Report for

GM Metrics Project

Lot 1c: Performance Management Framework

Prepared for GM Metrics Project Steering Group

By Wood Holmes

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GM Metrics Project

Lot 1c: Performance Management Framework

Contents

1 Introduction

1.1 The Greater Manchester (GM) Carbon Metrics Project seeks to establish an Inventory of Carbon Metrics and Performance Management Framework serving Climate Change Strategy in the city region.

1.2 The Project is divided into three 'Lot' components:

1.3 Lot 1a seeks to establish a Carbon Metrics Inventory concerning emissions from Local Authority operations and estates. The Lot 1a Inventory will blend with a parallel Inventory from Lot 1b collating Carbon Metrics concerning the geographic area.

1.4 Lot 1a and Lot 1b Inventories will provide the data underpinning the Performance Management Framework of Lot 1c.

GM Climate Strategy Carbon Metrics Project Lot 1 – Terms of Reference[1]:

Lot 1 – research and development of an integrated foundation for development and utilisation of Carbon Metrics in support of Greater Manchester Climate Change Strategy

1a – Data Inventory: Local Authority Carbon Metrics

1b – Data Inventory: Area Wide Carbon Metrics

1c – Metrics Framework: Performance Management Framework

1.5 This report takes the research and development process of the Lot 1c Performance Management Framework as its primary focus.

Outline

1.6 The Performance Management Framework incorporates key functional components that include:

- A facility to track the annual CO2 account with consistency, reliability, and regularity
- A facility to scrutinise the shape and constitution of the annual CO2 account and its evolution
- A facility to translate the headline ambition though to its component targets

[1] Please refer to GM Climate Strategy Carbon Metrics Project Lot 1 Tender Brief and Proposal for full details of objectives and methodology.

- A facility to contextualise the GM decarbonisation programme within the broader UK programme
- A facility to design a decarbonisation programme tuned to the specific reduction challenge
- A facility to devise a pipeline of efficient and effective mitigation and abatement projects
- A facility to manage planned and achieved decarbonisation actions in aggregate and in isolation
- A facility to feedback actual project impact and situate within the broader CO2 account

1.7 In this form, the Performance Management Framework adopts the 'Measure-Manage-Govern' convention set out in literature from leading authorities on the subject of decarbonisation[2].

1.8 Ultimately, the Performance Management Function is anchored by pursuit of the GM carbon reduction target of a 48% reduction in CO2 by 2020 measured against a 1990 baseline (equal to a 40.23% reduction in CO2 by 2020 measured against a 2005 baseline).

1.9 In this pursuit, the fundamental role of the Framework is to support identification, plotting, and execution of an effective mitigation and abatement project pipeline able to meet the target ambition.

[2] e.g. www.ghgprotocol.org

2 Establishing the Challenge

2.1 The purpose of Lot 1c is to deliver a platform supporting the identification and implementation of a decarbonisation programme across GM.

2.2 To this end, a solid understanding of the required effort and structure of that decarbonisation programme is required.

2.3 An insight into the extent and structure of the decarbonisation is provided by:

- Prevailing CO2 reduction targets
- Broader UK decarbonisation programme

2.4 The two are outlined in turn:

Targets

2.5 The UK decarbonisation target for the 1990-2020 period is informed by analysis from the Committee on Climate Change (CCC). Two targets were proposed:

- Interim Budget: requires an emissions reduction of 34% in 2020 relative to 1990 levels (21% relative to 2005); an annual average emissions reduction of 1.7%.
- Intended Budget: requires an emissions reduction of 42% in 2020 relative to 1990 (31% relative to 2005); an annual average emissions reduction of 2.6%.

2.6 The Interim Budget was legislated in Summer 2009. The Intended Budget would apply following a global deal on climate change.

2.7 In GM, a tighter decarbonisation target has been adopted by the Greater Manchester Combined Authority in August 2011[3].

2.8 The target requires an emissions reduction of 48% in 2020 relative to 1990 levels. Based on the assumption that GM emissions reduced by 13% in the 1990-2005 period[4], the target translates to 40.23% relative to 2005.

2.9 A comparison between GM and UK targets is outlined below:

[3] GMCA. 2011. Greater Manchester Climate Change Strategy: Report of Chief Executive, Oldham MBC'. 29th July 2011. www.agma.gov.uk/cms_media/files/9_g_m_climate_change_strategy.pdf

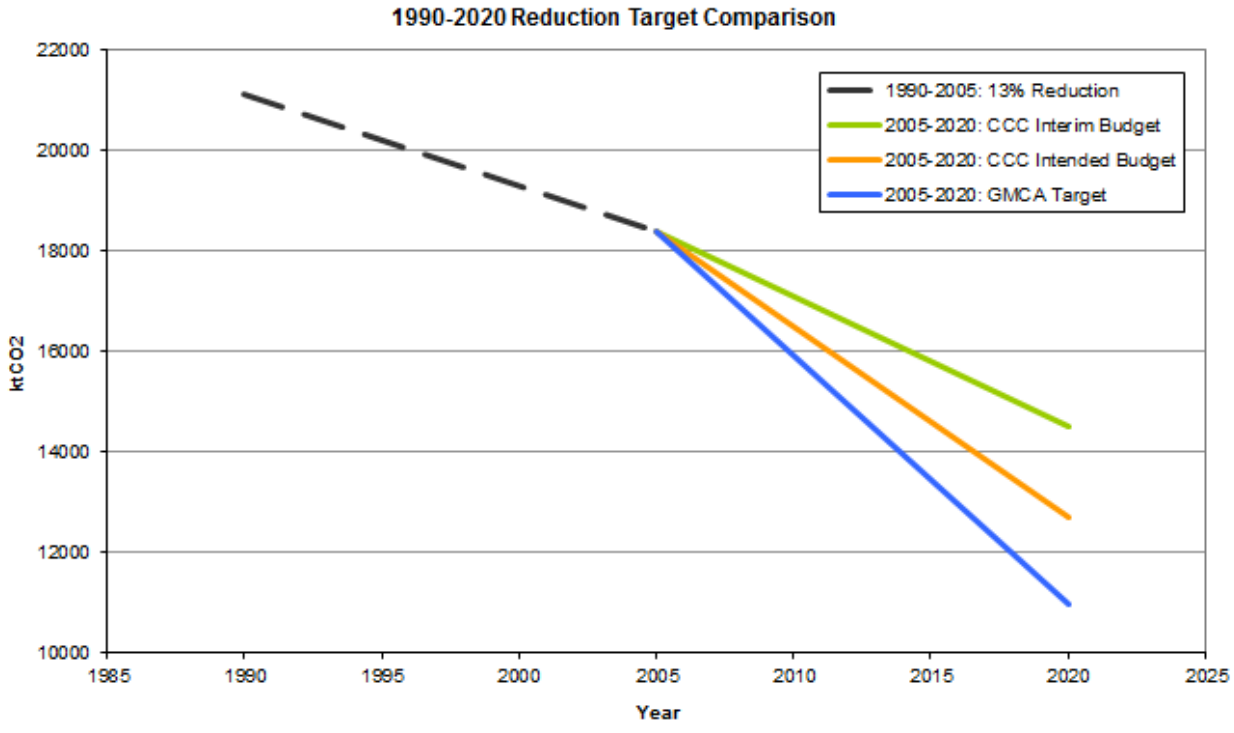
[4] AEA. 2009. '4NW Energy and Greenhouse Gas Emissions study update 2005'. www.climatechangenorthwest.co.uk/assets/_files/documents/oct_09/cli_1256232878_4NW_Final_Issue3.2.pdf

Table 1 – GM 1990-2020 Targeted CO2 Reduction Pathway:

Year	Description	Total CO2 (ktCO2)
1990	Estimate of 1990 back-casted from 2005 assuming 13% reduction in the 1990-2005 period	21,136.24
2005	'Actual' figure for GM published by DECC	18,388.53
2020	CCC Interim Budget 21% reduction (2005-2020) applied to GM	14,526.94
2020	CCC Intended Budget 31% reduction (2005-2020) applied to GM	12,688.09
2020	GM 48% reduction (1990-2020)	10,990.82

2.10 The GM target represents an additional 3,536.12ktCO2 reduction required on the CCC Interim Budget and an additional 1,697.27ktCO2 reduction required on the CCC Intended Budget.

Chart 1 – GM 1990-2020 Targeted CO2 Reduction Pathway:



2.11 The GM target can be situated within the existing decarbonisation programme in place at UK level; articulated within literature such as the Low Carbon Transition Plan.

1990-2005

2.12 In pursuit of the 48% target, the assumed progress over 1990-2005 is critical.

2.13 This work assumes an achieved reduction in GM of 13% over the 1990-2005 period. This assumption derives from AEA and the NW Greenhouse Gas Inventory project[5].

2.14 It is important to acknowledge that, as analysis improves, revision of past data is routine in the field of emissions data. This section will simply identify alternative perspectives of GM 1990-2005 decarbonisation in order to provide a resource for the development of GM carbon accounting.

2.15 Two alternatives are apparent:

- Assumptions made in the CCC's setting of Interim and Intended Budgets
- Back-casted estimates presented by the GM Forecast Model

2.16 The CCC Intended and Interim Budgets each present equivalent 1990 and 2005 reductions from which a 1990-2005 reduction figure can be resolved. The figures return a 1990-2005 reduction of 16%.

2.17 The GMFM presents an estimate for 1990 of 28,666.51ktCO2. Under this circumstance, the reduction for 1990-2005 would be 36%.

2.18 The implications are summarised in the following:

Table 2 – Implications of Alternative 1990-2005 Decarbonisation Estimates:

Year	Current (13%)	CCC (16%)	GMFM (36%)
1990	21,136.24	21891.11	28,666.51
2005	18,388.53	18,388.53	18,388.53
2020	10,990.82	11383.38	14906.59
Required Saving 2005-2020	7,397.71	7,005.15	3,481.94

2.19 The GM Metrics Steering Group must consider if and how revision to the 1990-2005 assumption may be made.

[5] http://www.climatechangenorthwest.co.uk/key-facts.html

UK Reduction Programme

2.20 An insight into the potential impact of the UK programme provides some understanding of the additional effort required at GM level.

2.21 Measures deployed in response to the CCC Interim Budget challenge of 34% reduction on 1990 by 2020 are packaged within the UK Low Carbon Transition Plan (LCTP)[6]. In 2011, the central role of the LCTP endures in Coalition policy in the form of the Carbon Plan[7].

2.22 The existing policy programme is captured by the CCC within the 'Current Ambition' scenario for the 2008-2020 period. The Current Ambition can be recast at GM level as follows:

Table 3 – Potential Impact of 'CCC 'Current Ambition 'in GM:

	Current Ambition: Savings in 2020 on 2008 (MtCO2)	
Sector	UK	GM
Power	51	2.09
Residential	13	0.53
Non-Residential	10	0.30
Transport	5	0.18
Total	79	3.09

2.23 A breakdown of the CCC package is provided in Appendix A.

2.24 Overall, the CCC Current Ambition recast to GM level presents a saving of 3,094.8ktCO2 from the annual account in 2020 (working from a 2008 baseline).

2.25 The 3,094.8ktCO2 figure represents the estimated impact of the existing UK policy package as interpreted by the CCC Current Ambition. This figure is validated by its close alignment with the 3,075.94ktCO2 figure implicated by the CCC Interim Budget (adjusted to work from a 2008 baseline).

2.26 The estimation of impact from the UK policy package in GM can be contrasted with the GM 48% target.

[6] DECC. 2009. 'Low Carbon Transition Plan'. www.decc.gov.uk/en/content/cms/tackling/carbon_plan/lctp/lctp.aspx
[7] DECC. 2011. 'Carbon Plan'. www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx

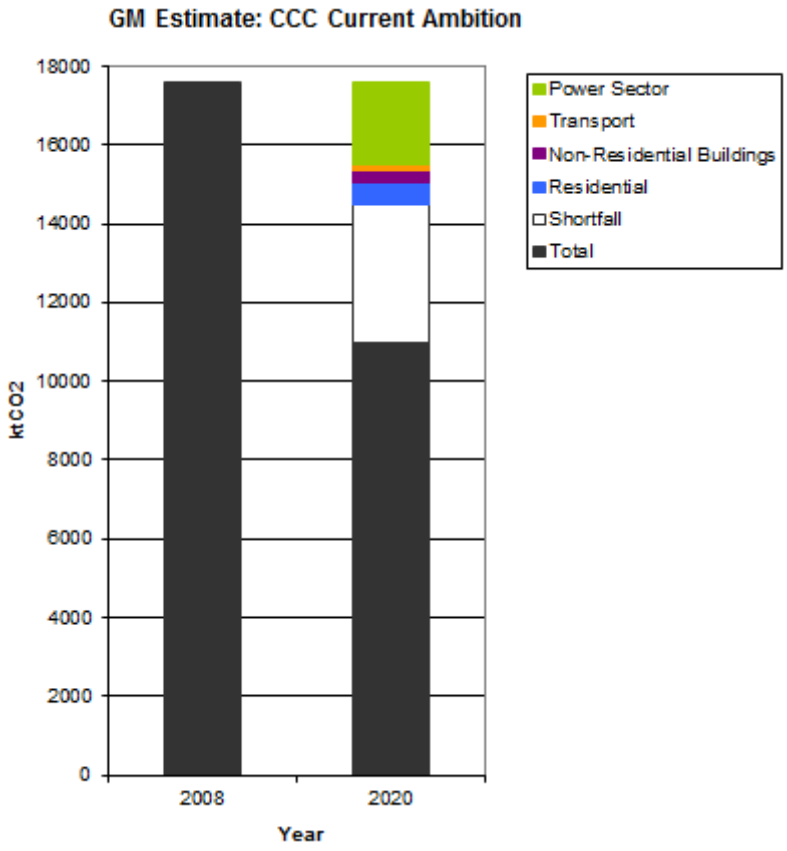
2.27 In 2008, DECC records a figure of 17,602.88ktCO2 for GM. The saving required on this 2008 figure to meet the GM 48% target is 6,612.06ktCO2.

