Carbon Now and Carbon Futures – a systems and performance based approach to reducing GHG emissions in the Auckland region.

Authors: Perry, Robert, Principal Policy Analyst – Auckland Council; and
Chambers, Paul, Sustainability Project Leader – Auckland Council.

Contact: Robert Perry: Ph 09 366 2000 (x8343), E robert.perry@arc.govt.nz
Private Bag 92012, Auckland, New Zealand.

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By Robert Perry and Paul Chambers

Abstract

The Auckland Regional Council (ARC) has led a consortium of all Auckland councils and key stakeholders to develop an integrated regional policy response to address the critical climate change-related issues affecting the Auckland region's resilience and sustainable development.

The development of climate mitigation policy has been underpinned by two separate but complementary initiatives known as Carbon Now, and Carbon Futures. Carbon Now is a performance and systems based management framework for measuring, monitoring and reporting greenhouse gas (GHG) emissions reductions against prescribed targets. Carbon Futures refers to a backcasting and visioning study which sought to (i) develop long-term (year 2040) emissions projections, and (ii) to evaluate a suite of mitigations to achieve a range of reduction targets.

These initiatives were developed in five broad stages. Stage one focused on the development of the Carbon Now framework and guidelines to provide a consistent methodology for the development of a detailed regional emissions inventory. An initial estimation of Auckland regional GHG emissions was undertaken in stage two based on a 2006 base year. In stage three a suite of potential GHG mitigation options were identified and evaluated to deliver GHG reductions and broader co-benefits for Auckland region. Stage four was the development of the Auckland regional GHG emission inventory using the Carbon Now Framework. In stage five a series of modified projection have be evaluated based on a series of scenarios and underpinning assumptions.

It was estimated using a 'top down' approach (stage one) that Auckland's regional emissions have risen by 17.7% between 2001 and 2008, compared to a 26% increase rise in national emissions since 1990. It was predicted that by 2040, regional emissions will increase by 87.3% relative to 2001 levels. The Auckland regional footprint equated to 10,040,084 tonnes carbon-dioxide equivalent (CO_2e) or 7.02 TCO_2e per capita in 2009. Revised emissions projections as developed by taking a 'bottom up' approach using the Carbon Now framework (and based on business as usual) indicate a 4% increase by 2015, a 12% increase by 2025 and a 33% increase by 2040.

Acknowledgements

The ARC would like to acknowledge the significant support, cooperation and assistance of the councils in the Auckland region, PricewaterhouseCooper, AECOM and URS New Zealand Limited in the development and implementation of the Carbon Now, and Carbon Futures initiative.

Introduction

As signatories to the Communities for Climate Protection – New Zealand (CCP-NZ), the ARC and the councils of the Auckland region formalised their commitment to address the management and reduction of corporate and community GHG emission.

CCP-NZ was a part of International Council for Local Environmental Initiatives global programme aimed at empowering local governments to take responsibility for measuring and reducing GHG emissions. CCP-NZ has been an instrumental systems based tool in initiating local mitigation actions, and provided key inputs in climate advocacy efforts of cities and local governments. However, the varied interpretation of the methodology by different councils has meant that comparability, consistency and accuracy of GHG inventories across council jurisdictions was problematic. Furthermore the potential opportunities that are provided through benchmarking have remained unrealised.

In 2009, the National Government of New Zealand ended funding to support the CCP-NZ programme. Consequently there was no single tool or programme to underpin, integrate and report the individual and collective contribution of local government initiatives in contributing to national reduction targets. Furthermore there was a fundamental need for greater accuracy, consistency and comparability across councils emissions inventories in accordance with international standards and best practice. The ARC therefore led a consortium of the councils in the Auckland region to seek a simpler, transparent more robust approach to measuring managing and reporting the reduction of GHG emissions across council jurisdictions. It also sought to develop the evidence base to inform the development of climate mitigation policy.

The response was to develop Carbon Now, a systems and performance framework by which regional and local councils could measure GHG emissions, manage, monitor and report reductions against the agreed targets across council jurisdictions in a clear, consistent and comparable manner. Stage one of Carbon Now was developed by PricewaterhouseCoopers (PwC) and comprised of guidelines, corporate and community inventory tools and GHG emission factors.

