CAWTHRON

Measuring District-Wide Greenhouse Gas Emissions

Cawthron Report No. 1571

February 2009

Measuring District-Wide Greenhouse Gas Emissions

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Prepared for

Nelson City Council

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Reviewed by: Helen Mussely

Approved for release by: Jim Sinner

Recommended citation:
Challenger IW 2009. Measuring District-wide Greenhouse Gas Emissions. Prepared for Nelson City Council. Cawthron Report No. 1571. 23 p.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

There is scientific consensus that human-induced "climate change is a serious and urgent issue … [that warrants] strong action to reduce greenhouse gas emissions" (Stern 2007, Pp. xiii). Nelson City Council recognises this need and joined Communities for Climate Protection (CCP-NZ) to enable it to respond (Nelson City Council 2008).

During consultation into the draft local action plan, it was observed by submitters and council staff that there was a lack of detail regarding current emissions. One submitter stated that the action plan needed to include a data collection programme (Nelson City Council 2008). As a result it was decided that a robust data collection and reporting process should be developed and Cawthron Institute was commissioned to assist Nelson City Council to develop such a system.

The CCP-NZ methodology for measuring, in particular, the community's emissions means that the results are not as accurate as they could be. This in turn limits the council's ability to manage emissions. In this report an alternative methodology for measuring both corporate and community emissions was developed, based on international standards, research carried out by ICLEI, and work undertaken by Lincoln University on behalf of Kaikoura District Council.

Broadly that methodology is as follows:

- Setting the "organisational" boundary
- Setting the "operational" boundary
- Identification of emissions sources and emissions factors
- Collection of activity data and emissions factors
- Quantifying and calculating the greenhouse gas emissions and removals
- Preparation of emissions report
- Developing a quality plan to document the process used to collect data

This methodology will enable Nelson City Council to commence measuring emissions in the coming year. In the process of developing this methodology it became apparent that there are several areas in need of further consideration and investigation. Such investigation should occur as soon as possible to ensure that the most accurate picture possible is presented of Nelson's emissions.

It is recommended that Cawthron Institute conduct a carbon inventory of the Nelson Community and update the inventory for Nelson City Council in order to incorporate those emissions not previously included.

It is also recommended that Cawthron Institute investigate the following questions and issues that arose in the course of developing this methodology:

1. Is there a need to report emissions from embodied energy in council-owned assets and facilities and what is a possible methodology for this if required?

2. What method can be used for measuring fugitive emissions from air conditioning and refrigeration units and where can the emissions factors be obtained from?
3. What is a possible method for measuring emissions from agriculture, forestry and land use changes and from the emissions reductions of forestry plantations?
4. What is a possible method for measuring reductions in emissions from Nelson City Council's gas to energy facility?
5. What is a possible method for measuring upstream and downstream emissions of both the corporate and community sectors and is there a need to do so?
6. What is a possible method for measuring emissions from industrial processes and what is an appropriate source of data?
7. What is a possible method for the estimating emissions from waste to landfill and wastewater for future years?
8. What is a possible method for measuring emissions of non-road transport?
9. Are emissions from fuel purchased within the Nelson City Council boundary but not used within its boundary balanced by emissions from fuel supplied outside the city boundary but used within it?

The cost of carrying out these recommendations is estimated to be $45,000 plus GST however this is indicative at this stage and is subject to further discussions to confirm the scope of work. It is also quite feasible to split this project into its different components (*i.e.* the corporate footprint and the community footprint) and that these could then be submitted separately for Envirolink funding.

It is believed that in answering these questions and carrying out the initial carbon inventory this will provide Nelson City Council with a robust methodology which is repeatable in future years and will enable the effective management of Nelson City's greenhouse gas emissions.

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1. INTRODUCTION AND THE CCP-NZ PROCESS

The Nelson City Council is one of 34 New Zealand councils to have joined the Communities for Climate Protection (CCP-NZ) programme. A government sponsored programme, CCP-NZ provides local authorities with a framework for identifying and implementing actions to reduce greenhouse gas (GHG) emissions. It is delivered by the International Council for Local Environmental Initiatives (ICLEI[1]) Oceania as part of ICLEI's International Cities for Climate Protection Campaign (ICLEI Oceania 2008).

The CCP-NZ methodology dictates that councils work through the following five milestones (ICLEI Oceania, 2008):

Milestone 1 – measure and forecast greenhouse gas emissions

Milestone 2 – establish emissions reduction goals

Milestone 3 – develop and adopt a local action plan

Milestone 4 – implement the local action plan

Milestone 5 – monitor and report on achievements

Each milestone comprises of a corporate or internal council component (emissions over which the council has direct control and responsibility) and a community component (emissions that are generated in the geopolitical area which the council controls). The member council agrees to achieve all five milestones on becoming a member of CCP-NZ (*ibid.)*.

To date Nelson has achieved Milestones 1, 2 and 3 for both the corporate and community sectors. Collection and reporting of a local authority's greenhouse gas (GHG) emissions occurs under Milestone 1.

1.1. Corporate Sector

The corporate emissions inventory, which is the same as a company footprint measured by the international standard ISO 14064-1, is broken down into six sectors (ICLEI Oceania 2008):

1. Buildings – emissions resulting from energy use of council operated building
2. Streetlights – emissions resulting from energy use of streetlights
3. Vehicle fleet – emissions resulting from fuel use of council operated vehicles and machinery
4. Employee commute – emissions resulting from council staff travelling to and from their place of employment (this sector is not compulsory)

[1] ICLEI –Local Governments for Sustainability, was founded in 1990 as the International Council for Local Environmental Initiatives, and is a not-for-profit association of local governments who have made a commitment to sustainability. ICLEI's mission is to achieve tangible improvements in environmental conditions through local action (ICLEI Oceania 2008).