2.28 The simple conclusion is that, with the UK policy programme delivering a saving of 3,094.8ktCO2 in the 2020 account, a further 3,517.26ktCO2 of annual savings on 2008 levels are required in 2020.

2.29 This assessment is made before the emissions increases associated with economic growth and population incline are factored in.

2.30 The Current Ambition and resulting shortfall 'shortfall' in GM is summarised in the following graph:

Chart 2 – CCC Current Ambition estimated impact at GM Level:



2.31 The results illustrate the significant upscaling of the decarbonisation effort, beyond the limits of the National policy programme, required.

Extended and Stretch Scenarios:

2.32 In complement to their Current Ambition, the CCC presents two greater Ambitions incorporating enhanced, but feasible, abatement packages for the UK[8].

2.33 The Extended Ambition incorporates policies to which the government and/or EU is committed in principle, but where precise definition and implementation of policy is still required. The Stretch Ambition adds further feasible abatement opportunities for which at the moment no policy commitment is in place[9].

2.34 Recasting the CCC Extended and Stretch Ambitions for GM provides an insight into the potential impact of stiffening resolve in the UK policy package; beyond the current limits of the Interim Budget commitment.

2.35 As with the Current Ambition, the Extended and Stretch Ambitions may be scaled to the GM context:

Table 4 – Potential Impact of 'CCC 'Extended Ambition' in GM:

	Savings in 2020 on 2008 (MtCO2)			
	Extended Ambition		Stretch Ambition	
Sector	UK	GM	UK	GM
Power	51	2.09	51	2.09
Residential	29	1.18	32	1.3
Non-Residential	17	0.51	17	0.51
Transport	23	0.81	30	1.05
Total	120	4.59	130	4.95

2.36 A breakdown of the CCC package is provided in Appendix A.

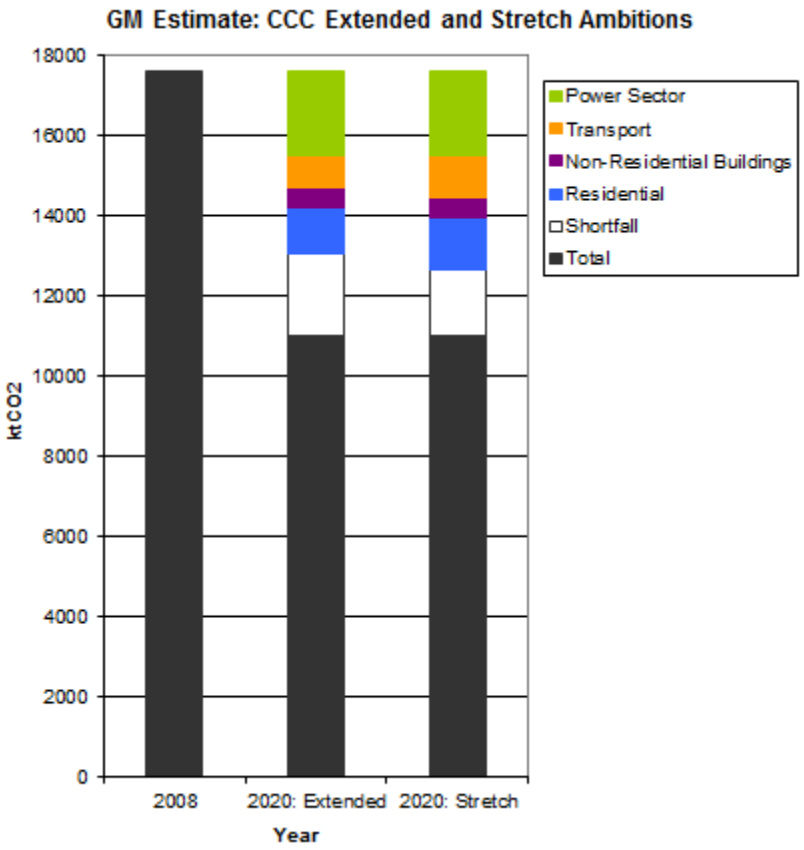
2.37 In this assessment, the Extended Ambition delivers a 4,585.1ktCO2 saving in 2020 on 2008; requiring an additional 2,026.96ktCO2 reduction effort to reach the 2020 target.

2.38 In contrast, the Stretch Ambition delivers a 4,951.9ktCO2 saving in 2020 on 2008; requiring an additional 1,660.16ktCO2 reduction effort to reach the 2020 target.

2.39 The potential function of the Ambitions in GM is summarised in the following:

[8] CCC. 'Scenarios to Meet Budgets'. www.theccc.org.uk/carbon-budgets/scenarios-to-meet-budgets
[9] CCC. 2008. 'Building a low-carbon economy'. www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

Chart 3 – CCC Extended and Stretch Ambitions estimated impact at GM Level:

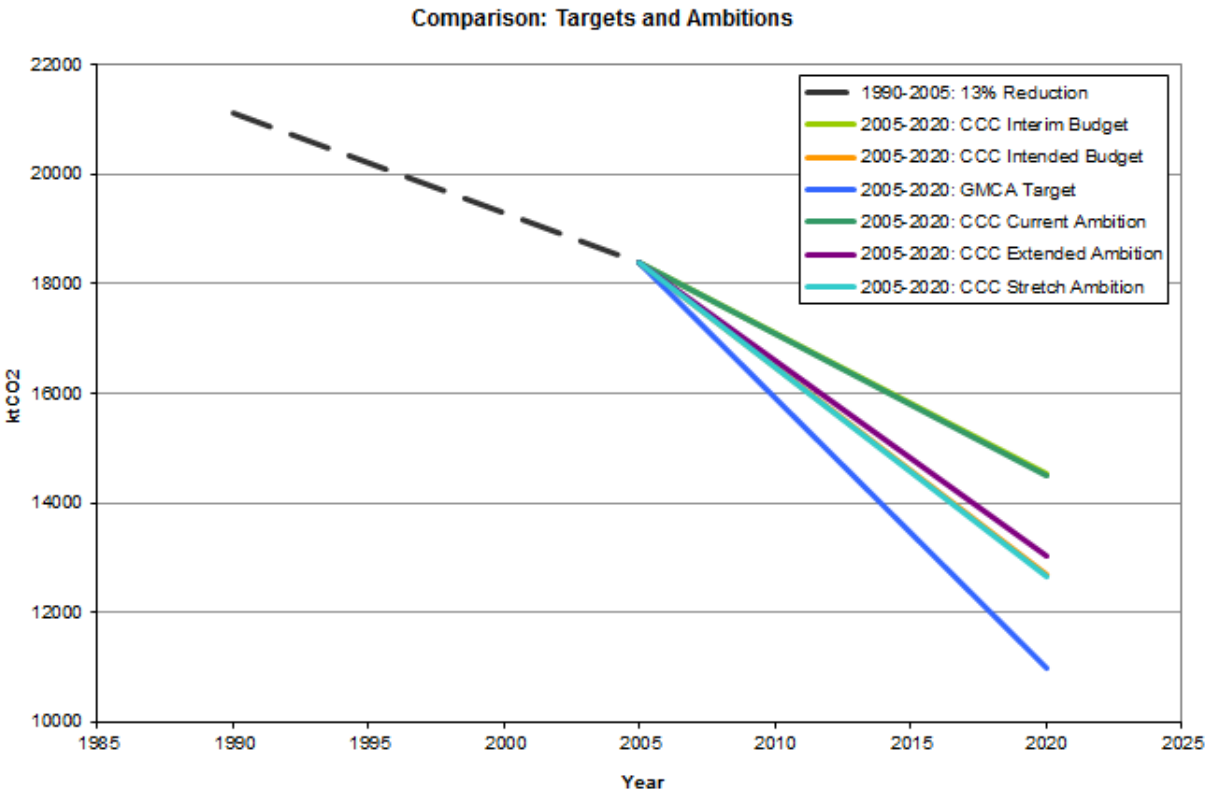


2.40 The graphs confirm that the GM target is not met as a consequence of the project packages of Extended or Stretch Ambitions; in each CCC Ambition, significant 'shortfalls' endure.

2.41 Therefore, the abatement strategy deployed in GM must add savings to the national programme. In order to do so, the definition of feasibility employed by the CCC when assembling the Ambition abatement packages may require modification.

2.42 In summary, the overall picture of Targets and Ambitions scaled to GM can be illustrated:

Chart 4 – Comparison of GM Targets with GM Estimates of CCC Targets and Ambitions:



2.43 In this simple presentation, the Current Ambition and the Interim Budget align, as do the Stretch Ambition and the Intended Budget; illustrating their relationship in CCC methodologies.

2.44 It must be recognised that this projection precedes inclusion of a counter assessment of emissions increases over the 2005-2020 period; derived from economic or population growth.

2.45 Overall, this simple analysis illustrates a significant additional effort required by GM in light of the 48% target. This effort includes both a need to maximise the benefit drawn through the UK abatement package and supplement that abatement package with novel reduction projects.

2.46 Future sections must consider the form of the required GM abatement package; engaging with projects and their potential within GM at a deeper level than the illustrative breakdowns prepared here.

Summary

2.47 This section seeks to articulate the decarbonisation challenge for GM. Two core dimensions are discussed:

2.48 The 48% reduction in 2020 on 1990 headline target established by GMCA implicates a removal of 7397.71ktCO2 from the annual account by 2020 (judged against a 2005 baseline).

2.49 This challenge is situated within a landscape of reduction Ambitions developed by the CCC on the basis of policy in place and potential feasible additions to the abatement effort. Recast at GM level, the Ambitions reveal significant additional effort required by GM stakeholders.

2.50 The impact of existing policy measures in place, summarised in the LCTP, suggest an additional 3,517.26ktCO2 savings required by 2020. Enhanced feasible Ambitions not yet in the UK policy package indicate an additional effort of between 1,660.16-2,026.96ktCO2 depending on the Ambition concerned.

2.51 This simple assessment illustrates the need to maximise capture and extend the impact of the UK decarbonisation programme by GM stakeholders. In considering the extension of effort, the feasibility of abatement projects as judged by the CCC in their Ambitions may need to be redefined.

3 Monitoring Performance

3.1 An effective decarbonisation programme depends on a robust data platform serving baselining and feedback.

3.2 Preceding Lots have explored the available metrics resource at length. Two dimensions have been covered:

- Metrics concerning the 'Direct' CO2 profile of AGMA Authorities (Lot 1a)
- Metrics concerning the 'Direct' CO2 profile of GM Area (Lot 1b)

3.3 Respective reporting explores the practicality and utility of metrics resources with the aid of AGMA stakeholders. In conclusion, a primary metrics set has been isolated for use in the performance management framework of Lot 1c; now and in the future.

3.4 In summary, the primary metrics set consists of:

Element	Data
Annual segmented CO2 profile of the GM area (immediate use).	Adoption of the DECC: Local and Regional CO2 Emissions Estimates for 2005-2009 (AEA) resource.
Annually updated, segmented CO2 profile of the GM area (future use).	Adaptation of the TfGM: Atmospheric Emissions Inventory for Greater Manchester (EMIGMA) resource.
Baseline Scope 1 + 2 organisational CO2 profile for the AGMA group.	Adoption and restructure of the DECC: NI185 – CO2 emissions from local authorities' operations during financial year 2008/09 resource.
Annual Scope 1 + 2 organisational CO2 profiles for the AGMA group.	Facilitation of a new AGMA: Reporting of Scope 1 + 2 organisational CO2 profiles resource through development of a bespoke Calculator Tool in Lot 1a.

3.5 A process of data-mapping has characterised a broader secondary metrics resource with an essential role in the facilitating the design and evaluation of interventions at a more granular scale.

3.6 Please refer to Lot 1a and Lot 1b reports for the full discussion of the search, selection, and development process behind metrics mapping.

3.7 The application of each metrics component is outlined within respective tools; please refer to Section 6 for the outline.

3.8 This section will provide an overview assessment of what the metrics reveal about performance to date.

CO2 Profile: GM Geography

3.9 The DECC and EMIGMA data resources present two complementary perspectives on CO2 profile of GM.

3.10 The DECC data resource provides a perspective derived from centrally developed information that may be framed 'top-down'. In contrast, the EMIGMA data resource provides a perspective derived from locally derived information that may be framed 'bottom-up'.

3.11 Lot 1b has recommended that DECC and EMIGMA data resources inform the GM decarbonisation programme.

3.12 Currently, the Lot 1c performance management framework utilises a DECC data platform; with annual performance validated against the EMIGMA perspective.

3.13 The following section will explore necessary steps in realising an ambition to shift to an EMIGMA data platform.

3.14 Available data from the DECC and EMIGMA resources are summarised in the table below. It is important to note that the selection dataset impacts the 1990 estimate and 2020 target with implications for the decarbonisation programme.