Stage two focused on the development of the Carbon Futures project and was undertaken concurrently with the development of the Carbon Now framework. In doing so, the ARC engaged Maunsell AECOM to undertake a GHG emissions backcasting and visioning study which sought firstly to establish an estimated baseline inventory, backcasted 1990 emission levels and business as usual projections to 2040. In stage three, a suite of potential mitigation options were identified and evaluated. Mitigation options for reducing regional GHG emissions were evaluated using multi-criteria analysis to determine cost effective policy interventions to deliver GHG reductions and broader co-benefits for Auckland region.

In stage four and five, URS NZ Limited (URS) were engaged to trial the Carbon Now framework (stage one output) in the Auckland region. Their role was to calculate a revised GHG emissions inventory (community emissions only) and revise long terms projections (the outputs of stages two and three). This was based on a 'bottom up' approach using regional datasets and national emission factors. The project also sought to identify a proposed project plan and methodology to establish a consolidated corporate emissions inventory for the Auckland Council and it's Council Controlled Organisations. In stage five a series of modified projections were evaluated, based on a series of scenarios and underpinning assumptions.

Methodology - Carbon Now

GHG inventories are a fundamental tool assisting local government to account for, manage and monitor their corporate emissions, as well as those that are community generated. A range of national and international protocols and standards provided the specifications, guidance (at the organisation level) and conventions for quantification and reporting of GHG emissions (and removals). These include:

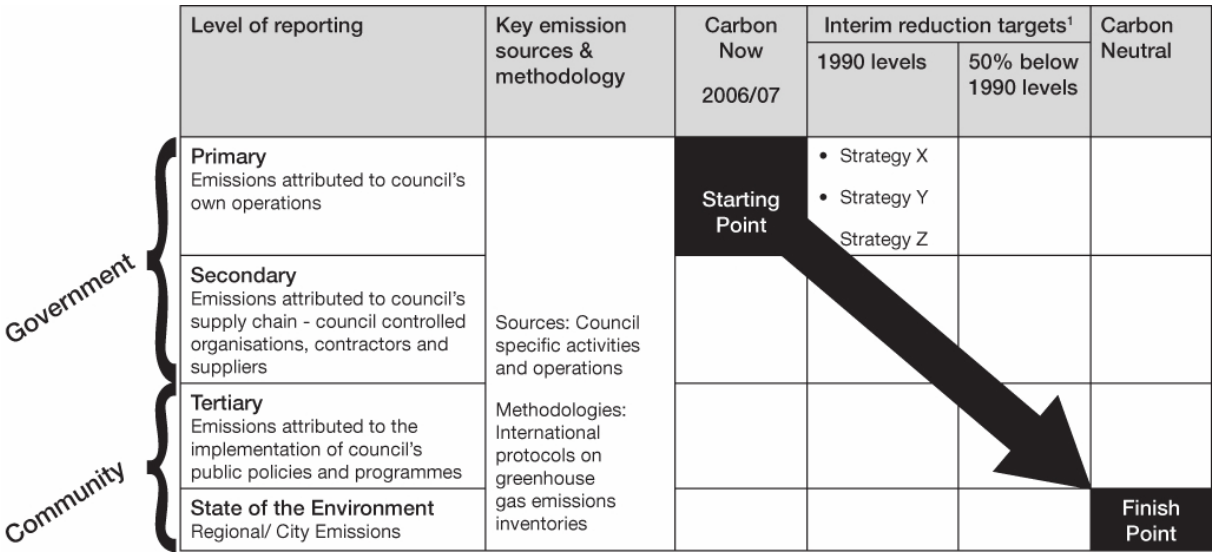
- GHG Protocol, (Bhatia P., and Ranganathan J., 2004);
- International Standard ISO 14064-1 (2006);
- Global Reporting Institute's Public Sector Agencies (2010);
- Local Government GHG Protocol, International Council for Local Environmental Initiatives (2008);
- Guidance for voluntary corporate GHG reporting, Ministry for the Environment (2008).

While such standards and protocols provide consistency as to "what should be counted at the corporate level", they do not indicate, "how the counting should be done" either directly through a tool or through a specific methodology for local government. The interpretation and application of inventory methodologies across local government is discretionary and it is subject to variability (e.g. no standard definition of organisational and operational boundaries; the inclusion of suppliers and contractors, or base years used). Therefore Carbon Now established the conventions at each of the points of flexibility or discretion in quantifying the GHG emissions from both internal operations and from the communities within council's geopolitical boundaries.