5. Water and sewage – emissions resulting from energy use in council-operated buildings, equipment and facilities that are used to pump and treat water and wastewater
6. Waste – emissions resulting from disposal of waste produced by council operations and activities

At present the collection of corporate emissions data is relatively simple and robust. Information is obtained from primary sources within council such as electricity invoices and fuel accounts, or from research into the commuting activity of employees. Once collected the data is entered into the CCP-NZ website which converts the activity into tonnes of carbon dioxide equivalent (CO_2-e). Data is collected for a specific base year and a forecast is made against that year assuming "business as usual".

1.2. Community Sector

The community emissions inventory has no similarities with existing standards for measuring emissions and is unique to ICLEI's CCP programme. It is broken down into five sectors (ICLEI Oceania 2008):

1. Residential – emissions resulting from household energy use within the council district
2. Commercial – emissions resulting from commercial operations including government institutions, retail and service providers
3. Industrial – emissions resulting from energy used in local industrial operations (including agriculture)
4. Transport – emissions resulting from fuel use associated with moving people and goods within the district
5. Waste – emissions resulting from waste disposed of to landfill by the community

Like corporate emissions, community emissions are collected for a specific base year and a forecast assuming "business as usual" is made against that year. In the absence of any locally available data, the community emissions data is provided by CCP-NZ who sources it from Statistics New Zealand, Ministry of Economic Development, Energy Efficiency and Conservation Authority (EECA) and the New Zealand Transport Agency.

This proxy data is generally national data and not specific to a particular community. National averages, for example of household energy use, are applied against local population data. The accuracy of this national data for a given community cannot be assumed as regional differences may be significant. In addition measurement is by a third party and is not provided on an ongoing basis meaning that it does not readily assist in the management of community emissions.

The problems with the methodology for assessing community emissions have been highlighted by the Nelson City Council while undertaking the CCP-NZ process. During consultation around the local action plan (Milestone 3), submitters and council staff observed that there was

a lack of detail regarding current emissions. One submitter stated that the action plan needed to include a data collection programme to be effective (Nelson City Council 2008).

It became clear that a better methodology is required for assessing community emissions, one that meets the requirements of CCP-NZ as well as the local community. As a result it was decided that a robust data collection and reporting process should be developed. Cawthron Institute was commissioned to assist Nelson City Council develop such a system.

2. INTERNATIONAL CARBON ACCOUNTING STANDARDS

Carbon accounting is the process of calculating and reporting the total GHG emissions of an organisation, company or individual. Preparation of a carbon account is the first step in managing emissions, in effect Milestone 1 of the CCP-NZ process.

A local authority is a unique institution in that its GHG emissions originate from two different sources, firstly the local authority organisation itself and secondly the community it represents. While a company calculating its GHG emissions need only consider the organisation itself, the local authority must look further and consider areas it can influence as well as those it controls.

There are two systems for measuring carbon footprints. The first calculates emissions of the company itself without consideration of upstream or downstream emissions. The second calculates emissions of a specific product produced by the company (and includes upstream and downstream emissions related to that product). International standards are available for both systems of measurement.

The standards for a company wide footprint are ISO 14064 Part 1 "*Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removals*" (ISO) and the World Resources Institute's "*Greenhouse gas protocol, a corporate accounting and reporting standard*".

The standard for calculating a product footprint is the Publicly Available Specification[2] (PAS) 2050, released by British Standards in October 2008. PAS 2050 assesses emissions across the full life cycle of a product, from production to consumer. It is applicable to all goods and services, from manufacture of a computer to an internet banking service.

The approach of all three standards is compatible, with each adopting the following principles:

- *Relevance:* selected GHG sources are appropriate to the needs of the user

[2] Although the status of a PAS is the same as a standard, the two do have distinct differences. ISO defines a PAS as "a normative document representing the consensus within a working group" (ISO 2008). Development of a PAS is quicker and easier than a standard, thus a PAS is developed when an issue urgently requires a normative solution. Subsequently it can however be converted into a standard.

- *Completeness:* all relevant GHG emissions are included
- *Consistency:* comparisons of GHG-related information are possible
- *Accuracy:* bias and uncertainty are reduced as much as is practical
- *Transparency:* it discloses sufficient and appropriate methodological details

Since PAS 2050 relates to emissions from individual products, it is not relevant to local authorities in the context of CCP-NZ. ISO 14064-1 and the GHG protocol standards on the other hand are directly relevant to local authorities.

ISO 14064-1 is based in a large part on the GHG protocol. Both use the same methodology, are widely recognised and have been adopted as the method for monitoring and reporting a company's carbon footprint.