Table 5 – Headline GM CO2 Totals:

		GM CO2 Total (ktCO2)					
	1990[10]	2005	2006	2007	2008	2009	2020[11]
DECC CO2	21,136	18,389	18,397	17,836	17,603	15,902	10991
EMIGMA CO2	22,789	19,827	18,166	-	-	-	11850

3.15 The modular structure of DECC CO2 and EMIGMA CO2 datasets is presented in Appendix B alongside the 2005 data.

3.16 Analysis of the DECC data resource is facilitated by the Lot 1c 'LA Tool'.

[10] Estimated based on the assumption that a 13% reduction has been achieved in the 1990-2005 period
[11] 2020 Target calculated as a 40.23% reduction on the 2005 figure

3.17 The data reveals that the annual GM CO2 account is dominated by three activities; Energy Use: Industrial/Commercial, Energy Use: Domestic, Fuel Use: Transport (listed highest to lowest contribution).

3.18 Both DECC and EMIGMA indicate a reduction trend across the 2005-2008 period. The basis for this decarbonisation is considered to reflect the interplay between early decarbonisation efforts and economic downturn.

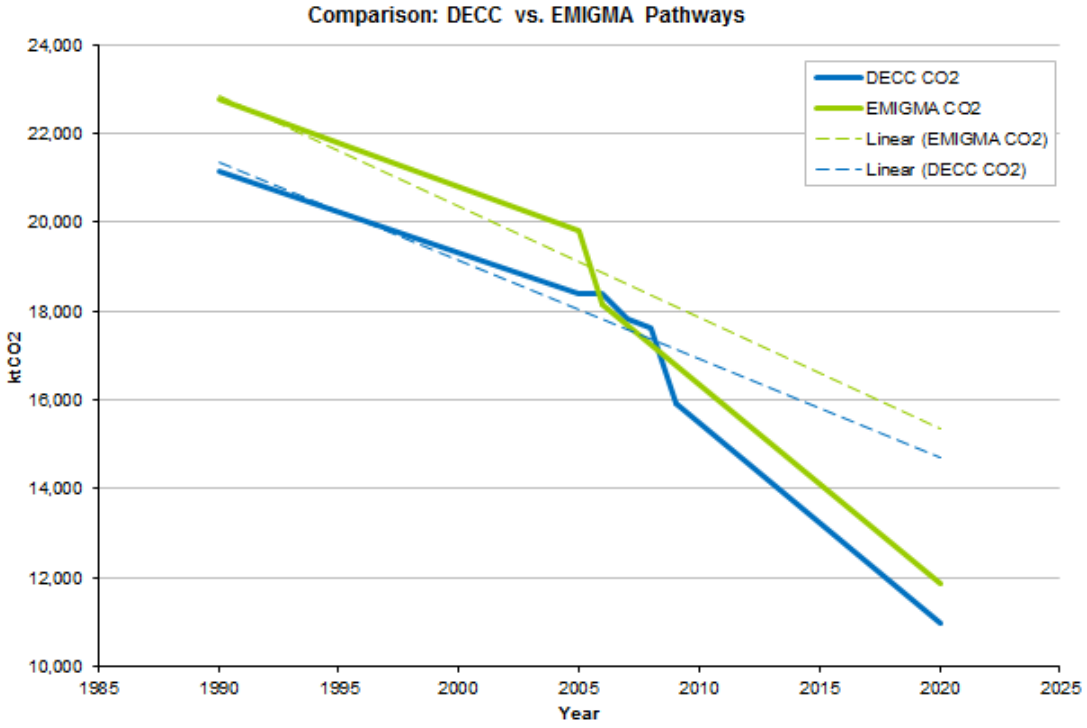
3.19 However, there is disagreement over 2005-2006; EMIGMA recording a 10% reduction and DECC recording essentially no change (9ktCO2 increase).

3.20 Differences in results reflect differences in methodology. The resolution of a 'correct answer' is not sought; each approach is valid and the contrast bolsters understanding.

3.21 The central consideration in proposing a shift from a DECC data platform to an EMIGMA data platform is: 'which dataset best serves the GM decarbonisation effort, and features the necessary reliability'? In this sense, 'reliability' is considered to be an amalgam of consistency, regular update, responsiveness to intervention, maximum primary data, minimum modelled data.

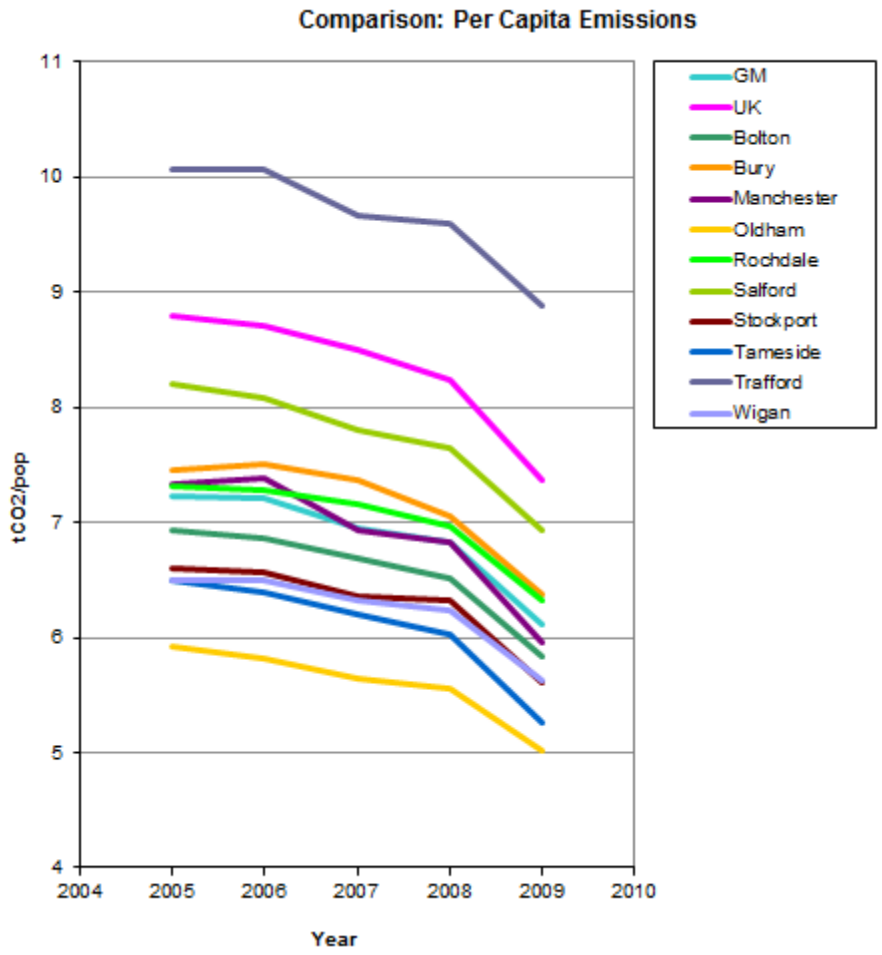
3.22 The dual perspective is summarised below; trendlines for the 1990-2006/8 are cast to demonstrate the step change required by the 48% 2020 target.

Chart 5 – Plot of GM CO2 Totals (1990-2020):



3.23 Care is required when comparing relative performance across geographic boundaries as differences in context dictate different outcomes. One insight into the relative performance of AGMA areas is provided by an assessment of tonnes of CO2 per capita:

Chart 6 – Per Capita Emissions for AGMA, GM, and UK (2005-2008):



3.24 Such presentations reveal that peak emitters in terms of total CO2 tonnage emitted per annum (in ktCO2) are not necessarily the greatest emitters per head of area population (in tCO2/capita). For example, Wigan is ranked at the 4th highest AGMA emitter with the 3rd lowest emission per head of population.

3.25 Furthermore, comparison of the tCO2/capita metric reveals GM and constituent AGMA areas all lie beneath the UK average with the exception of Trafford.

3.26 The Lot 1c 'Performance Tool' and 'LA Tool' support further exploration.

3.27 Currently, the DECC CO2 dataset is applied as the sole data platform for the Lot 1c performance management framework. This reflects the relative stability in the DECC reporting cycle for the 2005-2011 period when compared to the EMIGMA alternative.

3.28 The EMIGMA data resource does not yet exist in a requisite form; the next section will outline a potential programme for transition to the EMIGMA data platform.

EMIGMA Transition

3.29 Transition to an EMIGMA data platform is desirable in the sense that it represents a shift to a data resource specifically tuned to GM. Foreseen benefits include removal of inaccuracies associated with assumptions made in the centrally estimated datasets.

3.30 The transition may take two forms:

i. Adoption of the complete structure and content of the EMIGMA data resource.

ii. Creation of a hybrid between the EMIGMA and DECC data resources; replacing centrally modelled modules with locally derived alternatives. The validity of this approach is indicated in the NW Greenhouse Gas Inventory[12].

3.31 Pros and cons follow each form. A significant issue is the comparability of the scope and boundaries employed in DECC and EMIGMA. Option 1 represents a move to a bespoke scope and boundary, removing elements such as LULUCF from the picture, Option 2 represents an effort to abide by the DECC convention.

3.32 Irrespective of the option taken, three EMIGMA components stand apart as desirable to integrate within the CO2 data platform:

- Road emission data developed with the SATURN model
- Industrial point-source emission data drawn from Part A1/2 and B permits
- Rail emission data developed via GM timetable and capacity information

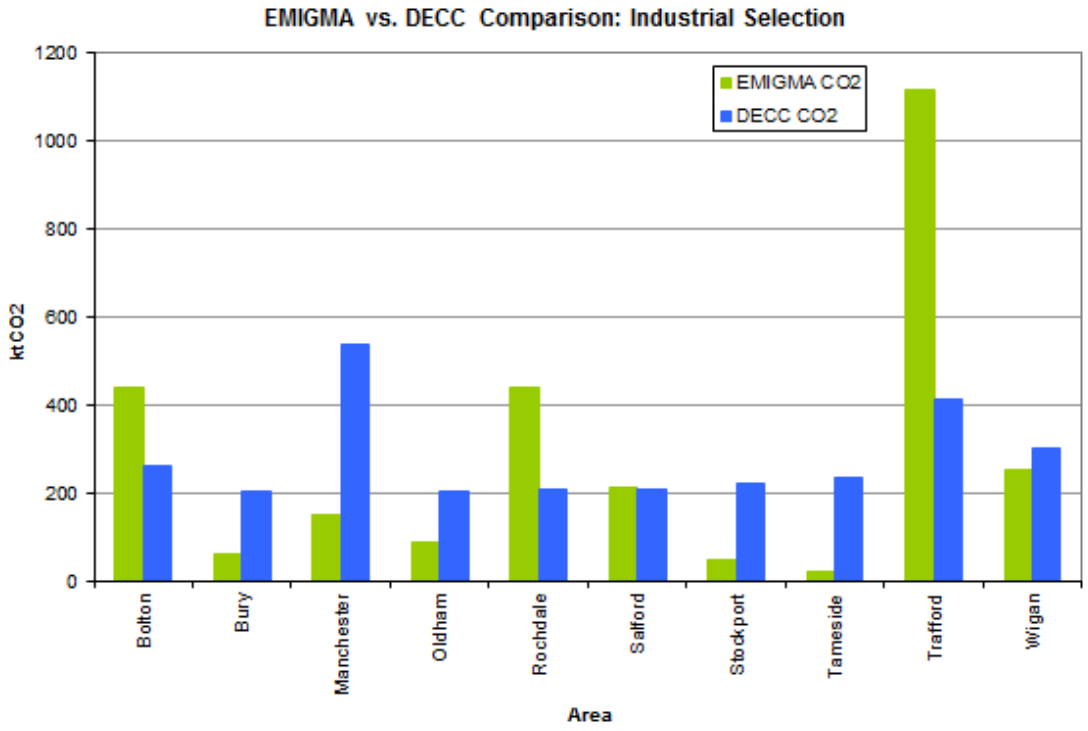
3.33 Lot 1b initiated development of hybrids of these EMIGMA components and the DECC data resource. Further development would be required to finesse overlaps between modules if such hybrids were to be deployed. However, they stand as useful illustrations.

3.34 One signal emerging from these probes is the potentially asymmetric impact of a transition from a DECC data platform to an EMIGMA data platform. Isolation and

[12] AEA. 2009. '4NW Energy and Greenhouse Gas Emissions study update 2005'. www.climatechangenorthwest.co.uk/assets/_files/documents/oct_09/cli_1256232878_4NW_Final_Issue3.2.pdf

comparison of industrial emission modules from each data resource suggests Trafford amongst others would face a significant change in their CO2 profile.

Chart 7 – EMIGMA vs. DECC Comparison (Industrial Selection)[13]:



3.35 The relative contribution and ranking of areas is the focal issue of this presentation; the magnitude is not comparable in this case.

3.36 The comparison suggests changes in the relative contribution brought by EMIGMA point source emission data (Part A1/2 and B Environmental Permits). The point is further apparent when areas are ranked in ascending order for each data resource.

Table 6 – Area Ranking in Ascending Order:

ktCO2			
EMIGMA CO2 2005		DECC CO2 2005	
Tameside	1251.44	Oldham	1289.29
Oldham	1259.82	Bury	1351.51
Bury	1529.78	Tameside	1384.73
Stockport	1727.59	Rochdale	1496.97

[13] Specifically, DECC Modules B, C, and D vs. EMIGMA Part A, Part B, and Boilers

Rochdale	1804.62	Salford	1801.46
Salford	1862.40	Bolton	1822.46
Wigan	2000.98	Stockport	1864.45
Bolton	2040.71	Wigan	1970.25
Trafford	3105.62	Trafford	2130.79
Manchester	3243.86	Manchester	3276.62

3.37 As such, transition to EMIGMA carries a burden weighted differently towards different areas of GM for which mitigation may be required. Potential mitigation is possible in the counter-balancing of targets across the AGMA group.