In accounting for GHG emissions, a council's sphere of influence and control can be reported in a number of different categories (Figure 1). The Primary Level of reporting refers to a council's own operations, i.e. the emissions arising from the direct use of a council's significant assets and services. In many of the international protocols aimed at GHG emissions reductions, this is commonly referred to as the 'corporate' or 'government' inventory.

The next level of influence is that over relationships with council-controlled operations, contractors and suppliers. In many cases the services supplied are indirect services that councils would ordinarily be providing. In the Carbon Now framework, this is regarded as the Secondary Level of reporting and is part of 'government' or 'corporate' emissions inventory (Table 1). This refers to emissions arising from the use of all significant assets and services and therefore includes the Primary and Secondary Levels of reporting from the Carbon Now framework. The variety of emission sources that should be considered to calculate an emissions profile will vary considerably between councils, depending on the range of activities and operations they undertake.

Figure 1 Carbon Now GHG emissions accounting and reporting framework



[1] *These are indicative as targets and are not currently set.*

Essentially, under the conventions of the international Greenhouse Gas Protocol, councils direct emissions (i.e. those over which they have direct control such as fuel consumed for heating) are regarded as scope 1. All emissions associated with purchased electricity are regarded as scope 2, and relevant and significant indirect sources (i.e. those that council does not control but which would have a direct impact on the footprint size if left out) are regarded as scope 3 sources (Bhatia P., and Ranganathan J., 2004). Carbon Now is the completion of an inventory for the baseline year 1 July 2006 – 30 June 2007. This gave a snapshot of GHG emissions for both the 'government' and 'community' inventories across all of the eight councils' jurisdictions in the Auckland region.

Table 1: How Carbon Now corresponds to the international GHG reporting protocol conventions.

Carbon Now framework	International GHG reporting protocols
Primary	Government or corporate
Secondary	
Tertiary	Community
State of the Environment	

Emissions attributed to the councils policies and programmes (Tertiary) and city-region-wide emissions are also both regarded as part of the 'community' inventory in international reporting on greenhouse gases. Community emissions inventory are those activities that occur within the context of the local government's policies i.e. those that are influenced by the local government's policies, called the 'geopolitical' boundary in the Local Government GHG Protocols. Emissions designated as State of the Environment refer to sources within the geopolitical boundary, but outside the influence of the Auckland councils.

Methodology - Carbon Futures

The methodology underpinning the Carbon Futures project (stages two and three) is detailed in the conference paper Hughes, J, Goldthorpe, S. and Perry, R.H., (2010). Stage four was undertaken by URS and sought to trial the Carbon Now framework to develop an inventory of emissions within the Auckland region, using the 2009 calendar year as the baseline. In doing so revised business as usual emissions projections were developed over the short term (up to 2015), medium term (up to 2025) and long term (up to 2040). This work refines and updates previous projections completed by Maunsell AECOM in 2008 through improved baseline data provision (Maunsell AECOM, 2008).

Emissions projections were based upon 2009 baseline levels and extrapolated out to 2015, 2025 and 2040 levels by calculated sector growth (or shrinkage), based on historical consumption or production figures. URS obtained this data from the Ministry for the Environment's National Inventory Reports and the Ministry for Economic Development's Energy Data Files.

For each emission source (e.g. natural gas) URS recorded the activity data changes between 2000 and 2009, applied a linear trend line, then using the 2009 data as a baseline, extrapolated this data out to the short, medium and long term. For less significant emission sources URS applied the overall rate of emissions change for New Zealand as estimated in the National Inventory Reports between 2000 and 2008. In some cases emission source data showed an historical negative trend. The resulting data for each emission source was summed to provide the overall projections for the short, medium and long term.

Results

Maunsell AECOM estimated that the Auckland region's GHG emissions for 2006 totalled 11.93 million tonnes of CO_2 equivalent. This was an increase of 1.79 million tonnes in the five years since 2001 (see Table 2). Auckland's regional GHG emissions have risen by approximately 17.7 per cent between 2001-2006 compared to a 26 per cent rise in national GHG emissions since 1990.