The methodology used by the both these standards is shown in Figure 1 below:

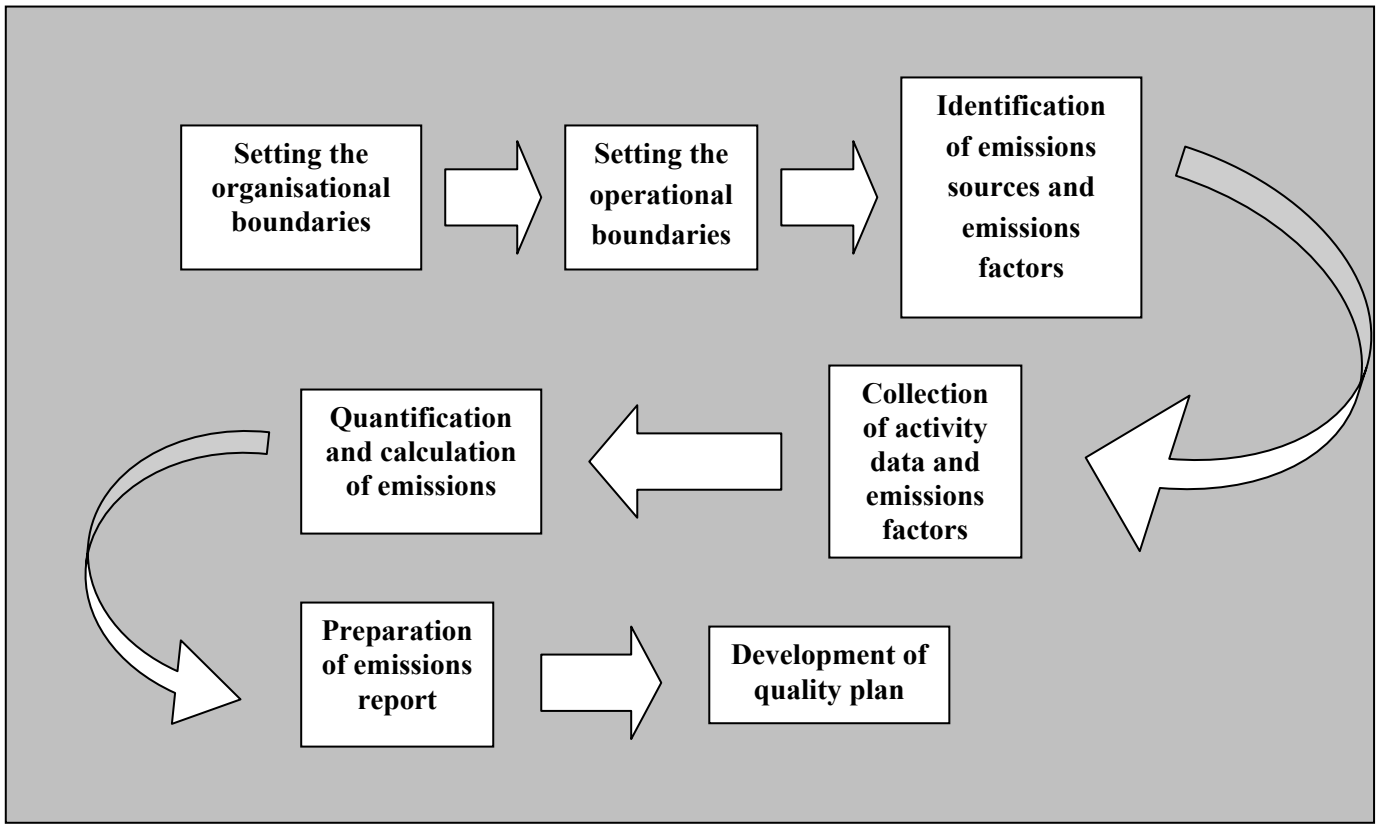

Figure 1. ISO 14064-1 and GHG protocol methodology.

3. PROPOSED METHODOLOGY

3.1. Background

The methodology being proposed to Nelson City Council is a hybrid system combining ISO 14064-1 with CCP-NZ requirements and building on similar research carried out for Kaikoura District Council.

ISO 14064-1 is particularly relevant to CCP-NZ's corporate sector as it provides a process for measuring emissions resulting from functions directly under a company's control. This is exactly the same as the CCP-NZ programme which states that corporate emissions shall be measured.

Emissions from the community sector are defined by CCP-NZ as those associated with activities occurring within the local government's geopolitical boundary (ICLEI 2008). Although not the result of its own activities, such emissions can be controlled or influenced by the policies of and education by the local authority.

This lack of direct council control makes the ISO 14064-1 standard of less relevance to the community emissions sector. It does however provide an applicable process that can be adapted to the requirements of this sector. The proposed methodology uses the ISO 14064-1 process as shown in Figure 1 for the framework for measuring both corporate and community sector emissions.

The case for using ISO 14064-1 is further strengthened by ICLEI's own documentation, in particular their *"International Local Government GHG Emissions Analysis Protocol"* (with a New Zealand Supplement), released in 2008. The purpose of this document was to increase the accuracy of measurement, provide local authorities with a standardised method for quantifying GHG emissions to enable comparisons between authorities, and to operate in parallel with GHG certification opportunities (ICLEI 2008).

The protocol follows the World Resources Institute's GHG protocol and, therefore by default, the ISO 14064-1 standard. It adopts the principles of these documents as outlined in Section 2 above, namely relevance, completeness, consistency, accuracy and transparency. Additionally it recognises the Intergovernmental Panel on Climate Change (IPCC) categorisation of emissions sources, combining these with CCP-NZ's requirements.

Broadly speaking the protocol recommends compiling activity data for energy use and waste production and multiplying this data against the relevant emissions factors. The result will quantify emissions of all six Kyoto greenhouse gases (carbon dioxide, methane, nitrous oxide, PFC, HFC and SF_6), for the corporate and community activities of the local authority and record these emissions as CO_2-e.

