS housing options 1,2 and 3 account for a difference of 8% between the lowest and highest housing projections. The lowest emission reductions from the baseline are from fuelling only new builds with 25% on-site renewables. The highest reductions, around 17%, can be achieved from a combined scenario that includes EU renewable targets for the national grid, a significant transformation towards energy efficient housing, retrofit measures, and better enforced building regulations that achieve energy efficiency gains of around 3% per year (Table 4 and Figure 7).

Cumulative CO_2 emissions (t)	**Option 1**	**Option 2**	**Option 3**	
RSS baseline	100%	100%	100%	**8%**
New builds renewables 25% / 2015	99%	99%	99%	
Ecohomes	98%	97%	96%	
Combined moderate	87%	86%	85%	
Combined aspirational	85%	84%	83%	
	18%	**19%**	**21%**	

Table 4. Summary of CO_2 reduction potentials, all options and scenarios

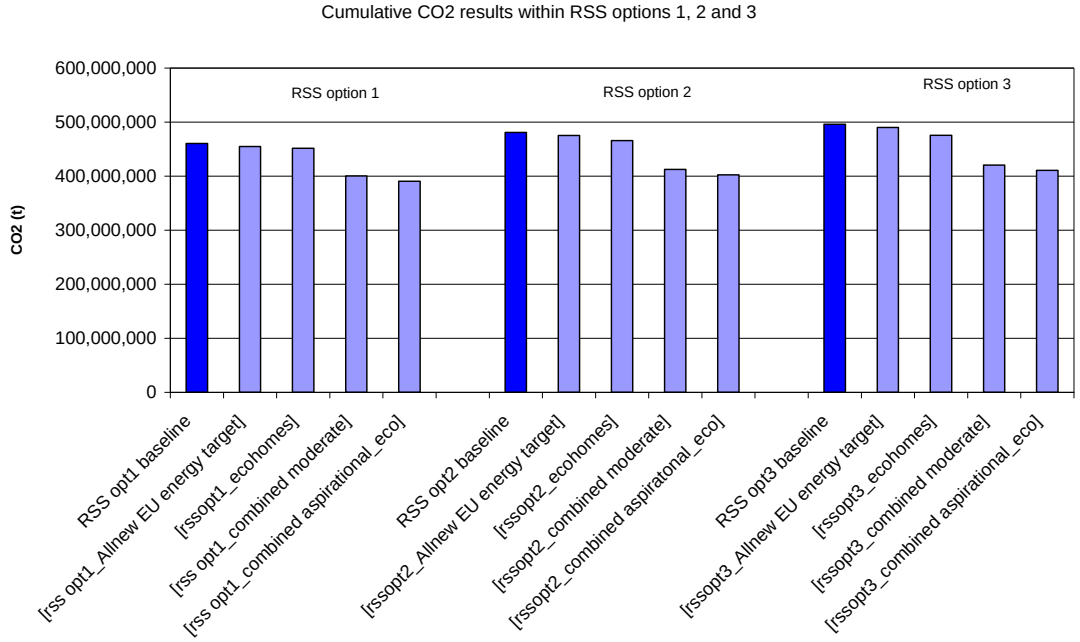


Figure 7. Ranking of cumulative CO_2 emissions within housing options

8.3. Carbon dioxide projections over time

Looking at the carbon dioxide emission projections over time, these results also show that significant energy savings can only be achieved by a combination of building and housing measures, such as the "combined aspirational" and "combined moderate" scenarios for housing options 1, 2 and 3. These findings also support our previous research from the Leeds City region. Although these measures would bring about significant reductions in carbon dioxide, they alone are not sufficient to meet the Government target of reducing carbon dioxide levels from 1990 by 60% by 2050, and the PPS1 policy on Sustainable Development. The scenario with the highest reduction potential – the "combined aspirational" in RSS option 1 - falls 21% short of meeting an emission target of approximately 9,969,295 tonnes of carbon dioxide in 2026 (Figure 8).

While these energy efficiency and building measures are crucial in achieving significant carbon dioxide reductions, other policy and planning options have to be considered in addition to the RSS so that the West Midlands can reduce their contribution to climate change. Since housing and transport policies are inextricably linked, one suggestion could be to integrate the region's spatial strategy into its transport strategy. Previous research by SEI for the North East of Scotland has shown that the lion's share of the housing and transport Footprint can be explained by a region's transport policy.