Table 2 Auckland regions estimated GHG emissions, 1990 – 2012, Maunsell (2006)

	Auckland region's estimated GHG emissions (Mt CO_2 –e)	**New Zealand GHG emissions (Mt CO_2 –e)**	**Auckland as % of national emissions**	**% NZ population resident in the Auckland region**
1990	7.9	61.9	12.8%	28% *(1991)*
2001	10.14	72.4	14%	30%
2006	11.93	77.9	15.3%	33%

Without any further action, it is predicted that by 2040, regional GHG emissions will increase by 87.3% (based on stage two initial estimations) relative to 2001 levels. The current national Kyoto commitment requires New Zealand to reduce its GHG emissions back to 1990 levels by 2012. If the Auckland region were to achieve this, we would need to reduce GHG emissions by approximately 40% (based on stage two initial estimations) by 2012.

In stage three a suite of potential mitigation options were identified and mitigation options for reducing regional GHG emissions were evaluated using multi-criteria analysis to determine cost effective policy interventions to deliver GHG emission reductions and broader co-benefits for Auckland region. The methodology, findings and outcomes of stage three are detailed in the conference paper Hughes, J, Goldthorpe, S. and Perry, R.H., (2010).

In undertaking stage four, URS calculated estimated that the Auckland region's GHG emissions in 2009 (Table 3) totaled 10.040 million tones of CO_2 equivalent or 7.02 TCO_2e per capita. It is estimated that GHG emissions will increase by 4% by 2015, 12% by 2025, and 33% by 2040. Based on estimated population forecasts for the region it is indicated that GHG emissions per capita will decrease to 6.69 TCO_2e/capita (2015), 6.33 TCO_2e/capita (2025) and 6.06 TCO_2e/capita (2040).

Auckland's carbon emissions profile (Figures 2 and 3) is relatively unique, particularly when compared to similar other cities in Australia and North America. This is because the proportion of GHG emissions is transport related (35% in 2009) as opposed to industry (14% in 2009) or agriculture (5% in 2009). High transport emissions means that any package of mitigation measures for the Auckland region is likely to be different to packages for much of the rest of New Zealand, emphasising more sustainable transport options and spatial planning measures ahead of agricultural innovations.

Table 3 Estimated Auckland regional GHG emission footprint for 2009 and projections until 2040.

Greenhouse Gas Emissions (t CO2e)	**2009**	**2015**	**2025**	**2040**
	t CO_2e	**t CO_2e**	**t CO_2e**	**t CO_2e**
Natural gas	603,450	459,708	292,113	147,963
Coal sub bituminous	1,611,720	1,592,476	1,560,911	1,514,734
Diesel	1,297,299	1,527,435	2,005,245	3,016,298
Petrol	2,498,430	2,672,743	2,990,709	3,539,970
Fugitive emissions	225,212	243,360	276,913	336,112
Iron and steel production	1,539,205	1,473,699	1,370,658	1,229,447
Agriculture	590,219	608,753	640,947	692,458
Forestry and other land use	-1,206,922	-1,145,121	-1,049,072	-919,890
Electricity	1,776,226	1,948,479	2,273,481	2,865,399
Air travel	162,420	175,507	199,705	242,399
Marine transport	325,128	351,326	399,766	485,229
Waste	617,698	489,584	332,336	185,868
Total	**10,040,084**	**10,397,949**	**11,293,713**	**13,335,988**