The protocol also specifies rules for emissions from biofuels and generating electricity or heat from biological sources (such as landfill gas). In both cases any CO_2 emitted is not considered to be anthropogenic as, under natural circumstances, it would have been released anyway[3]. It is therefore not necessary to include any CO_2 emitted, but emissions of other Kyoto gases from biofuels should be included (*ibid.*).

3.2. Relationship between CCP-NZ and IPCC sectors

The ICLEI protocol also states that local governments shall categorise both corporate and community emissions into the Intergovernmental Panel on Climate Change sectors (IPCC). The relationship between CCP-NZ sectors and the IPCC sectors is not always obvious so this has been clarified in Table 1 below:

Table 1. Relationship between CCP-NZ and IPCC emissions sectors (ICLEI 2008).

<table>
<tr><th colspan="2">Macro Sector (IPCC)</th><th>CCP-NZ Corporate Sector</th><th>CCP-NZ Community Sector</th></tr>
<tr><td rowspan="5">Energy</td><td rowspan="3">Stationary Combustion</td><td>Buildings and facilities</td><td>Residential</td></tr>
<tr><td>Street lights and traffic signals</td><td rowspan="2">Commercial</td></tr>
<tr><td>Water/sewage (energy only)</td><td>Industrial</td></tr>
<tr><td rowspan="2">Mobile Combustion</td><td>Vehicle fleet</td><td rowspan="2">Transportation</td></tr>
<tr><td>Employee commute</td></tr>
<tr><td>Fugitive Emissions</td><td>Not measured</td><td>Not measured</td></tr>
<tr><td colspan="2">Industrial processes and product use</td><td>Not measured</td><td>Not measured</td></tr>
<tr><td colspan="2">Agriculture, forestry and other land use</td><td>Not measured</td><td>Not measured</td></tr>
<tr><td rowspan="4">Waste</td><td>Solid waste disposal</td><td rowspan="4">Waste</td><td rowspan="4">Waste</td></tr>
<tr><td>Biological treatment of waste</td></tr>
<tr><td>Incineration and open burning of waste</td></tr>
<tr><td>Wastewater treatment and discharge</td></tr>
</table>

[3] The biomass used in biofuels releases CO_2 whether it is used in biofuel or dies at some other point so it's release has a neutral effect. Landfills and sewage facilities create anaerobic conditions causing the release of methane, but decomposition in aerobic (natural) conditions produces CO_2. Capturing and oxidising the landfill and sewage gas converts it to CO_2 which would have happened anyway and is therefore considered neutral.

3.3. The process

The remainder of this section will provide background information on each step of the ISO process (as shown in Figure 1) and then present the recommended methodology for **corporate emissions** and **community emissions** separately.

3.3.1. Setting the organisational boundaries

For an individual company, the organisational boundary determines which facilities or subsidiaries will be included or excluded from the carbon inventory. Where there are multiple sites and/or subsidiaries the emissions from each need to be consolidated to establish the total emissions for the company. The organisational boundary can be set based on either the level of financial or operational control that the company has over a subsidiary or facility, or by the equity share the organisation has over the facility or subsidiary.

Application to corporate emissions methodology

The organisational boundary will include all emissions that are a consequence of the operations of the local authority, regardless of where they occur (inside or outside the council geopolitical boundary) (ICLEI 2008). This means that all buildings, vehicles, and facilities that are owned or operated by the council, need to be included in the inventory, regardless of where they are used or located.

Application to community emissions methodology

The community organisational boundary is the geopolitical boundary of the local authority and emissions resulting from activities within that boundary need to be measured. Emissions that occur outside the community's geopolitical boundary but that are the responsibility of the community will also be collected. For example, the emissions from a community's landfill are included even if the landfill is located within the boundary of a neighbouring authority.

3.3.2. Setting the operational boundaries

The operational boundary relates to which sources of emissions to include and which to exclude. These emissions are categorised as follows (ISO 2006):

- Scope 1 emissions are those resulting directly from the organisation's (corporate) operations, and from the activities of the community.
- Scope 2 emissions are indirectly created by the corporate or community sectors through the importing of electricity, heat or steam generated elsewhere.
- Scope 3 emissions are from indirect sources such as air travel, car hire, taxis, and waste production that the corporation or community causes to be emitted by others, due to the purchase of goods and services.

Under the ISO and GHP standards, measuring Scope 1 and 2 emissions is compulsory while measuring Scope 3 is voluntary. In general if a Scope 3 emission is significant in terms of quantity or the goals of the organisation then it should be included. Thus if air travel is required for a company to conduct its business then these emissions should be collected even if it is a small percentage of total emissions.

The GHG protocol recommends that Scope 3 emissions be included if possible, though it recognises that their inclusion may make it difficult to compare different companies (World Resources Institute 2004). ISO 14064-1 also makes allowance for measuring emissions reductions if it is possible to calculate them.

Application to corporate emissions methodology

The operational boundary for corporate emissions is shown in Table 2 below. This identifies the Scope categories that emissions relevant to a local authority fall within.

Table 2. Corporate emissions sources (ICLEI 2008).