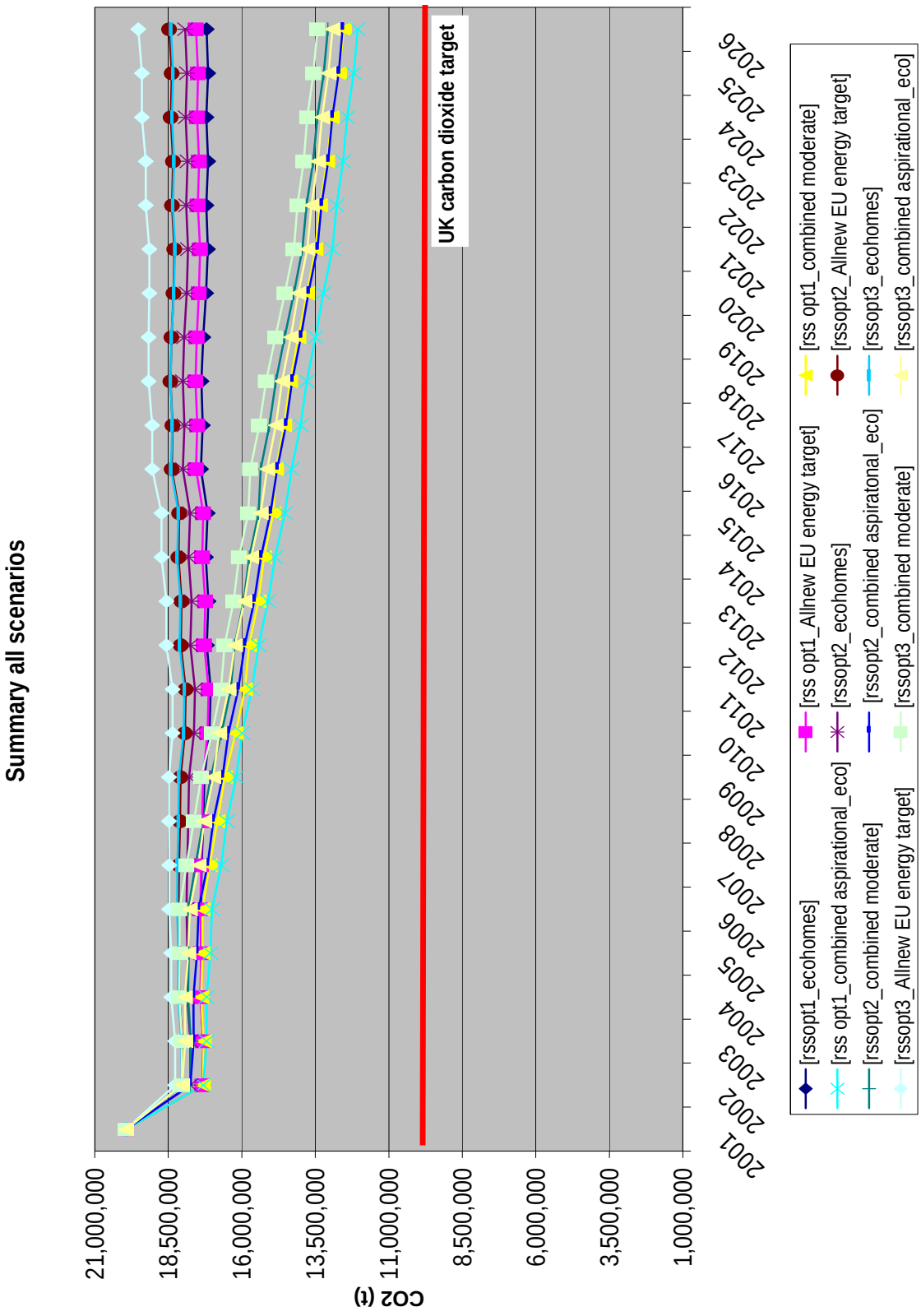


Figure 8. Carbon dioxide projections for all scenarios including CO_2 reduction target