3.38 A schedule supporting transition to the EMIGMA data platform would require the following steps to be taken:

- Agreement on the asymmetric impact brought to some areas through the transition from a DECC data platform
- Establish necessary rebalancing of the 2020 target to ameliorate asymmetrical impact
- Establish resource demand and viability of annual EMIGMA updates 2008-2020
- Select the EMIGMA or Hybrid option:
  - → The Hybrid will require development and adoption for new reporting format within the EMIGMA cycle; integrating DECC CO2 data modules
  - → Selection of EMIGMA as a whole must recognise the implicated divergence from the DECC scope and boundary
- Confirm the EMIGMA methodology to be applied; data gathering, analysis, and reporting
- Assess impact on the required decarbonisation effort and align additional resource
- Schedule transition and adoption timetable across AGMA
- Modify performance management tools

3.39 The critical technical issue with regards to transition is to guarantee consistent annual reporting without rick of collapse in the data platform. If the data platform falls in the 2008-2020 period, the decarbonisation programme is strongly challenged.

3.40 Under the current situation, the DECC data platform underpins Lot 1c outputs and its perpetuation as a backstop measure post-transition is recommended.

CO2 Profile: AGMA Authorities

3.41 Lot 1a identified the NI185 2008/09[14] dataset to best serve as the baseline data record for CO2 emissions from AGMA operations and estates.

3.42 The NI185 reporting mandate has since been replaced by a request from DECC for Local Authorities to report operations and estate CO2 in accordance with the 3-Scope standard[15].

3.43 The request prompts Local Authorities to publish follow-up reports for 2009/10 and 2010/11.

3.44 In response, Lot 1a established a protocol for the restructuring of the NI185 2008/09 record to abide by the 3-Scope convention and built a Calculator Tool for subsequent recording, calculation, and reporting of operations and estate CO2.

3.45 The 2008/09 baseline reveals the AGMA operation and estate accounts for 5.7% of the English Local Authority CO2 output.

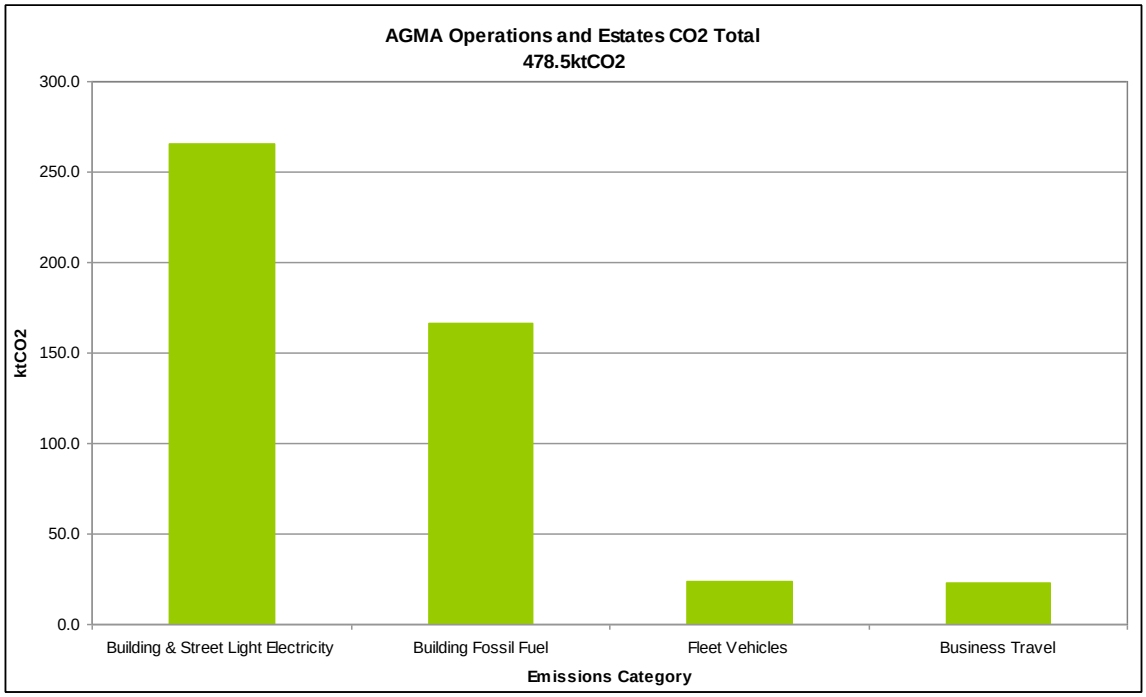
Table 7 – 2008/09 LA Operations and Estate Co2 Overview:

	ktCO2		
	Building And Street Lighting	Transport	Total
England	7,294.3	1,038.6	8,332.9
AGMA	432.0	46.5	478.5
AGMA as % of England	5.9	4.5	5.7

[14] NI185: CO2 emissions from local authorities' operations during financial year 2008/09
[15] DECC. 2011. 'Sharing information on greenhouse gas emissions from local authority own estate and operations (the successor to National Indicator 185)'. www.decc.gov.uk/en/content/cms/statistics/indicators/ni185/ni185.aspx

3.46 The dominant portion of Authority CO2 output is energy use within buildings and stationary infrastructure. Electricity associated with buildings and street lights is the single largest component.

Chart 8 – Breakdown of AGMA Operations and Estate CO2 (2008/09):

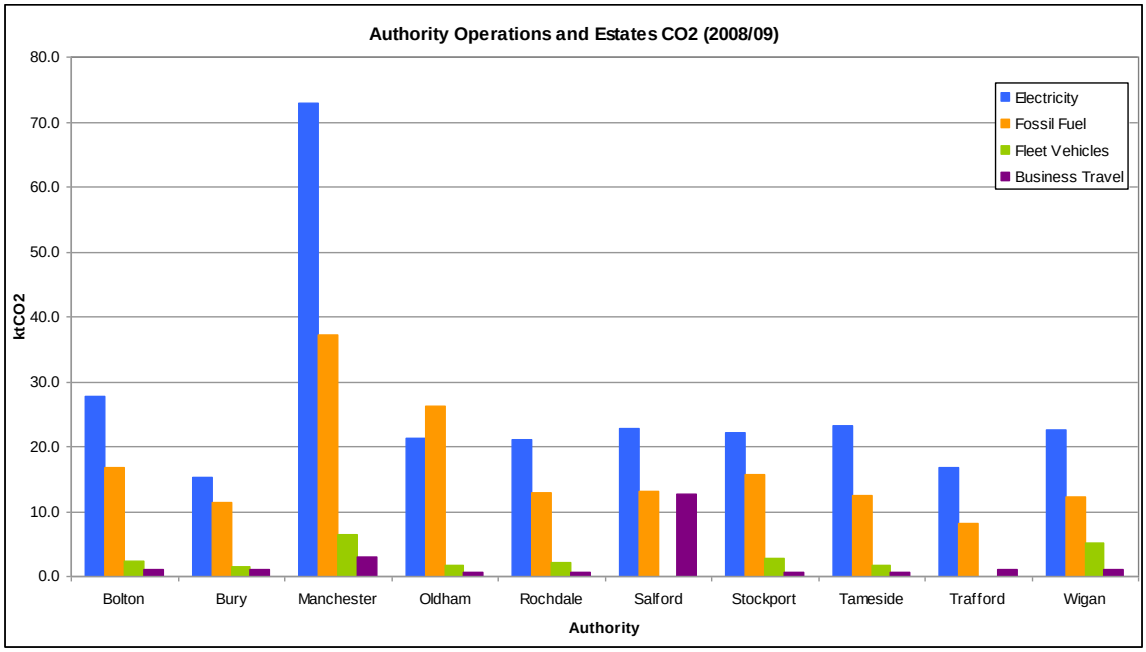


3.47 The 2008/09 data record does not allow electricity components to be broken down further. The Lot 1a Calculator Tool features capability to segment the operations and estate Co2 report to a deeper level of granularity.

3.48 The 2008/09 record supports comparison across the AGMA group. The AGMA group largely adopt a pattern in which Electricity represents the greatest proportion of the CO2 total, followed by Fossil Fuel, Fleet Fuel, and Business Transport Fuel (in that order).

3.49 Exceptions to the rule include Oldham; the only Authority to post a Fossil Fuel component greater than its Electricity component. In addition, Salford demonstrates potential for variation in the designation of Fleet and Business Transport.

Chart 9 – Authority Operations and Estate CO2 Breakdown (2008/09):



3.50 The validity of comparison between absolute CO2 tonnages for organisations of such substantial variety of form and context is limited. A Lot 1c 'LA Operations and Estate CO2 Tool' supports other means of comparison.

Table 8 – CO2 Operations and Estate Components as a % of Authority Totals (2008/09):

	% of Each Authority Total			
Authority	Electricity	Fossil Fuel	Fleet Fuel	Business Transport Fuel
Bolton	57.67	35.11	5.03	2.18
Bury	52.16	39.09	5.05	3.70
Manchester	61.06	31.08	5.36	2.49
Oldham	42.62	52.55	3.36	1.47
Rochdale	57.41	34.95	5.79	1.85
Salford	46.99	26.92	0.00	26.09
Stockport	53.52	38.14	6.73	1.61
Tameside	61.00	32.75	4.38	1.87
Trafford	64.04	31.50	0.00	4.46
Wigan	54.94	29.91	12.70	2.45

3.51 Analysis of proportions within each Authority record confirms a high level of consistency across the group. Outliers are apparent in the higher Fossil Fuel proportion of Oldham, the higher Fleet Fuel proportion of Wigan, and the higher Business Transport Fuel of Salford.

3.52 No firm conclusions can yet be made with regards to the performance of the AGMA group with regards to decarbonisation of their operations and estate due to the fragmentary and incomplete nature of CO2 records post-2008.

3.53 The Lot 1c 'LA Operations and Estate CO2 Tool', in tandem with the Lot 1a 'Calculator Tool' establishes a capability to track performance as data is published.

3.54 Clarification of the decarbonisation target with regards to Authority operations and estate CO2 will be critical to the judgement of performance. Assuming AGMA will lead pursuit of the 48% 2020 target, a target trajectory may be calculated.

3.55 The 40.23% reduction in 2020 on 2005 level translates to a 35% reduction in 2020 on 2008 levels, assuming a 'straight line' trajectory over the 2005-2020 period. On this basis, reduction pathways may be calculated for each AGMA Authority.

Table 9 – Calculation of 35% 2008-2020 Reduction Targets for AGMA Authorities:

	ktCO2									
Year	Bolton	Bury	Manchester	Oldham	Rochdale	Salford	Stockport	Tameside	Trafford	Wigan
2008	47.93	29.19	119.37	50.03	36.84	48.62	41.29	38.17	26.05	40.99
2009	46.53	28.34	115.89	48.57	35.76	47.21	40.09	37.06	25.29	39.80
2010	45.13	27.49	112.41	47.11	34.69	45.79	38.88	35.95	24.54	38.60
2011	43.73	26.64	108.92	45.65	33.62	44.37	37.68	34.83	23.78	37.41
2012	42.34	25.79	105.44	44.19	32.54	42.95	36.48	33.72	23.02	36.21
2013	40.94	24.93	101.96	42.73	31.47	41.53	35.27	32.61	22.26	35.02
2014	39.54	24.08	98.48	41.28	30.39	40.12	34.07	31.49	21.50	33.82
2015	38.14	23.23	95.00	39.82	29.32	38.70	32.86	30.38	20.74	32.62
2016	36.74	22.38	91.52	38.36	28.24	37.28	31.66	29.27	19.98	31.43
2017	35.35	21.53	88.03	36.90	27.17	35.86	30.45	28.15	19.22	30.23
2018	33.95	20.68	84.55	35.44	26.09	34.44	29.25	27.04	18.46	29.04

2019	32.55	19.83	81.07	33.98	25.02	33.02	28.04	25.93	17.70	27.84
2020	31.15	18.97	77.59	32.52	23.95	31.61	26.84	24.81	16.94	26.65

3.56 These pathways are tentatively included within the Lot 1c performance management framework. However, targets for the AGMA operations and estate projecting to 2020 require discussion and confirmation.

Summary

3.57 This section sets a data foundation and develops a toolset for performance monitoring. Available data from the DECC and EMIGMA resources are summarised:

Table 5 – Headline GM CO2 Totals:

		GM CO2 Total (ktCO2)					
	1990[16]	2005	2006	2007	2008	2009	2020[17]
DECC CO2	21,136	18,389	18,397	17,836	17,603	15,902	10991
EMIGMA CO2	22,789	19,827	18,166	-	-	-	11850

3.58 The DECC CO2 data platform will be utilised in expectation that the EMIGMA data platform will be developed such that a transition can be made.

3.59 Whilst transition to the EMIGMA data platform presents an advance in the use of locally derived metrics, an impact on the weighting of the GM CO2 account across AGMA areas is expected.

3.60 The Lot 1c 'Performance Tool' and 'LA Tool' support exploration of CO2 performance by GM and AGMA.

3.61 Valid comparison across UK, GM, and AGMA areas is supported by the tCO2/capita metric which reveals that peak emitters in terms of total CO2 tonnage emitted per annum (in ktCO2) are not necessarily the greatest emitters per head of area population.

3.62 Furthermore, comparison of the tCO2/capita metric reveals GM and constituent AGMA areas all lie beneath the UK average with the exception of Trafford.