Macro Sector (IPCC)		**Scope 1**	**Scope 2**	**Scope 3**
Energy	Stationary Combustion	Utility-delivered fuel consumption (*e.g.* natural gas) Decentralised fuel consumption (*e.g.* propane, kerosene, fuel oil, stationary diesel, biofuels, coal) Utility-consumer fuel for electricity/heat generation	n/a	Stationary combustion-based emissions from facilities operated by contracted businesses performing essential government services Upstream/downstream emissions (*e.g.* mining/transport of coal)
	Electricity/heat consumption	n/a	Electricity/heat/ steam/ consumption	Electricity/heat/steam consumption-based emissions from facilities operated by contracted businesses performing essential government services Upstream/downstream emissions
	Mobile combustion	Tailpipe emissions from government owned and operated vehicles	n/a	Tailpipe emissions from vehicles operated by contracted businesses Upstream/downstream emissions
		n/a	n/a	Tailpipe emissions from vehicles operated by employees travelling to and from work Upstream/downstream emissions
	Fugitive emissions	Fugitive emissions not already accounted for	n/a	Upstream/downstream emissions
Industrial processes and product use		n/a	n/a	Upstream/downstream emissions
Agriculture, forestry and other land use		Methane from government owned livestock	n/a	n/a
		Net biogenic carbon flux of government own/operated sources	n/a	n/a
Waste		Government owned/operated landfill, incineration, compost and wastewater facilities	n/a	Analysis-year emissions from government waste disposed to date Embodied future emissions associated with analysis-year waste generation Upstream/downstream emissions (*e.g.* transport to the landfill)

It is suggested that the following Scope 3 emissions are collected, (CCP-NZ emissions are marked with an *):

- Losses from distribution of electricity

- Employee business travel (air, hire cars, taxi and ferry travel)
- Employees commuting to and from work*
- Disposal of corporate-generated waste*
- Emissions from contracted services[4]

Longer term consideration should be given to collecting the following emissions:

- Upstream and downstream emissions
- Embodied energy of capital expenditure (it is advised that this should apply to new purchases and constructions only).

At this point however, collection of these emissions will be problematic and therefore needs to be delayed until a methodology has been fully developed.

Application to community emissions methodology

The operational boundary of community emissions is outlined in Table 3 below. This identifies the scope categories that emissions relevant to the community fall within.

[4] It is ICLEI's view that emissions from contractors must be included if the service they deliver is normally provided by a local government, if the emissions were included in any earlier inventories, or if the local government has significant control over the emissions.

Table 3. Community emissions sources (ICLEI 2008).

Macro Sector (IPCC)		Scope 1	Scope 2	Scope 3
Energy	Stationary Combustion	Delivered energy , decentralised energy or utility-consumed energy	n/a	Upstream/downstream emissions (*e.g.* transport)
	Electricity/ heat consumption	n/a	Delivered or decentralised electricity/ heat/steam/consumption	n/a
	Mobile combustion	Emissions from on-road or non-road vehicles operating in the community	Electricity consumption associated with vehicle movement (*e.g.* light rail)	Emissions from vehicles used by residents or from vehicles departing from or arriving in community Upstream/downstream emissions
	Fugitive emissions	Fugitive emissions not already accounted for	n/a	Upstream/downstream emissions
Industrial processes and product		Decentralised process emissions	n/a	Upstream/downstream emissions
Agriculture, forestry and other land use		Livestock methane, managed soils	n/a	Upstream/downstream emissions from fertiliser/pesticide manufacture
		Net biogenic carbon flux	n/a	n/a
Waste	Solid waste disposal	Direct emissions from landfill, incineration and compost facilities located inside the community	n/a	Landfill, incineration and compost emissions in present year from waste produced to date inside the community. Future emissions from waste disposed Upstream/downstream emissions (*e.g.* transport to the landfill)
	Wastewater treatment and discharge	Direct emissions from wastewater facilities located inside the community	n/a	Present-year emissions from wastewater produced to date inside the community Future emissions from treated wastewater Upstream/downstream emissions (*e.g.* transport to facility)

It is suggested the only Scope 3 emission to be collected at this stage is losses from the distribution of electricity. The remaining Scope 3 emissions are listed below:

- Upstream and downstream emissions
- Emissions from vehicles used by residents or vehicles departing from or arriving in community[5]
- Emissions from landfill waste for the present year

[5] Councils can choose to measure either emissions from on-road or non-road vehicles operating in the community or emissions from vehicles used by residents or vehicles departing from or arriving in community but not both. Cawthron's recommendation is to measure emissions from on-road or non-road vehicles operating in the community.

- Emissions from landfill waste for future years
- Emissions from waste water produced in the year to date
- Emissions from waste water produced in future years

Collection of these emissions should be delayed because either a methodology does not exist or there are no easily obtainable emissions factors.

3.3.3. Identification of emissions sources and emissions factors

Emissions sources and sinks are identified and documented, with sources and sinks within each scope identified and documented separately. Generally sources and sinks fall within the following categories (ICLEI 2008):

- Stationary combustion of fuel within boilers, stationary engines, heating units *etc.*
- Mobile combustion of fuel in transportation devices such as cars, trucks, planes *etc.*
- Process emissions from physical or chemical processes, for example the calcination step in cement manufacturing.
- Fugitive emissions from leaks in refrigeration equipment, or the release of gas from landfills, wastewater facilities and livestock production.

Internationally accepted practice recommends the exclusion of emissions sources that are less then 1% of the total inventory as long as combined they do not account for greater than 5% of the entire inventory. There are sharply diminishing returns from seeking to document and estimate the last few percent of emissions and it is possible that sources such as fugitive emissions within the corporate sector will fall into this category.

Emissions factors are factors that enable the GHG emissions to be estimated from a particular activity (MFE 2008). For every source and sink identified an emissions factor must also be available. These factors can be sourced from government agencies, either national or international, universities or research organisations, regional authorities and councils, non-government organisations and corporate reports.