Figure 2 Provisional $CO_{2\text{-eq}}$ estimates for Auckland region for 2009

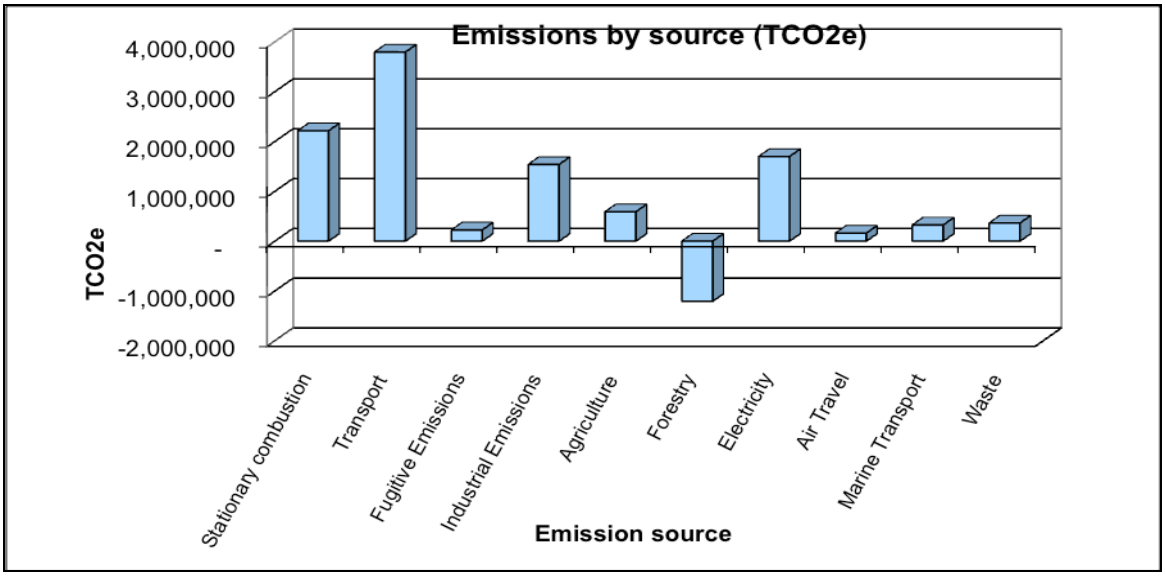
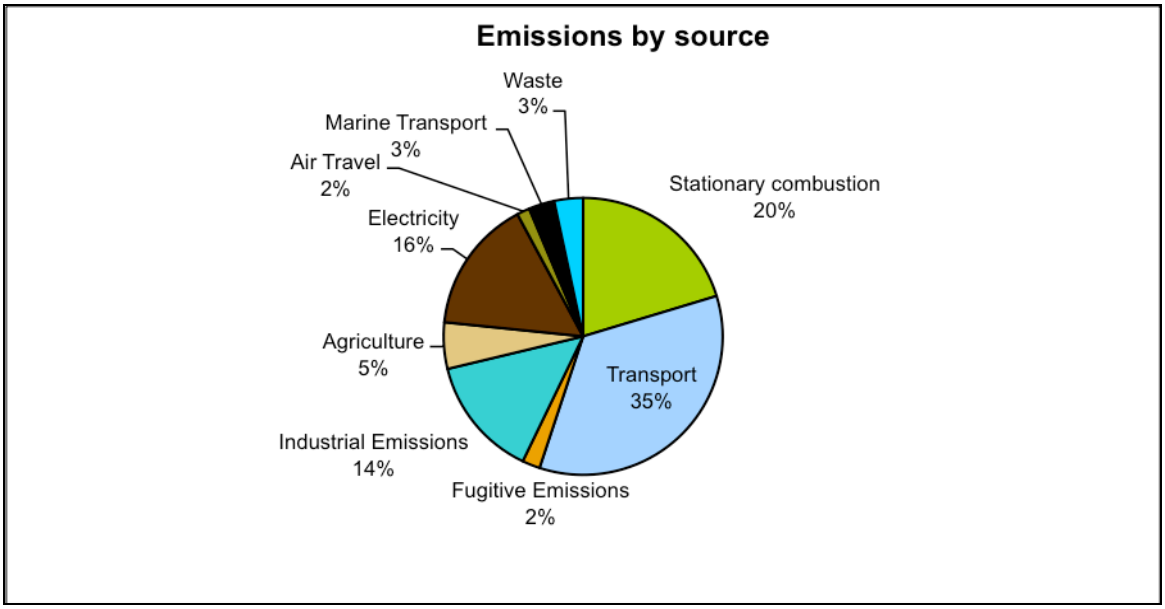


Figure 3 Emissions by source for Auckland region for 2009



The 'Princeton Wedge' is a commonly used term to describe a series of graphical data representations, which are variations on the theme of stabilisation of atmospheric GHG concentrations and the reductions in emissions required to meet a given level. The premise behind a Princeton Wedge graphical representation is that each wedge represents one greenhouse gas emissions scenario. The 'y' axis typically contains atmospheric greenhouse gas concentrations. Such a display allows the effect of one scenario to be easily visualised and compared with the effect of another scenario. In the business as usual CO_2-equivalent emissions

Projections for Auckland region, eight 'wedges' depict eight different greenhouse gas concentration stabilisation scenarios. The different colours each represent a range of possible atmospheric GHG concentrations, which correlate to various GHG emissions rates. It is clear

from this 'Princeton Wedge' type of representation that reducing emissions does not have an immediate effect.

Figure 4 Provisional estimate of business as usual CO_2-eq emissions projections for Auckland region 2001 to 2006.