[16] Estimated based on the assumption that a 13% reduction has been achieved in the 1990-2005 period
[17] 2020 Target calculated as a 40.23% reduction on the 2005 figure

4 Structuring a Decarbonisation Programme

4.1 The preceding section outlines the challenge presented to GM by targets articulated at UK and GM level:

- UK Interim Budget: reduction of 21% in 2020 relative to 2005 levels
- GM Target: reduction of 40.23% in 2020 relative to 2005 levels

4.2 A performance monitoring system has been aligned to judge achievement against these targets. The system is built upon core data platforms:

- DECC Local and Regional CO2 resource
- 3-Scope reporting of CO2 from AGMA operations and estate

4.3 Together, these components represent 'Target' and 'Feedback Loop' components of a performance management framework. In order to complete the foundation for structured decarbonisation, a third 'Programme Management' component is required.

4.4 A number of prior works investigate technically and economically feasible decarbonisation programmes specific to GM. This section will consider the value of such resources to structure the 'Programme Management' tool.

Programme Management: Outline

4.5 The Programme Management component will need to support the following efforts:

- Compilation of the scheduled project pipeline and its expected impact
- Compilation of the actual impact of the project pipeline
- Appraisal and selection of potential decarbonisation actions
- Design of potentially effective decarbonisation actions
- Evaluation of impact of individual deployed decarbonisation actions

4.6 Preceding work in GM provides a significant advantage in the form of feasible decarbonisation programmes specific to GM that pump-prime the project pipeline. Specifically, the programmes lend structure to the pipeline and direct the project design effort.

4.7 In addition, a fragmentary project roster is in development for application18. The intention is that the contents of this roster will populate the scaffold informed by the integrated decarbonisation programmes.

4.8 It is important to recognise that, although the project pipeline is the core focus, a majority of actions and interventions in GM will have a positive or negative impact on CO2. These components of the annual CO2 account will require incorporation.

Reduction Programme: SEAP

4.9 The July 2010 Sustainable Energy Action Plan (SEAP) sought to define energy priorities for GM. A focal theme of the work was estimation of potential CO2 savings associated with identified feasible energy actions[19].

Table 10 – SEAP 2005-2020 MTP and LCTP Scenario Summaries:

	CO2 Saving in 2020 on 2005	
Family	% of Total	ktCO2
Grid Decarbonisation: Market Transformation Programme (MTP) Projections	8.9	1590.88
Grid Decarbonisation: Low Carbon Transition Plan (LCTP)	22.9	4093.39
Supply: Macro and Community Scale Renewable and Low Carbon Energy Actions	24.92	361.08
Supply: Micro-Generation Actions	2.30	411.13
Transport Actions	3.10	554.13
Demand Reduction Actions in the Residential Sector	10.20	1823.26
Demand Reduction Actions in the Commercial and Services Sector	6.30	1126.13
Demand Reduction Actions in the Industrial Sector	0.60	107.25
Total (MTP Scenario)	33.42	5973.85
Total (LCTP Scenario)	47.42	8476.36

[18] A 'Project Mapping v2' database has been accessed via the GM Carbon Metrics Project steering group that does not yet include CO2 impact estimates for listed projects.
[19] ARUP, Manchester: Knowledge Capital Ltd. 2010. 'Sustainable Energy Action Plan: A report to inform and help shape energy priorities in Greater Manchester'. July 2010

4.10 Two scenarios for UK grid decarbonisation are presented due to uncertainty over pacing of the UK grid decarbonisation programme.

4.11 GM is particularly sensitive to UK grid decarbonisation due to Domestic, Commercial, Industrial, and Infrastructure electricity use. The sensitivity is made apparent in the table below; please note the outcome does not factor in increases to the baseline over the 2005-2020 period.

Table 11 – Comparison of SEAP Scenarios and the GM Reduction Target:

Element	Required Saving in 2020 on 2005 (ktCO2)	Outcome
GM Target	7397.71	-
SEAP LCTP Scenario	8476.36	GM target exceeded by 1078.65ktCO2
SEAP MTP Scenario	5973.85	GM target missed by 1423.86ktCO2

4.12 The SEAP concludes:

> *A slower or less successful decarbonisation of the grid than that suggested in the two scenarios would mean that GM needs to identify additional actions to meet the shortfall*[20]

4.13 Furthermore, on reflection of their recommendation for a minimum target of a 34% reduction in CO2 emissions by 2020 on 2005 levels, the SEAP team call for contingency measures to be built in:

> *The SEAP report recommends that GM should select actions that would achieve more than a 34% reduction to ensure success in meeting this target. This is because it is highly likely that barriers (e.g. funding, influencing behavioural change and politics) will affect the success of some actions*[21]*.*

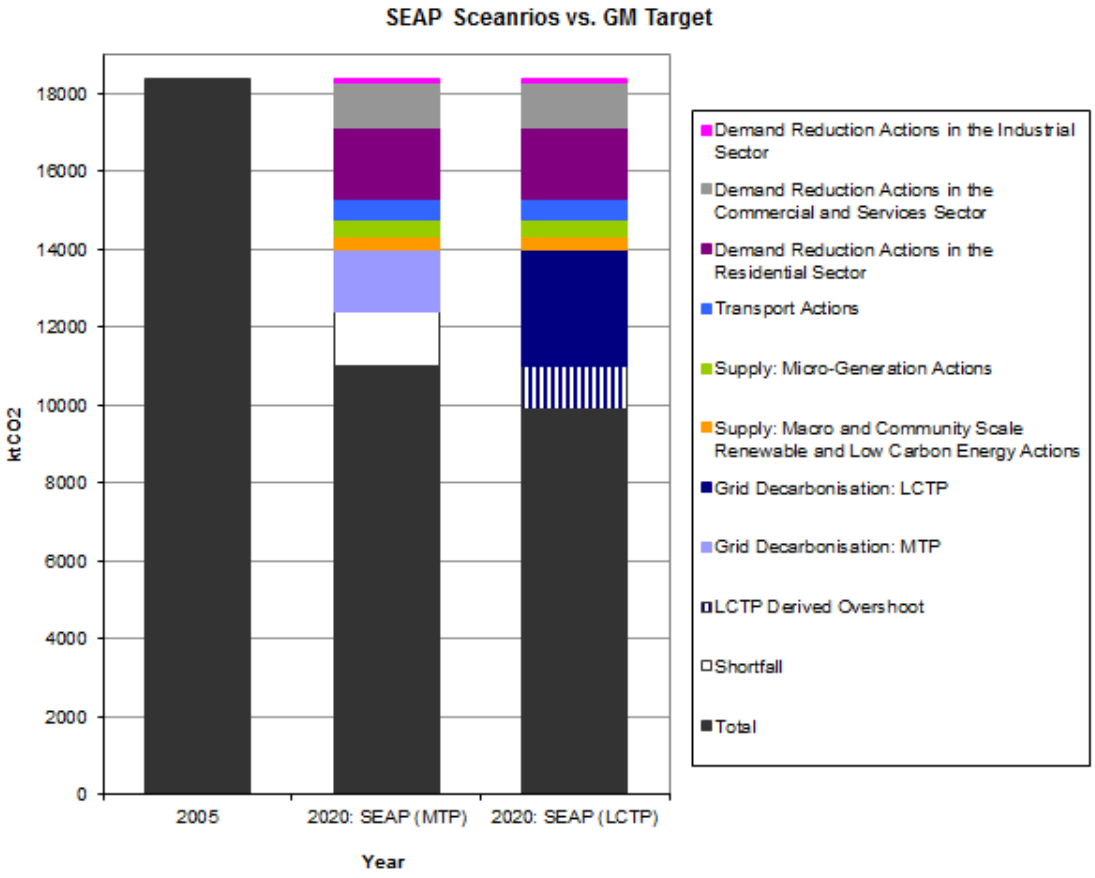
4.14 The implication for the GM decarbonisation programme is twofold.

[20] ARUP, Manchester: Knowledge Capital Ltd. 2010. 'Sustainable Energy Action Plan: A report to inform and help shape energy priorities in Greater Manchester'. July 2010
[21] ARUP, Manchester: Knowledge Capital Ltd. 2010. 'Sustainable Energy Action Plan: A report to inform and help shape energy priorities in Greater Manchester'. July 2010

4.15 First, the search for novel projects and enabling interventions must deliver a body of potential actions able to accommodate slower pacing of UK grid decarbonisation. The necessity of a robust scanning and appraisal process is clear.

4.16 Second, a facility to closely track the pace of UK grid decarbonisation is necessary if interventions are to be deployed efficiently. The necessity of regularly updated 'actual' performance signal within the performance management framework is clear.

Chart 10 – SEAP Scenarios vs. GM Target:



4.17 The SEAP scenarios provide a valuable insight into the shape of a technically feasible package of measures able to meet the challenge of the GM 2020 reduction target.

4.18 As such, the SEAP scenarios are utilised within the Lot 1c Programme Management tool to provide a scaffold supporting compilation of the actual package of enabling actions and interventions.

4.19 SEAP scenarios are outlined in Appendix C.

4.20 In this application the SEAP scenario scaffold is neither a fait accompli nor a directive. The scaffold provides the benefit of early estimations of feasible action to

the compilation of the GM decarbonisation programme and serves as a measuring stick for action.

4.21 Subsequent sections will detail the function of specific Lot 1c tools.

Reduction Programme: Carbon Descent

4.22 Carbon Descent applies the VantagePoint carbon scenario planning tool to compile a feasible decarbonisation programme for GM[22].

4.23 Incorporating economic appraisal and practical feasibility to the estimation of reduction impacts, a decarbonisation scenario for the 2005-2020 period is prepared.

Table 12 – Carbon Descent 2005-2020 Reduction Scenario:

Technology	CO2 Savings in 2020 on 2005 (ktCO2)
Biomass CHP	163
Heat from Large Gas CHP	85
Heat from Gas CHP in Buildings	49
Heat from power stations	208
Domestic PV	40
Non Domestic PV	47
Large Wind	112
Medium Wind	4
Domestic Wind	0
Domestic Solar Thermal	28
Domestic Biomass Boilers	36
Non Domestic Biomass Boilers	155
Domestic Ground Source Heat Pumps	3
Cavity Wall Insulation	175

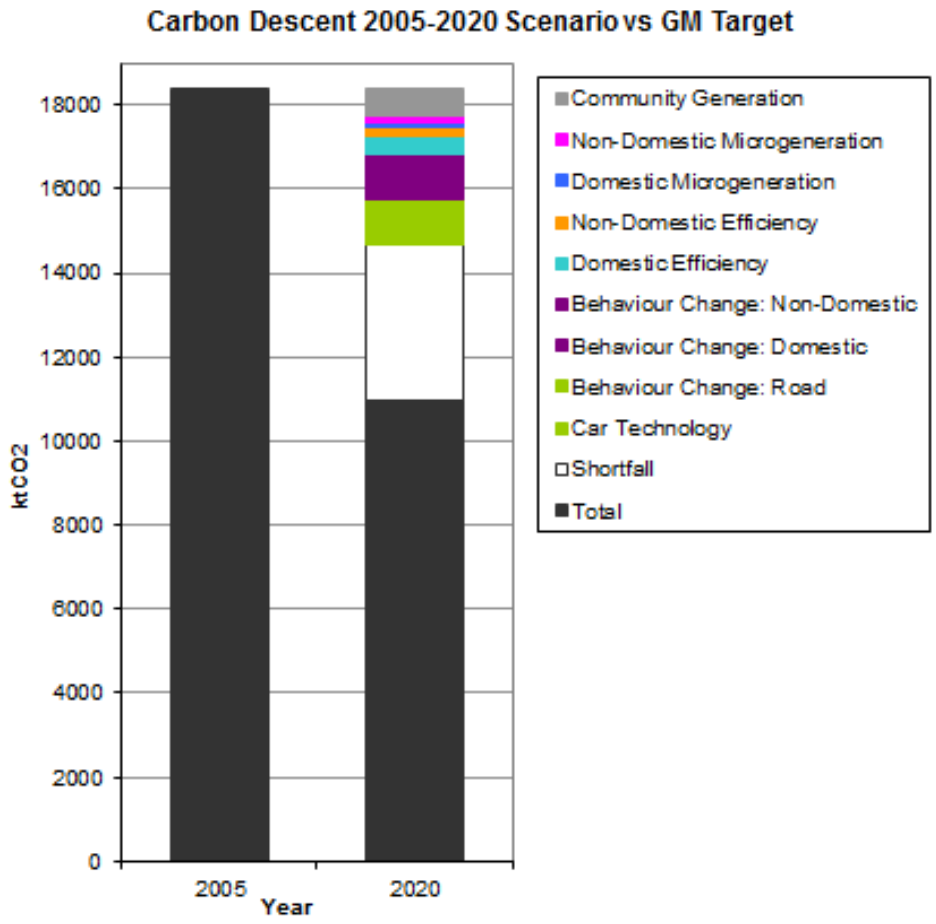
[22] Carbon Descent. 2010. 'EST Low Carbon Cities: Manchester FINAL REPORT'. Version 2.0, 12th February 2010

Domestic Loft Insulation	156
Domestic Double Glazing	77
Solid Wall Insulation	8
Commercial Energy Efficient Lighting	126
Commercial Double Glazing	66
Efficient Street Lighting	1
Behaviour change – Domestic – Gas	314
Behaviour change – Domestic – Electricity	186
Behaviour change – Non Domestic – Gas	166
Behaviour change – Non Domestic – Electricity	428
Changing people's interaction with cars	293
Improved conventional cars	390
Electric Vehicles	385
Total CO2 savings	3,701

4.24 The Carbon Descent reduction programme bears a local focus in the sense that it does not include an estimated impact of reduction in the carbon intensity of grid electricity.