In the absence of any locally obtainable data the most readily available emissions factors in New Zealand are those provided by the Ministry for the Environment in their "Guidance for Voluntary, Corporate Greenhouse Gas Reporting" which is publicly available from http://www.mfe.govt.nz/publications/climate/guidance-greenhouse-gas-reporting-apr08/index.html.

Application to corporate emissions methodology

The corporate *emissions sources* that are necessary to measure are the Scope 1 and 2 emissions identified in Table 2 above. In addition consideration should be given to the measuring the Scope 3 emissions outlined in Table 2. Emissions reductions from waste to energy facilities and forestry can be included.

Emissions factors can be sourced from the Ministry for the Environment document detailed above. If this does not provide the factors required then advice should be sought as to the next best available source.

Application to community emissions methodology

The community *emissions sources* that are necessary to measure are the Scope 1 and 2 emissions identified in Table 3 above. In addition consideration should be given to the collection of the Scope 3 emission - losses from distributed electricity. Emissions reductions from waste to energy facilities and forestry can also be included.

Emissions factors should again be derived from the Ministry for the Environment document referred to above and again, if this does not identify the factor required, then advice should be sought as to the next best available source.

3.3.4. Collection of activity data and emissions factors

Activity data shall be collected for each source and sink. PAS 2050 specifies that for processes owned and operated by the organisation conducting the inventory, this data shall be from primary sources. For upstream and downstream emissions, secondary data can be used, however the use of peer reviewed publications, documents from national governments or the United Nations is preferable to other secondary sources (BSI 2008).

Regardless of where activity data is sourced from it should relate to the time being assessed, be geographically and technologically specific, and be accurate (*ibid.)*.

Emissions factors will be obtained from a recognised source and for practical reasons this will generally be from a secondary source such as New Zealand's Ministry for the Environment annual publication of emissions factors. If possible it is preferable for the emissions factor to be obtained from source or facility-specific data.

Factors will also be current at the time of quantification, appropriate for the source or sink and able to allow for uncertainty in order to obtain an accurate carbon inventory (ISO 2006).

Both activity data and emissions factors must be as accurate as possible, although with increased accuracy the level of difficulty in collecting the data also increases. In their emissions analysis protocol ICLEI refer to three "tiers" of data accuracy (ICLEI 2008). Tier 1 data utilises IPCC country level defaults, while Tiers 2 and 3 are each more accurate and require more effort to collect. Tier 3 is the most accurate, being derived from local research and specific to the area or company conducting the analysis.

ICLEI states that it may be necessary to use several tiers when collecting data but the most accurate data (tier) possible must be used to calculate emissions.

Application to corporate emissions methodology

Table 4 below identifies the tiers and possible sources of corporate sector activity data.

Table 4. Sources and tiers for corporate sector activity data.

Scope	Emission source	Source of activity data	Tier
Scope 1	Buildings and facilities* (coal, gas and other energy)	Invoices for energy (Coal, LPG, propane *etc*.)	Tier 3
	Vehicle fleet* (petrol and diesel consumption)	Invoices for fuel	Tier 3
	Fugitive emissions	General industry data	Tier 2
	Forestry and land use change (council owned land only)	Council planting records	Tier 3
Scope 2	Buildings and facilities* Street lights and traffic signals* Water and sewer*	Kilowatt hours off electricity invoices	Tier 3
Scope 3	Business travel	Travel invoices (air and hire car) and staff expense claims (taxi use)	Tier 3
	Losses from distributed electricity	Kilowatt hours off electricity invoices	Tier 3
	Employee commute*	Primary research of staff	Tier 3
	Waste*	Records of waste disposed of from corporate buildings, public parks and facilities	Tier 3
	Contracted services	Records from contractors, spreadsheets may need to be provided to assist with collection	Tier 3

* indicates that these sources are also CCP-NZ sectors

The emissions factors will be derived from the Ministry for the Environment's "Guidance for Voluntary, Corporate Greenhouse Gas Reporting" document which is classified as Tier 2 data.

Application to community emissions methodology

Activity data and emissions factors for the community sector will also be as accurate as possible. In collecting this data a variety of tiers and sources are required and these are outlined in Table 5 and Table 6 below.

The emissions factors will also come from the Ministry for the Environment Tier 2 information.

Table 5. Sources and tiers of Scope 1 community sector activity data.

IPCC sector	Emission Sector (*denotes CCP-NZ sector)	Emission source	Source of activity data	Tier
Stationary combustion	Residential * Commercial* Industrial*	Coal, gas, fuel oil,	Direct from the utility company & reported by sector if possible If not sectors can be combined, but this must be documented. [6] [7]	Tier 3
Mobile combustion	Transportation* (on-road vehicles)	Petrol, diesel, LPG	Direct from oil company, or the local authority petroleum tax,[8] or estimated based on vehicle distance modelling	Tier 2
	Transportation (non-road vehicles)	Aviation and marine fuel	Direct from the airport or calculated based on flights from Nelson Airport. For marine fuel the port authority could possibly provide data.[9]	Tier 3
Fugitive emissions		Air conditioning/ refrigeration units	This requires further investigation. ICLEI suggests this is problematic and that Tier 1 data maybe necessary.	Tier 2

[6] ICLEI allows for the combining of sectors if needed. It may be possible to use Tier 2 data from the Ministry of Economic Development and Energy Efficiency and Conservation Authority to classify this information into sectors and this requires further investigation.