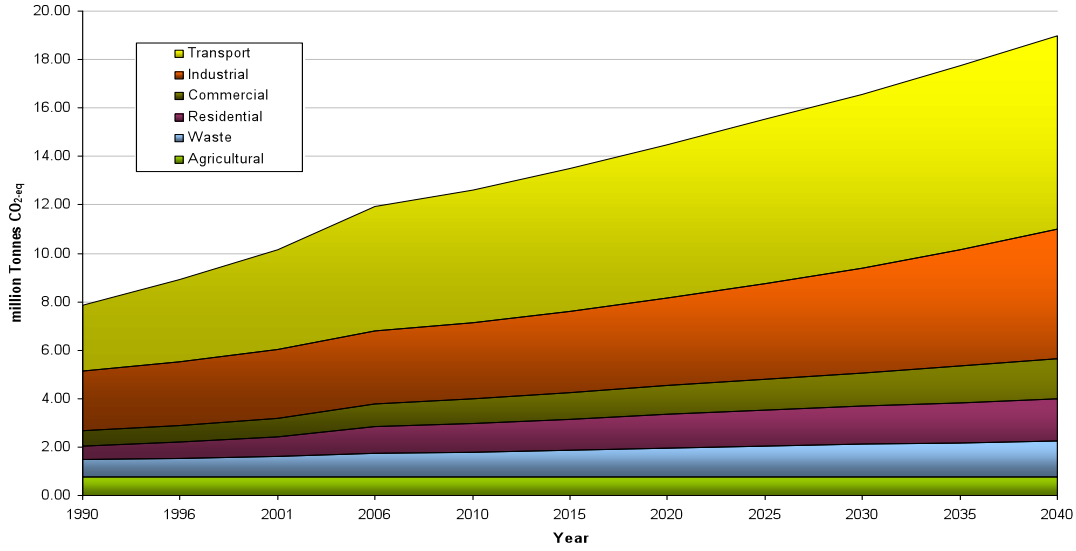
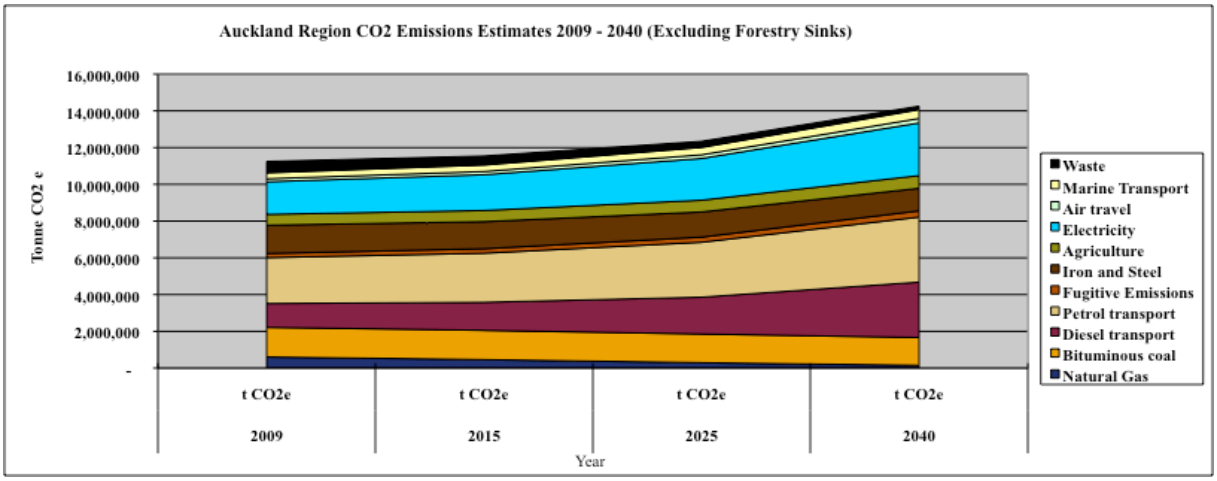


Figure 4 illustrates business as usual GHG emissions projections as developed by Maunsell AECOM in 2008. It was estimated that by 2040 total GHG emissions for the Auckland region would be 11million tonnes above 1990 levels. It is noted that both 1990 and 2006 years have been used for comparative purposes: 1990 because this aligns with New Zealand's Kyoto Protocol commitments and 2006 because this aligns with the most recent baseline data set developed.