4.25 This is reflected in the shortfall when considering the service to the GM 48% target. Before the counter-balance of CO2 growth is factored in, a simple subtraction of the Carbon Descent scenario from the required reduction leaves 3696.71ktCO2 remaining.

Chart 11 – Carbon Descent 2005-2020 Scenario (condensed) vs. GM 2020 Target:



4.26 Reflecting on an extension of the scenario to 2050, Carbon Descent concludes:

> *The scenario created for this piece of work was not able to meet a target of 80% reduction in carbon emissions (vs. 1990 baseline) even with all the technical potential for all the measures included in VantagePoint. The modelling carried out for this project has highlighted how difficult it will be to reduce emissions to globally sustainable levels. Even applying current technology ambitiously, assuming policy interventions such as further financial support and enhanced national regulations would only achieve a 54.9 % reduction in CO2 emissions on a 1990 baseline (52.2 % on a 2005 baseline).*
>
> *The most significant conclusion from this work is that to achieve an 80% cut in 1990 CO2 levels is an extremely challenging objective and the comprehensive array of currently available measures provided by VantagePoint are unlikely to be sufficient. One example of the kind of measures which may be needed to achieve a higher level of emissions reduction could be the decarbonisation of grid electricity through*

increased reliance on renewable sources and possibly also new technologies such as carbon capture and storage[23].

4.27 The exclusion of grid reductions in the picture casts some light on the estimated shortfall on the 2050 reduction target; a 52.2% reduction 2005-2050 proposed feasible.

4.28 The principal utility of the Carbon Descent work to Lot 1c is as a resource informing compilation of the decarbonisation programme; fast-forwarding early feasibility study and defining quotas against which to scale effort.

4.29 As such, the Carbon Descent decarbonisation scenario will be utilised to provide an initial decarbonisation programme within the Lot 1c toolset. Complementary estimates of the impact of grid decarbonisation will be used to complete the picture (see 'Decarbonisation Programme – Carbon Descent' tool).

4.30 Over time, it is proposed that additional scenarios are developed in complement to that of Carbon Descent; utilising alternative feasibility criteria and/or energy pathways. Section 5 discusses a toolset supporting this development process.

Summary

4.31 Review of Carbon Descent and the SEAP informs a scaffold for the GM decarbonisation programme.

4.32 In each case, early considerations of technical and economic feasibility paired with estimation of maximum impact pump-primes a broad decarbonisation programme into which specific projects may be built.

Table 11 – SEAP 2005-2020 MTP and LCTP Scenario Summaries:

Family	ktCO2
Grid Decarbonisation: Low Carbon Transition Plan (LCTP)	4093.39
Supply: Macro and Community Scale Renewable and Low Carbon Energy Actions	361.08
Supply: Micro-Generation Actions	411.13
Transport Actions	554.13

[23] Carbon Descent. 2010. 'EST Low Carbon Cities: Manchester FINAL REPORT'. Version 2.0, 12th February 2010

Demand Reduction Actions in the Residential Sector	1823.26
Demand Reduction Actions in the Commercial and Services Sector	1126.13
Demand Reduction Actions in the Industrial Sector	107.25
Total (LCTP Scenario)	8476.36

4.33 Compilation of the pipeline is supported by the associated 'Decarbonisation Programme' tool.

4.34 Specifically, the proposed application of Carbon Descent and SEAP is as follows:

- SEAP – scaffold of the Decarbonisation Programme tool – the SEAP provides a vision of the potential shape of emissions reductions based on the capability to remove carbon from specific sectors of the GM landscape.
- Carbon Descent – an economically feasible decarbonisation scenario overlayed upon the SEAP scaffold – Carbon Descent provides a costed, 'feasible', decarbonisation programme for consideration and development.

4.35 This relationship is played out in the 'Decarbonisation Programme – Carbon Descent' tool.

5 Performance Management Toolset

5.1 The core purpose of Lot 1c is to support performance management of a decarbonisation programme tuned to the 48% reduction on 2005 CO2 by 2020 targeted by GM.

5.2 In order to achieve this ambition, a suite of tools has been assembled.

Overview

5.3 The 'Decarbonisation Programme' is the principal tool; providing oversight of the decarbonisation programme aligned to the target.

5.4 The 'Decarbonisation Programme' provides a scaffold informed by the SEAP LCTP 2005-2020 decarbonisation scenario requiring population with specific planned CO2 abatement and mitigation projects.

5.5 The design, appraisal, and evaluation of mitigation and abatement projects is supported by two further tools:

5.6 The 'MAC Appraisal' tool supports compilation of project packages according to the Marginal Abatement Cost of each measure (MAC) of each measure. The 'Design and Evaluation Resources' database provides information supporting the design of mitigation and abatement projects; including quantification of intended and actual impact.

5.7 Finally, two tools provide a dashboard resource concerning the 'actual' CO2 performance of GM and AGMA areas year-on-year; providing comparison of performance against the target, relative performance across AGMA, and performance against the UK trend.

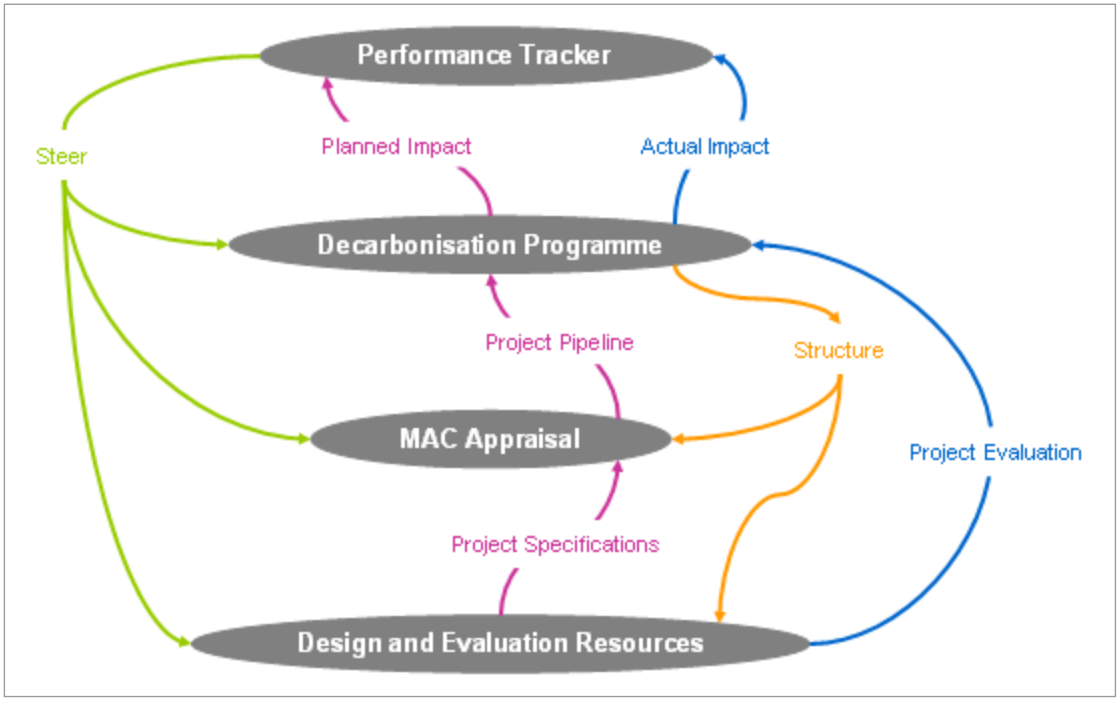
5.8 The 'Performance Tracker' tool concerns the annual CO2 performance of GM and AGMA areas. The 'LA Operations and Estate Tracker' concentrates on a subset of the area data; the annual CO2 performance of GM and AGMA Local Authorities.

5.9 The suite of tools operate on a data platform that includes data drawn from the DECC Local and Regional CO2 publication, together with data generated by AGMA stakeholders via the 'Design and Evaluation Resources' and 'Lot 1a Calculator Tool'.

Model

5.10 The Lot 1c toolset supports a number of analyses. In its role of performance management of the GM decarbonisation programme in pursuit of the 48% reduction target, a model for application can be mapped.

Graphic 1 – Model of Lot 1c Application:



5.11 Four pathways are proposed to underpin this model of application:

1) Structure – orange in Graphic X – in which the scaffold for the decarbonisation programme is communicated through the project development process.

    a. The Decarbonisation Programme tool adopts a broad structure informed by the annual CO account; framing the decarbonisation effort and weighting feasible effort in specific areas.

    b. The MAC Appraisal tool adopts the scaffold outlined in the Decarbonisation Programme tool.

    c. The Design and Evaluation Resources are employed to populate the scaffold laid down in sibling tools.

2) Planned project performance – purple in Graphic X – in which the planned impact of a decarbonisation programme is contrasted with the target reduction trajectory.

    a. The Design and Evaluation Resources inform project design, impact quantification, and baseline.

b. The MAC Appraisal tool aligns the project pipeline according to MAC.

c. The Decarbonisation Programme tool collates the planned impact of the project pipeline and compares to the target trajectory.

3) Actual project performance – blue in Graphic X – in which the actual impact of projects within the decarbonisation programme is contrasted with the planned and target reduction trajectory.

a. The Design and Evaluation Resources, in tandem with bespoke primary research, evaluate the actual impact of individual projects.

b. The Decarbonisation Programme tool collates the actual impact of the project pipeline and compares to the planned and target trajectories.

4) Feedback – green in Graphic X – in which the decarbonisation performance, planned and actual, is used to steer compilation of the decarbonisation programme.

a. The Performance Tracker provides feedback on the actual decarbonisation achieved, trajectories of components of the CO2 account, and performance against the target:

i. The weighting of the Decarbonisation Programme tool is retuned

ii. The weighting of the MAC Appraisal tool is retuned

iii. The Design and Evaluation Resources are employed to develop projects in response

5.12 These pathways function on a data platform based on the DECC Local and Regional CO2 resource and the Carbon Tools provided in the form of the Lot 1a Calculator Tool and the Lot 1c Design and Evaluation Resources (both derived from Defra guidance[24]).

5.13 Transition to a data platform based on the EMIGMA resource is discussed in preceding sections of this report.

5.14 A high degree of flexibility surrounds the application of the toolset. Exact models of application must be finessed in discussion with potential users.

[24] Defra. 2009. 'Guidance on how to measure and report your greenhouse gas emissions'. www.defra.gov.uk/environment/economy/business-efficiency/reporting/

5.15 A key issue surrounds whether the toolset is employed as single centralised aggregation or as ten components operated by AGMA area representatives.

5.16 In addition, reporting from the toolset is an issue for discussion; both in terms of how formal performance is reported and how the outputs are utilised for engagement and influence. The toolset contains a wide array of automatically updated graphic resources capable of supporting such activity.

Carbon Descent

5.17 The Carbon Descent decarbonisation scenario has been loaded into the Decarbonisation Programme tool in order to demonstrate the tool's utility.

5.18 The Carbon Descent scenario presents an initial project package achieving a desired economic feasibility.

5.19 Over time, it is intended that alternative scenarios are developed and an agreed roadmap ultimately agreed. The Decarbonisation Programme tool represents a platform upon which alternative scenarios may be visualised in concept.

5.20 In addition, the Decarbonisation Programme tool supports development of alternative scenarios by providing a scaffold shape and structure of potential reductions. Subsequently, the Decarbonisation Programme tool provides a system for tracking of the selected scenario's progress.

5.21 This outlines the utility of the Decarbonisation Programme tool to multiple stages of the decarbonisation framework.

Toolset Detail

5.22 An outline of structure and function for each Lot 1c toolset component follows:

Title	Performance Tracker
Overview	Tool supports: ▪ Tracking of actual annual performance of GM, AGMA, and components of the CO2 account ▪ Comparison of actual performance and the target reduction trajectory for GM and AGMA ▪ Exploration of component trends in the CO2 account of GM and AGMA; informing development of the mitigation/abatement project package

Components	Components include: ▪ 'GM Challenge vs. Performance' – allows comparison of the annual CO2 account with the reduction pathway required by the GM 48% target ▪ 'Component Breakdown' – allows scrutiny of components of the GM annual CO2 account and their progress over time. Requires data entry to update. ▪ 'Relative Performance' – supports comparison of annual CO2 per capita for each of the AGMA areas, GM, and the UK. Requires data entry to update. ▪ '% Reduction on 1990' – supports comparison of the cumulative % reduction on 1990 levels for AGMA areas, GM, and the UK. ▪ AGMA Area Sheets – provides a metrics dashboard concerning the actual performance of AGMA areas over time, including progress against the area target and estimation of the impact of the UK decarbonisation programme on the area. Requires data entry to update.

Title	Decarbonisation Programme
Overview	The tool supports structuring, scheduling, and tracking of decarbonisation actions deployed in pursuit of a 40.23% reduction of CO2 by 2020 on a 2005 baseline.
Components	The programme scaffold is provided by the SEAP LCTP scenario (see 'Reduction Scenario'). An overview of scheduled and confirmed decarbonisation actions is provided by the 'Project Dashboard'. The 'Project Pipeline' provides a comparison between Potential, Scheduled, and Confirmed decarbonisation actions against the 2020 reduction target. Overlay of cumulative Actual, Scheduled, and Confirmed decarbonisation actions upon the Target over the 2005-2020 period is provided in 'Projects vs. Target'. Sheets '2a' to '6e' allow entry of projects corresponding to the SEAP scenario category. A comparison to the potential scale of reduction deemed feasible is derived from the SEAP. A final sheet, 'Other Net' allows +ve and -ve impacts to the baseline derived from economic or population change to be factored into the performance tracking in 'Projects vs. Target'.