[7] The provider may not wish to provide the data due to commercial sensitivity, but as the data is reported as a combined figure that cannot be isolated, a non-disclosure agreement may be appropriate to overcome this.

[8] Previous research (Hoehe H 2001; McNicol J, Shone M, Horn C 2002) indicates that oil companies will not supply data on fuel use for commercial sensitivity reasons. The local authority petroleum tax is a useful alternative but is based on the fuel supplied in the district, not necessarily consumed in the district. However it can be assumed that some fuel will be supplied outside the district but consumed inside, as such it was considered by the studies referred to above that this situation balances itself out.

[9] At present Kyoto excludes air and sea travel as it cannot be attributed easily to either the departing or arriving points. Also the airport services a much wider area and as such not all emissions are the result of Nelson people travelling; both these issues need further consideration before measurement occurs.

IPCC sector	Emission Sector (*denotes CCP-NZ sector)	Emission source	Source of activity data	Tier
Agricultural, forestry and other land use	Forestry and land use changes	Tree Planting (reductions) Soil carbon	Requires further investigation. It may be possible to obtain this from Ministry for the Environment's land use and carbon analysis system	Tier 2
	Agricultural emissions	Methane from farm animals	Obtained from government sources	Tier 2
Industrial process emissions		Emissions from heavy industry	This requires further investigation to establish what process emissions occur in Nelson.[10] ICLEI suggests this is problematic and that Tier 1 data maybe necessary.	Tier 2
Waste	Solid Waste*	Landfill emissions	From council records on waste to landfill, less gas to energy reductions	Tier 3
	Wastewater	Methane from sewage treatment	From council records	Tier 3

Table 6. Sources and tiers of Scope 2 and 3 community sector activity data.

IPCC sector	Emission Sector (*denotes CCP-NZ sector)	Emission source	Source of activity data	Tier
Electricity and heat combustion	Residential *	Electricity consumption	Direct from electricity distributor(s) to the area. Reported by sectors if possible, if not, sectors can be combined, but this must be documented. 6 7	Tier 3
	Commercial *			
	Industrial *			
	Losses from distributed electricity (Scope 3 emissions)			

3.3.5. Quantifying and calculating of emissions

There are several methods available to an organisation for quantifying emissions. Regardless of the choice of methodology quantification must minimise uncertainty, be accurate and be able to produce consistent and reproducible results (ISO 2006).

[10] Research by NIWA (2007) suggests emissions for Nelson are 70,000 tonnes of CO_2-e or 17% of Nelson's total reported in its CCP-NZ inventory, however this appears to include emissions such as wastewater that are included elsewhere in this inventory

Quantification can either be through continuous or intermittent measurement or calculation, the use of modelling, facility-specific correlations or mass balance approaches. However the simplest and most common method is simply to multiply the activity data by an emissions factor. The formula for this calculation is as follows:

$$\text{Tonnes of } CO_2\text{-e} = (\sum \text{ghg activity} \times EF) / 1000$$

Where $\sum$ ghg activity = the sum of greenhouse activity in relevant units, which is multiplied by the relevant EF (emissions factor). This is then divided by 1000 to convert it from kilograms to tonnes of carbon dioxide equivalent (CO_2-e). For example 3000 kwh per year electricity usage x 0.2287 CO_2-e per kwh = 0.6861 tonnes of CO_2-e.

Application to corporate and community emissions methodology

The requirements for the corporate and community sectors are the same and it is recommended that quantifying emissions is done by multiplying the activity data by the relevant emissions factor as defined by the equation above.

3.3.6. Preparation of emissions report

Having completed the carbon inventory, this must be documented in a publicly available report. ISO 14064-1 specifies the full requirements of the report; fundamentally however it quantifies the company's GHG emissions sources and sinks, specifying the total emissions of the company in tonnes of CO_2-e for a specified period.

In addition, the report must include:

- Documentation of the organisational and operational boundaries
- The reason for the exclusion of any sources or sinks
- The base year selected
- A description of the quantification methodology
- Documentation of the emissions factors used
- A statement that the report was prepared in accordance with ISO 14064-1 (ISO 2006)

Application to corporate and community sector emissions methodology

The requirements for the corporate and community sectors are the same with the emissions report prepared by the local authority meeting the requirements of ICLEI's international emissions analysis protocol. ICLEI requires that a local authority emissions report specify the year, organisation and geopolitical area that the report relates to.

The report will cite corporate and community emissions separately and for each sector will cite Scope 1, 2 and 3 emissions separately. It will include all documentation used to prepare the report and a statement specifying the tiers that activity data and emissions factors were

obtained from. Each Scope 1 greenhouse gas will be reported separately and aggregated as CO_2-e with any CO_2 from biomass combustion included for information only. Scope 2 and 3 emissions will only be reported as CO2-e.

In addition to the above, local authorities could consider reporting against a specific unit. For example, emissions against full time equivalent staff members, against floor area of council owned or operated buildings or facilities, or against dollars of revenue (including and excluding rates income).

3.3.7. Developing a quality plan

The carbon inventory, like a financial accounting system, is an ongoing process that enables year-on-year comparisons to be made. For this reason a quality plan is produced to ensure that data collection is consistent between years. The plan documents the process used to collect and calculate data, the choice of organisational and operational boundaries and the rationale for inclusion or exclusion of emissions.

The quality plan will also specify the procedure for reviewing the plan and for providing training in data collection. Also included will be a base year recalculation policy. This enables recalculation of base year emissions (to which all subsequent years will be compared) in the event of the company purchasing or selling any of its operations.