Initial business as usual emissions projections (based on a 2009 baseline) undertaken by URS in Stage four of the Carbon Now project is illustrated in Figure 5. This reaffirms that projected increases in long term GHG emissions are primarily driven by electricity and transport. Based on previous consumption figures natural gas and coal usage for non-electricity production is shown to be decreasing, although this inference is based on a limited dataset (10 years). There is also a slight decrease in GHG emissions form iron and steel production. With respect to forestry sinks, a slight drop in forestry sinks is anticipated out to 2040, although it should be noted that the national data from which the analysis data was sourced indicated a large drop in forestry assets in the period 2007-2009. This skews the results and has the effect of putting a slight fall in the forecast CO_2 equivalent sink volume (Forestry sinks are not included in Figure 5).

Figure 5 Updated business as usual projections from revised 2009 baseline data.



Detailed analysis undertaken, as part of the Carbon Now review as undertaken by URS has developed revised scenarios based on a revised baseline. This assessment was based on a deterministic model, that is, the use of a single number to represent an inferred growth rate. To provide a greater level of confidence in the projections we have recommend a probabilistic assessment be undertaken at some stage in the future that would better reflect the uncertainty (or randomness) in some of the input data. For example, population growth may be best expressed in three scenarios - high growth, business as usual and low growth. Each of these scenarios will give rise to differing GHG emissions. The results can then be expressed as a percentile i.e. 95% of the time an emission is estimated to be less than this value. 'Monte Carlo simulation' affords itself well to undertake this kind of work. Monte Carlo simulation is a computerised mathematical simulation technique that provides a range of possible outcomes and the probabilities they will occur for any choice of action, by building models of possible results by substituting a range of values for any factor that has inherent uncertainty.

While there are multiple international guidance and conventions for measuring the GHG emissions and removals, the inherent points of flexibility results in limited consistency in the interpretation of international standards and therefore comparability across tiers and jurisdictions of local government. Currently, there is no widely available tool for estimating community-level inventories and tracking progress over time. This is a direct result of the demise of the CCP – NZ programme. It is envisaged that the next step is to develop trial the Carbon Now inventory tool across other areas of local government with a view to possible development for web based application nationally across local government.

The development of a user friendly web based front end tool would provide consistent methodology and data sources, enabling all regions to include the same activities and use the same emissions factors to produce inventories. Further, a web based tool allows methodologies and emission factors to be updated centrally, reducing the time frame and cost of this exercise for all councils and maintaining comparability between inventories and between councils over time. Collaboration across council jurisdictions would thus become a great deal easier. A standardised, easily used tool would have the added benefits of: providing transparency and consistency in how local government corporate and community level inventories are developed; reducing the total workload across the country by removing the need for each council to develop its own inventory tool; assisting regional councils to build their inventories from the bottom up by aggregating their local councils' inventories; and

assisting small, under resourced councils to contribute to the regional climate change response for least effort.

Conclusion

As a means of encouraging emissions reductions in local communities, a number of councils in New Zealand are already, and have for a number of years, been reporting their GHG emissions through CCP-NZ (an initiative aimed at empowering local councils to take responsibility for measuring and reducing community GHG emissions). This has been extremely important in encouraging councils to address their energy profile and better understand possibilities for energy efficiency and GHG emissions reduction. However, whilst it has helped to raise awareness within councils for the need to reduce emissions (and identify specific areas of the energy profile to target), the varied interpretation of the methodology (using a 'top down' approach) by different councils has meant that comparability is difficult.

A need for greater consistency in the interpretation and reporting of GHG emissions, coupled with a need for greater comparability and compatibility between council's emissions figures, has led ARC to seek a simpler approach to the accounting for emissions. The Carbon Now framework introduces a clear and concise approach for local government to measure emissions, to prepare reduction targets and to provide the opportunity to track reductions against the agreed targets. All councils within the Auckland region are signed up to this framework.

Initial estimations indicate that the Auckland region's GHG emissions for 2006 totalled 11.93 million tonnes of CO_2 equivalent. This was an increase of 1.79 million tonnes in the five years since 2001. The Auckland's regional GHG emissions have risen by approximately 17.7% between 2001-2006 compared to a 26% rise in national GHG emissions since 1990.

Without any further action, it is predicted that by 2040, regional GHG emissions will increase by 87.3% relative to 2001 levels (based on stage two initial estimations). The current national Kyoto commitment requires New Zealand to reduce its GHG emissions back to 1990 levels by 2012. If the Auckland region were to achieve this, we would need to reduce GHG emissions by approximately 40% (based on stage two initial estimations) by 2012.

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