Title	MAC Appraisal
Overview	The tool supports appraisal of potential decarbonisation actions via the Marginal Abatement Cost convention.

	(An overview of MAC analysis is provided in Appendix D)
Components	Sheets are provided for each of the 7 decarbonisation families presented in the SEAP LCTP scenario for decarbonisation in the 2005-2020 period.

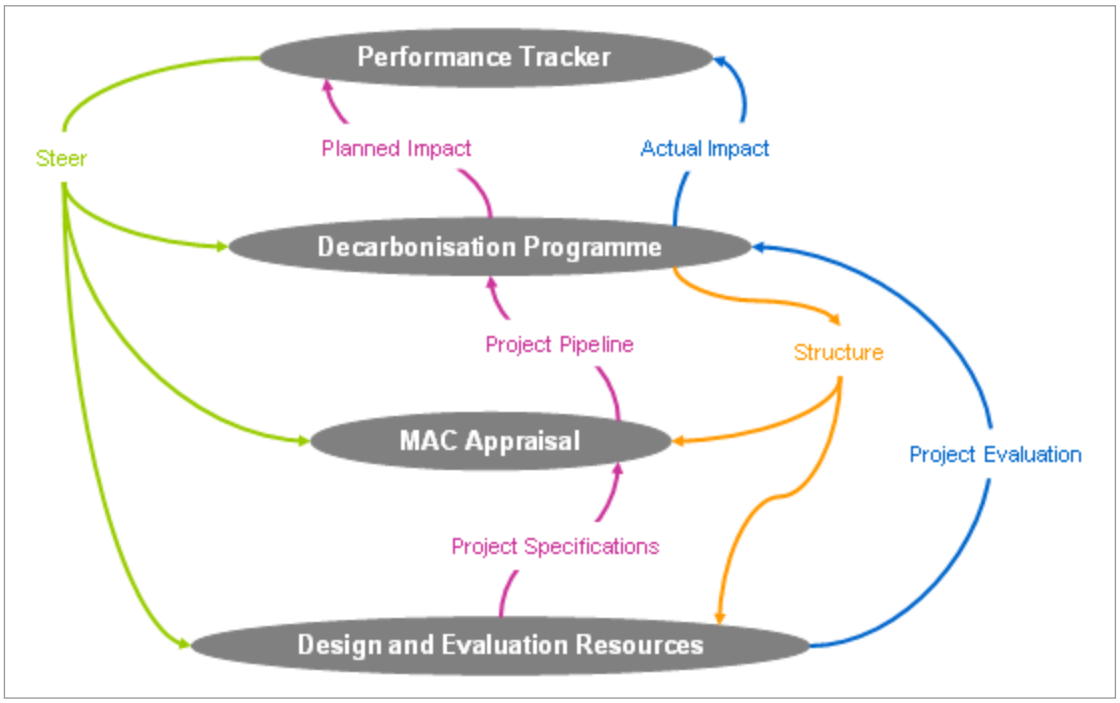
Title	Design and Evaluation Resources
Overview	The spreadsheet contains tools supporting estimation of potential and actual CO2 impact of decarbonisation actions and interventions pursued by GM stakeholders.
Components	Components include: ▪ 'Scope & Boundary' – a statement on the scope and boundary of the DECC data platform being applied as the annual GM CO2 account. In service to the GM decarbonisation target, the information serves selection of actions and interventions capable of reducing components of this data resource. ▪ 'Carbon Tools' – resources allowing the estimation of CO2 impact of specific actions and interventions. The Tools are applicable to both CO2 increases and decreases; converting actual or projected activity measures into a tCO2 figure. Tools corresponding to components of the DECC data platform scope and bounds are included. ▪ 'Datasets' – datasets with potential to serve as baseline and evaluation resources for specific actions and interventions; informing design decisions and potentially providing evaluative feedback on specific interventions.

Title	LA Operations and Estate Tracker
Overview	Supplemental to the 'Performance Tracker', this tool concentrates on characterising relative annual CO2 performance of AGMA Authorities with regards to their operations and estates. The tool supports interpretation of data derived from the Lot 1a 'Calculator Tool'.
Components	Components include: ▪ Authority sheets tracking trend in operations and estates CO2 ▪ Baseline assessment for AGMA group as a whole ▪ Summary sheet detailing relative performance against the reduction target

Summary and Example

5.23 The Performance Management toolset is summarised in the following:

Graphic 1 – Model of Lot 1c Application:



5.24 Application of the toolset may be further elaborated through the following example:

5.25 The 'Performance Tracker' tool reveals Industrial and Commercial Electricity to be a significant component of the GM annual CO2 account. Furthermore, this component demonstrated an increase in the 2007-08 period that bucked the collective trend.

5.26 In the 'Decarbonisation Programme' tool, the SEAP LCTP scenario identifies a series of supply and demand measures with capacity to reduce the Industrial and Commercial Electricity CO2 component in the GM account.

5.27 The scaffold provided by the 'Decarbonisation Programme' tool directs focus in the design of feasible abatement and mitigation projects. Reference to the tool's 'Reduction Scenario' sheet reveals scope for projects based on wind power.

5.28 The 'Design and Evaluation Resources' support quantification of the CO2 impact of potential mitigation or abatement projects. The kWh output of the envisaged wind power project is translated into CO2 figure using the 'Carbon Tools Electricity' sheet. This represents the potential CO2 saving based on replacement of grid-based electricity by that derived from renewable wind.

5.29 Naturally, the concept and design stage of the process will require passage through a series of gateways concerning the technical feasibility of the project. The quotas assigned by the SEAP LCTP scenario, and included within the 'Decarbonisation Programme' tool, provide an initial insight into feasible maximums achievable.

5.30 Articulation of the project specification, including the logic chain, is supported by data resources listed in ‘Design and Evaluation Resources’. In this case, the Ofgem E-Serve database provides data on renewable energy installation in the area against which a ‘before and after’ target may be formulated for the project.

5.31 Project specifications are loaded into the ‘MAC Appraisal’ tool and the most efficacious options carried forward.

5.32 The ‘scheduled’ impact of selected projects is entered into the ‘Decarbonisation Programme’ tool; allowing their service to the reduction target to be visualised.

5.33 Subsequent impact evaluation of the project is supported by the baseline resources selected from the ‘Design and Evaluation Resources’, alongside bespoke primary research.

5.34 Most projects will be measured in terms of indicators of CO2; the ‘Design and Evaluation Resources’ provide a raft of indicator resources that provide support to tracking of performance, together with the CO2 quantification tools.

5.35 The ‘confirmed’ project impact is entered into the ‘Decarbonisation Programme’ tool, supported by the ‘Carbon Tools’ of the ‘Design and Evaluation Resources’ as appropriate.

5.36 The ‘Decarbonisation Programme’ tool supports contrast of the ‘scheduled’ and ‘confirmed’ impact of the project; informing consideration of future commission and improvement in the specification.

5.37 In addition, the ‘Decarbonisation Programme’ and ‘Project Tracker’ provide feedback on the annual CO2 account; against which the ‘confirmed’ and ‘scheduled’ project impact may be contextualised.

5.38 Over time, a project package may be compiled through iteration of this cycle. The ‘Decarbonisation Programme’, ‘MAC Appraisal’, and ‘Project Tracker’ tools each guide the assembly of a project package summing to the GM 48% target; defining relative emphases and providing feedback on savings achieved.

6 Next Steps

6.1 Actions required to gear up the Performance Management toolset and engage the decarbonisation programme are:

1. Finalisation	Review of the proposed operational model for the Performance Management toolset and confirmation of required outputs from specific tools.
3. Population	Population of the 'Decarbonisation Programme' tool: ▪ 'Confirmed' actions for the 2005-2011 period ▪ 'Scheduled' actions for the 2011-2020 period A 'Project Mapping v2' resource has been highlighted by the GM Metrics Steering Group containing projects deemed relevant to the GM climate change response. Currently, the 'Project Mapping v2' resource does not provide estimates for CO2 impact and thus cannot be recorded in the 'Decarbonisation Programme' tool. A strategy for resolution is required. The 'Decarbonisation Programme' tool has been loaded with a temporary, 'holding', reduction figure for the 2005-2011 period.
2. Implementation	Discussion of the implementation plan; including resourcing, responsibility, and annual cycles. A key issue is how the Performance Management toolset is deployed across GM; currently centralised or dispersed approaches are possible. Two broad groups of project must be loaded annually into the 'Decarbonisation Programme' tool: ▪ Interventions directly driven by GM Authorities; decarbonisation actions and enabling strategies ▪ Actions undertaken by communities and organisations in GM under the influence of regulation, central policy, and/or market forces A cycle of project mapping must be devised in order for the Performance Management tool to operate effectively. The strategy for update must be lead by GM stakeholders.
5. EMIGMA	Decision on the EMIGMA transition strategy and timetable.

6.3 The Lot 1c engagement programme will be employed to develop initial discussions and tentative decisions lead by stakeholder input.

7 Appendix A – CCC Ambitions

7.1 The CCC outlines three Ambitions outlining CO2 savings in the 2020 annual account working from a 2008 baseline. The breakdown of Ambitions in the UK is[25]:

		Savings in 2020 on 2008 (MtCO2)		
Sector	Activity	Current	Extended	Stretch
Residential	Insulation Measures	4	5	9
	Heating Efficiency	0	0	0
	Lights and Appliances	4	5	5
	Lifestyle Measures	1	4	4
	Zero Carbon Homes	4	4	4
	Renewable Heat and Microgeneration	0	10	10
	Total	13	29	32
Non-Residential Buildings	Process Efficiency	5	10	10
	Energy Management			
	Energy Efficiency			
	Lights and Appliances			
	Renewable Heat and Microgeneration			
	Industry-Specific Measures	5	7	7
	Total	10	17	17
Transport	Biofuels	0	5	5
	Car Technology	5	12	14
	Van Technology			
	HGV Technology			

[25] CCC. 2008. 'Building a low-carbon economy'. www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

	Rail: Efficiency Measures	0	1	1
	Demand: Smarter Choices	0	3	3
	Demand: Eco-Driving (Cars)	0	1	2
	Demand: Eco-Driving (Vans and HGVs)	0		
	Speed Limiting	0	1	5
	Total	5	23	30
Power Sector		51	51	51
Total		79	120	130

7.2 Sector totals can be recast at GM level through the following method:

GM Estimates for CCC Ambitions Savings in 2020 on 2008 (MtCO2)				
Sector	Current	Extended	Stretch	Basis of Breakdown
Power	2.09	2.09	2.09	GM % Electricity consumption of UK (4.1)
Residential	0.53	1.18	1.30	GM % Domestic CO2 of UK (4.06)
Non-Residential	0.30	0.51	0.51	GM % Commercial CO2 of UK (3.01)
Transport	0.18	0.81	1.05	GM % Road and Rail CO2 of UK (3.5)
Total	3.09	4.59	4.95	

8 Appendix B – DECC and EMIGMA Platforms

8.1 Modular structure of DECC CO2 and EMIGMA CO2 datasets:

Area		Modules	
		DECC CO2	EMIGMA CO2
Bolton Bury Manchester Oldham Rochdale Salford Stockport Tameside Trafford Wigan	x	A. Industry and Commercial Electricity B. Industry and Commercial Gas C. Large Industrial Installations D. Industrial and Commercial Other Fuels E. Agricultural Combustion F. Diesel Railways G. Domestic Electricity H. Domestic Gas I. Domestic Other Fuels J. Road Transport (A roads) K. Road Transport (Motorways) L. Road Transport (Minor roads) M. Road Transport Other N. LULUCF Net Emissions	Roads Rail Part A Part B Boilers Combustion Bus Stations Electricity

8.2 EMIGMA 2005[26]

	Roads	Rail	Part A	Part B	Boilers	Combustion	Bus Stations	Electricity	Total
GM	3958.56	257.00	1560.98	36.19	1236.02	6850.87	4.78	5922.41	19826.80
Bolton	424.73	19.52	160.69	0.28	277.92	645.46	0.42	511.69	2040.71

[26] GMTU. 2007. 'EMIGMA'. www.gmtu.gov.uk/reports/emigma/GMTUReport1331.pdf

Wigan	Trafford	Tameside	Stockport	Salford	Rochdale	Oldham	Manchester	Bury
453.13	295.94	275.02	382.27	532.64	433.68	227.32	564.32	369.51
50.41	8.37	20.74	52.97	24.69	12.09	14.63	49.69	3.90
138.21	747.40	7.63	0.00	51.51	365.53	41.84	20.41	27.75
3.84	0.00	0.00	1.07	2.60	1.01	5.03	5.22	17.14
111.63	368.16	16.29	49.10	157.82	73.95	41.49	123.59	16.06
681.43	867.90	493.87	664.30	544.58	505.15	511.95	1190.07	746.14
0.50	0.23	0.57	0.35	0.34	0.55	0.33	1.10	0.39
561.81	817.61	437.32	577.53	548.21	412.65	417.23	1289.46	348.89
2000.97	3105.62	1251.44	1727.59	1862.40	1804.62	1259.82	3243.86	1529.78