The company must also retain and maintain any documentation that supports the design, development and maintenance of the carbon inventory (ISO 2006). Any third party verification will check the existence of such a plan and the supporting documents as much as they will audit the carbon inventory itself.

Application to corporate and community sector emissions methodology

The requirements for the corporate and community sectors are the same with the development of a quality plan being a necessity. The plan needs to follow the ISO 14064-1 requirements, recording separately any differences in approach of the corporate and community sectors.

4. MEASURES OF BROADER SUSTAINABILITY INDICATORS

The management adage that “You can’t manage what you have not measured” is highly relevant to sustainable management. Unless an impact is measured it is not possible to know where actions and possibly finances are required. An important aspect of a sustainability strategy is therefore to measure sustainable performance

In the first year, measurement is to prepare a benchmark or a base year figure against which future years can be compared. Subsequent years will determine trends and also highlight

where more or less action is needed. The indicators of performance need to be chosen with care to ensure they measure what is required.

Geurk & Manuel (2008), in their paper on social indicators, outline criteria for selecting indicators. The relevant criteria are as follows:

- An indicator must be relevant for an issue according to the definition used.
- An indicator must be measurable.
- If possible indicators should be independent of each other and have no mutual overlap[11].
- Data for an indicator must be available from public, scientific or institutional sources.
- Data must be reliable.
- Data must be recent and be regularly updated.

To assist Nelson City Council measure its internal sustainability performance, Cawthron was asked to provide a description of possible indicators. Table 7 below outlines these proposed indicators. It should be noted however that it was not within the scope of this report to provide a detailed analysis of the methodology for each indicator. Further advice should be sought if such detail is required.

[11] This is not necessarily true and occasionally it is not possible as there may be good reasons for measuring an issue with several indicators.

Table 7. Possible sustainability indicators for internal Nelson City Council performance.

Category	Topic	Indicator
Lean environment	Hazardous waste disposal	Kg of waste deemed hazardous*/kg of waste
Resource use	Water use	Total volume of water used (litres) per annum/dollars of revenue
	Rates of recycling	Kg of recycling/FTE
	Waste production to landfill	Kg of waste/FTE
	Agri-chemical use**	Kg of biodegradable agri-chemicals used per annum/kg of agri-chemicals used per annum
	Cleaning product use**	Kg of eco-label cleaning products used per annum / kg of cleaning products used per annum
	Energy use – electricity	Kilowatt hours of electricity used per annum/FTE
	Energy use – petrol and diesel	Litres of petrol and diesel used per annum/FTE
Sustainable world	Contributions to sustainability (leading by example)	Good news stories***
	Sustainable procurement	Number of environmentally aware suppliers**** dealt with per annum / total number of suppliers

* Hazardous waste is defined in the New Zealand Waste Strategy as "materials that are flammable, explosive, oxidising, corrosive, toxic, ecotoxic, radioactive or infectious. Examples include unused agricultural chemicals, solvents and cleaning fluids, medical waste and many industrial wastes". It is recommended that this definition is used when determining what is hazardous or not.
** It is appreciated that use of these products is likely to be under contracted services. However it is important that their use is measured as chemical use is an extremely visible activity and it is easy to gain kudos by changing behaviour and using more biodegradable products.
*** Good news stories are an outline of internal Nelson City Council activities contributing in some way to sustainability in Nelson. Guidelines will need to be developed to determine how items are included on this list. This is less of an indicator and more of an opportunity for Nelson City Council to lead by example and promote its activities to other organisations in Nelson.
**** The term "environmentally aware suppliers" means those suppliers with at least an environmental or sustainability policy.

5. SUMMARY

CCP-NZ provides councils with a framework for measuring and managing emissions. However the methodology it uses, particularly for the community sector, reduces the accuracy of the results and limits council's ability to manage emissions. This report presents an alternative method, based on ISO 14064-1, ICLEI recommendations and research carried out for Kaikoura District Council.

Although the proposed methodology will enable Nelson City Council to measure emissions in the coming year, it raised several questions requiring further consideration as described below:

- Corporate sector only:
  - Is there a need to measure emissions from embodied energy in council owned assets and facilities and what is an appropriate methodology if measurement is needed?
- Both corporate and community sectors:
  - What is an appropriate method for measuring fugitive emissions from air conditioning and refrigeration units, and what are the appropriate emissions factors?
  - What is an appropriate method for measuring emissions from agriculture, forestry and land use changes and emissions reductions from forestry?
  - What is an appropriate method for measuring reductions in emissions from Nelson City Council's gas to energy facility?
  - What is an appropriate method for measuring upstream and downstream emissions and is there a need to do so?
- Community sector only:
  - What is an appropriate method for measuring emissions from industrial processes?
  - What is an appropriate method for estimating emissions from waste to landfill and wastewater for future years?
  - What is an appropriate method for measuring non-road transport (air and sea travel) emissions?
  - Are emissions from fuel supplied in Nelson city and not used in the city balanced by emissions from fuel supplied outside the city but used in city?

It is clearly possible to measure emissions from the start of the new financial year without answering the above questions. However, it is felt that these questions should be addressed as soon as possible to ensure an accurate picture of Nelson's emissions.

To assist Nelson City Council to answer these questions, Cawthron propose that it carry out a carbon inventory of both the Nelson community and Nelson City Council itself. In so doing, Cawthron will answer the questions raised by this report and provide council with a robust methodology that can be repeated in future years. This wills enable the effective management of Nelson City's greenhouse gases.

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