8.3 DECC 2005[27]

	Bo	Bu	Ma	Ol	Ro	Sa	St
A. Industry and Commercial Electricity	335.31	217.51	974.40	272.60	285.31	392.54	385.97
B. Industry and Commercial Gas	146.64	143.04	419.17	119.90	135.31	159.88	167.28
C. Large Industrial Installations	11.67	0.00	29.05	4.58	0.00	6.00	0.39
D. Industrial and Commercial Other Fuels	105.64	60.39	90.94	79.52	74.10	43.18	56.52
E. Agricultural Combustion	1.60	1.29	0.38	0.97	1.60	0.41	1.62
F. Diesel Railways	6.02	0.00	13.04	4.76	3.15	8.36	8.54
G. Domestic Electricity	261.26	177.59	425.05	194.06	191.15	224.70	287.33
H. Domestic Gas	399.56	290.75	584.77	326.04	305.90	308.47	463.35
I. Domestic 'Other Fuels'	11.00	7.01	13.50	8.58	8.59	7.79	10.19
J. Road Transport (A roads)	180.50	97.04	244.20	117.07	106.40	177.69	160.34
K. Road Transport (Motorways)	130.90	220.55	161.23	47.80	265.45	282.83	122.08
L. Road Transport (Minor roads)	228.67	132.91	314.22	110.07	114.82	152.43	195.17
M. Road Transport Other	2.48	1.91	3.49	1.33	1.88	2.69	2.29
N. LULUCF Net Emissions	1.22	1.52	3.21	2.02	3.31	34.49	3.38

[27] DECC. 2010. 'Local and Regional CO2 Emissions Estimates for 2005-2009'. www.decc.gov.uk/assets/decc/Statistics/climate_change/localAuthorityCO2/458-local-regional-co2-2005-2008-main-rpt.pdf

Wi	Tr	Ta
376.29	722.57	301.78
211.16	360.50	144.95
6.66	3.12	0.14
86.94	50.22	92.73
1.73	0.69	0.84
7.97	2.77	6.31
283.74	221.02	203.59
438.81	354.90	323.21
22.28	7.46	8.66
183.17	109.87	92.99
163.42	99.71	98.17
179.01	188.23	107.61
2.31	1.90	1.35
6.77	7.84	2.42

9 Appendix C: SEAP Scenarios

Family	Action	Potential - 2020	% reduction 2005-2020 period	ktCO2 reduction 2005-2020 period
Supply: Macro and Community Scale Renewable and Low Carbon Energy Actions	Grid Decarbonisation: Market Transformation Programme (MTP) Projections	Grid decarbonisation, as predicted by the MTP projections, would result in a reduction of overall GM CO2 emissions by 8.9% by 2020.	8.9	1590.88
	Grid Decarbonisation: Low Carbon Transition Plan	GM emissions savings resulting from meeting LCTP targets would reduce GM CO2 emissions by 22.9% by 2020. The Low Carbon Transition Plan (LCTP) has set a target for 40% of the UK's electricity generation to be derived from renewable sources by 2020. This represents a notable increase when compared to the proportion of renewable generation assumed by the MTP projection of 16%.	22.9	4093.39
	Energy from Biomass	Potential GM emissions savings from biomass Combined Heat and Power plants have been projected as 0.3% by 2020	0.3	53.63
	Energy from Waste	Potential GM emissions savings from Energy from Waste have been projected as 0.5% by 2020	0.5	89.38

	Wind	Based upon initial utilisation of the identified 'less constrained land', potential GM emissions savings from wind have been projected as 0.4% by 2020.	0.4	71.50
	Hydro-Electricity	It is projected that hydro-electricity could provide up to a 0.02% saving in overall GM emissions by 2020	0.02	3.58
	Minewater Geothermal	A realistic uptake of mine water geothermal technologies could provide up to a 0.1% saving in overall GM emissions by 2020	0.1	17.88
	Heat Networks: Manchester Town Hall Cluster	Based on the staged growth of such a network, it has been estimated that a 0.1% saving in overall GM emissions could be delivered by 2020, assuming use of a natural gas-fired plant.	0.1	17.88
	Heat Networks: Manchester City Centre	Based on the staged growth of such a network, it has been estimated that a 0.2% saving in overall GM emissions could be delivered by 2020, assuming use of a natural gas-fired plant, or up to 0.5% if CHP were biomass-fuelled	0.2	35.75
	Heat Networks: Sub-Regional Networks	Based on the staged growth of such networks, a GM emissions saving of 0.2% has been projected for 2020, assuming natural gas-fired plant, or up to 0.7% if CHP were biomass-fuelled	0.2	35.75
	Heat Networks: Local Heat Networks	Based on a similar staged growth of such networks, a GM emissions saving of 0.2% has been projected for 2020, assuming natural gas fired plant, or up to 0.7% if	0.2	35.75

		CHP were biomass fuelled		
Supply: Micro-Generation Actions	Micro-Combined Heat and Power	Based upon a limited update of micro-CHP (where appropriate), initial GM emissions savings of 0.6% are predicted by 2020	0.6	107.25
	Photovoltaics	Potential GM emissions savings are up to 1.1% are predicted by 2020. The majority of these technologies are assumed to be installed on residential buildings.	1.1	196.63
	Solar Thermal	Overall GM emissions saving from solar thermal installations of up to 0.6% are predicted by 2020	0.6	107.25
Transport Actions	Aviation and Shipping	International and national interventions on aviation are expected to provide a reduction in overall GM CO2 emissions savings of 0% by 2050.	0	0.00
	Driver Efficiency for Freight and Buses	Increasing freight and bus driver efficiency could provide a reduction in overall GM CO2 emissions of 0.7% by 2020	0.7	125.13
	Freight Mode Capacity Increase	Freight mode capacity increases could provide a reduction in overall GM CO2 emissions of 0.1% by 2020	0.1	17.88
	Making Smarter Choices: Modal Choice	Modal choice towards more sustainable modes of transport could reduce CO2 emissions in GM by 0.5% by 2020	0.5	89.38
	Driver Efficiency for Personal Transport	Encouraging car drivers to drive more efficiently could result in 0.3% reduction in CO2 emissions by 2020	0.3	53.63

	Maintenance of Existing Vehicles	Maintenance of existing vehicles could potentially reduce GM CO2 emissions by 0.3% by 2020	0.3	53.63
	Public Transport Mode Capacity Increase	Increasing the capacity of public transport could reduce GM CO2 emissions by 0.1% by 2020	0.1	17.88
	Reducing Distance Travelled and Smart Transport	Reducing the distance GM residents travel could potentially reduce GM CO2 emissions by 0.7% by 2020	0.7	125.13
	Renewable and Alternative Fuels for Transport	Use of renewable and alternative fuels for transport could potentially reduce GM CO2 emissions by 0.4% by 2020	0.4	71.50
Demand Reduction Actions in the Residential Sector	Insulation Improvements	Potential GM emissions savings by 2020 have been projected at 3.7%	3.7	661.38
	Low-Energy Lighting	Associated GM emissions savings possible by 2020 via low-energy lighting are projected at 0.3%	0.3	53.63
	Draught Proofing	Achievable GM emissions savings by 2020 are 0.4%	0.4	71.50
	Boiler Replacements	The replacement of old boiler with more efficient plant is expected to provide GM with emission savings of up to 1.6% by 2020.	1.6	286.00
	Double-Glazing Installation	Glazing improvements are predicted to provide GM emissions savings of up to 1.1% by 2020	1.1	196.63
	Behavioural Change	Such measures could provide GM emission savings of up to 3.1% by 2020	3.1	554.13

Demand Reduction Actions in the Commercial and Services Sector	Energy Efficient Lighting	Overall GM emission savings from energy efficient lighting in the commercial and service sector could be up to 0.7% by 2020	0.7	125.13
	Modify Building Heating Set Points	GM emissions saving from modification of commercial and service sector building heating set points are estimated at 2.8% by 2020	2.8	500.50
	Night-Time Cooling	GM emission savings achieved by introducing night-time cooling into commercial and service sector buildings are estimated at 0.7% by 2020	0.7	125.13
	Time Switches on Small Equipment	Overall GM emissions saving from appropriate time-switching are estimated at 0.2% by 2020	0.2	35.75
	Behavioural Change	Behavioural change measures are predicted to provide GM emissions savings of up to 1.9% by 2020	1.9	339.63
Demand Reduction Actions in the Industrial Sector	European Union Emission Trading Scheme and Carbon Reduction Commitment Energy Efficiency Scheme	In terms of overall GM emissions, this would represent savings of up to 0.6% by 2020	0.6	107.25
		Total (LCTP Scenario)	47.42	8476.36
		Total (MTP Scenario)	33.42	5973.85

10 Appendix D – MAC Curves

10.1 Marginal Abatement Cost (MAC) charts support comparison of the relative efficacy of mitigation and abatement projects and what combination of projects need to be employed to reach a specific carbon reduction goals.

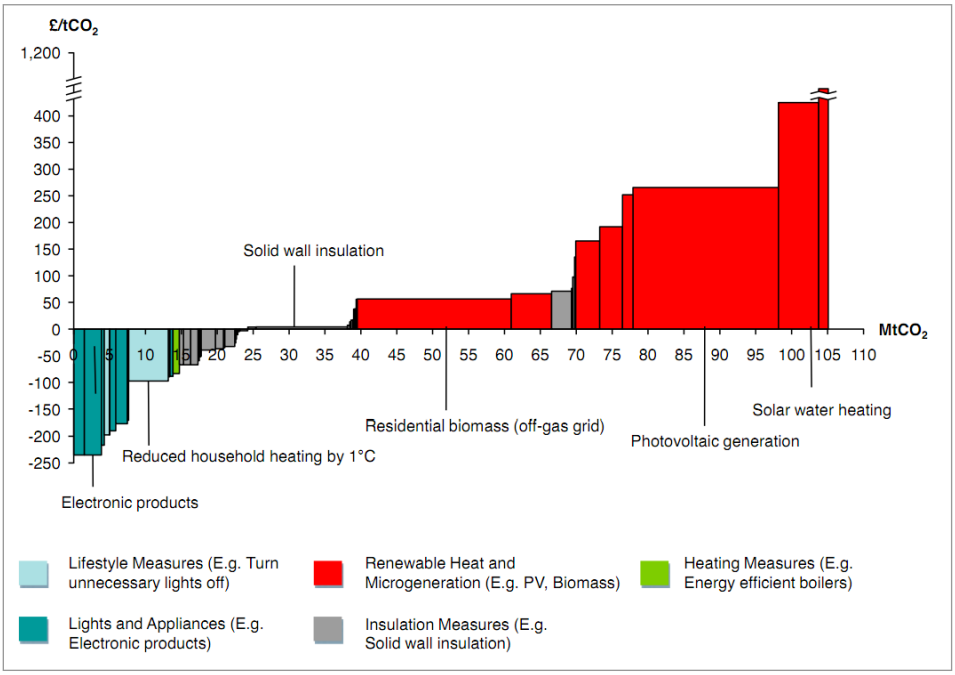
10.2 MAC curves enable a visual comparison between different projects regarding their cost to implement and the amount of carbon they can save.

10.3 MAC charts, typically histograms, plot the Marginal Abatement Cost of a project against the amount of carbon saved. The Marginal Abatement Cost is a calculation of the project Net Present Value (NPV) per tonne of CO2 abated (net). Thus, the area of a project entry is equal to the total cost of the project.

10.4 When applied as a comparison device, convention dictates sorting by ascending MAC value. Negative MACs indicate a project with 'profit' over the evaluation period, positive MACs indicate net cost over the period.

10.5 Under the convention, projects with negative MAC are plotted first. Such projects promise net return on investment. The package of projects reaching a desired CO2 saving most effectively consists of those projects summing to the desired reduction figure (read left to right across the x-axis).

10.6 An example of the use is provided by the CCC[28]:



[28] Committee of Climate Change. 2008. 'Building a Low Carbon Future'. www.theccc.org.uk/pdf/TSO-ClimateChange.pdf

10.7 The calculation of a MAC in Excel is outlined by Somar[29]:

> *Calculating the Marginal Abatement Costs*
>
> *Marginal abatement costs can be formed around different investment criteria depending on a company's preferences, but the most widely-used approach is to use projects' NPVs. This provides a better weighted insight as to how the technology will perform financially over an evaluation time span rather than just the immediate project implementation.*
>
> *NPVs for low-carbon projects can be tricky calculations when everything is taken into account fully, such as differing cost increases for energy, carbon and maintenance. However, rough calculations can be made simply and easily using Excel's in-built present value PV() function. The syntax for this is simply:*
>
> *NPV = Project cost + PV(discount rate, evaluation period, annual benefit/cost)*
>
> *The discount rate is the only unintuitive element to the lay person here: it is the minimum level of return on investment the company deems acceptable. If a company wished investments only to keep track with inflation, then the value of inflation would be used as the discount rate: however, most companies will look to substantially exceed such a figure.*
>
> *The marginal abatement cost is then simply the NPV divided by the carbon saved by the project over the same period (the annual carbon savings multiplied by the evaluation period). The only proviso here is if the carbon is being traded on a carbon market: in such a scenario the carbon has direct monetary value and needs to be discounted prior to calculating the MAC in the same way and with the same rate as with the NPV calculation.*
>
> *Negative marginal abatement cost values signal a project which pays for itself over the evaluation period, whilst positive MACs cost money over the period and need to be compared to the cost of inaction/carbon price or ethical/marketing valuations to judge whether to proceed or not.*

[29] Somar. 2010. 'How To Create Marginal Abatement Cost Curves In Excel'. www.energy-savingnews.com/2010/10/marginal-abatement-cost-curves-how-to-create-one-using-excel/