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Southland Regional Carbon Footprint 2018 Review

On behalf of Great South

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Executive Summary

Great South is Southland's regional development agency that aims to leverage opportunities for Southland in the areas of economic development, business development, tourism and events, and regional wellbeing. Great South commissioned AECOM New Zealand Limited (AECOM) to assist in the development of the Southland Regional Carbon Footprint for the 2018 calendar year.

The Southland Regional Carbon Footprint 2018 follows the BASIC+ methodology outlined in the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC) (WRI, C40, ICLEI, 2014)). It includes emissions from stationary energy, transport, waste, industry, agriculture and forestry activities within the district boundary. AECOM used the City Inventory Reporting and Information System (CIRIS), developed by C40 to collate the greenhouse gas inventory, and in addition, AECOM used an in-house model to calculate emission factors. The study boundary includes the jurisdictions of the Southland District Council, Invercargill City Council, Gore District Council and Environment Southland.

Unless stated otherwise, greenhouse gas (GHG) emissions from the Southland Regional Carbon Footprint 2018 are expressed on a carbon dioxide-equivalent (CO_2e) basis using the 100-year Global Warming Potential (GWP) values including climate-carbon feedback from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) (IPCC, 2014).

thinkstep-anz (thinkstep) reviewed the methodology, data sources and calculations of Southland's Regional Carbon Footprint 2018. This report summarises the findings of the review as well as resulting recommendations.

The review focuses on agriculture and stationary energy as the main emission contributing sectors for Southland (86% of total gross emissions). For the agricultural sector activity data and emission factors were verified and results were recalculated. In the energy sector, the emission factors were verified, but no review procedure was performed on the activity data. The review scope for the remaining sectors was limited to a methodology review and high-level sensitivity checks.

Our review has shown that the carbon footprint is essentially in line with the GPC BASIC+ methodology, and that small deviations from the methodology do not result in major changes to the total Southland Regional Carbon Footprint. Verification of activity data and emission factors did not uncover any missing data and only minor errors in the sector Stationary Energy. Emission factors developed in AECOM's third party verified, in-house tool could not be reviewed. This is especially significant for N_2O emission factors for livestock in the agricultural sector (1,659,690 tCO_2e).

If our adjustments are adopted, the total gross Southland Regional Footprint 2018 would change from 8,910,806 tCO_2e to 8,917,265 tCO_2e, a rise of ~0.1%.

The activity data for several categories is based on national data, we recommend investigating if more specific data for the Southland region can be collected for future carbon footprint calculations. Towards the end of our review Great South discovered minor emissions in the sector

Stationary Energy from biofuel inputs that have not been included in the carbon footprint 2018. It was agreed to exclude the emission for 2018 due to time constraints, but it is recommended to include them if the carbon footprint is renewed in future years.

Total emissions for the Southland region are reported as net and gross emissions. Gross emissions exclude biogenic CO_2 emissions, whereas net emissions include biogenic CO_2 emissions. The definition of net emissions was changed from only including forestry emissions to including all biogenic CO_2 emissions. The change of definition for net emissions results in a change of total net emissions from to 6,679,154 tCO_2e to 6,466,458 tCO_2e; a reduction of 3.3%.

Please note that following two areas are not part of this review:

- emissions from harvested wood products (HWP), and
- breakdown of the emissions into economic sectors.

thinkstep was commissioned to calculate the delayed emissions arising from harvested wood products (HWP) for a New Zealand specific context in addition to the direct, single-release of harvesting emissions. thinkstep was also asked to apply a different economic breakdown based on more Southland specific methodologies and calculations. The results are summarised in the report 'Southland Regional Carbon Footprint 2018 – Harvested Wood Products & Economic Breakdown'.

Abbreviations

Term	Definition
AECOM	AECOM New Zealand Limited
AFOLU	Agriculture, Forestry and Other Land Use
CIRIS	City Inventory Reporting and Information System (CIRIS)
GHG	Greenhouse Gases
GPC	Global Protocol for Community Scale Greenhouse Gas Emissions Inventory
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
IPCC AR 5	Intergovernmental Panel on Climate Change Fifth Assessment Report: Climate Change 2014.
IPPU	Industrial Processes and Product Use
MfE	New Zealand's Ministry for the Environment
WRI	World Resource Institute
CO_2e	Carbon Dioxide-equivalent
CH_4	Methane
N_2O	Nitrous Oxide

Southland Regional Carbon Footprint 2018

Sector: Agriculture, Forestry and Other Land Use (AFOLU)

The values below are from the original report, which is the basis for the review.

Gross Scope 1 Emissions: 6,127,073 tCO_2e
69% of 8,910,806 tCO_2e (Southland's gross emissions)
Net sequestration (single-release method), mainly from forestry management: -2,231,654 tCO2e

Global Protocol Categories

1. Livestock
2. Land
3. Aggregate sources and non-CO_2 emissions sources on land

Global Protocol BASIC+ Scopes

Scope 1: In-boundary emissions from agricultural activity, land use and land use change within the region boundary

Review and Results

The Southland Regional Carbon Footprint includes all three categories recorded under the GPC sector AFOLU.

All GHG emissions within AFOLU sector were calculated in accordance with IPCC Tier 1 methodologies. The verification of the activity data for the three categories with the indicated sources did not identify any significant discrepancies.

GHG emissions were calculated based on emission factors from AECOM's in-house model and could not be checked in detail. The following statement by Maurice Marquardt, Team Leader - Sustainability & Resilience at AECOM describing the methodology, data sources and external review of their in-house tool let us assume that the emission factors used are reliable.

"AECOM has developed an internal tool to estimate Regional GHG emissions. The majority of the calculations in our tool are based on the 2006 IPCC Guidance for national GHG inventory reporting, which is the same methodology used for New Zealand's national inventory. Our calculations generally use IPCC Tier 1 calculations, with New Zealand specific emission factors (as provided in the National Inventory) or IPCC default factors where required. We use emissions factors outlined in the National Inventory (2017, 2015, 2011 and 2008), depending on last time specific factors have been published.

Due to the limitations of the CIRIS tool (e.g. only 50 emission factors) and the complexity of the Agricultural emissions calculations, we have calculated the emissions for the Southland Region

using our in-house tool. We have created "regional average emissions factors" for each animal class to enable Southland to report agricultural emissions using CIRIS.

Our calculations [for livestock emissions] are based on IPCC 2006 Tier 1 calculations and include emissions from enteric fermentation (CH_4 and N_2O), Manure management (CH_4 and N_2O), Agricultural Soils (N_2O), Grazing animals (N_2O), Leaching (N_2O), atmospheric depositions (N_2O) and liming (CO_2). Emissions from these sources are based on animal numbers, horticultural crops, fertiliser and organic soils.

Due to limited data available at the time, we have not estimated the emissions from land-use-change. The Southland CIRIS model calculates the emissions and carbon sequestered by forests remaining forest (i.e. exotic and indigenous forests). The carbon sequestered by exotic forests have been estimated using the MPI [Ministry for Primary Industries] National Exotic Forest description tables for all exotic species within the Region, applying average carbon sequestration rates per age class. We have similarly estimated the carbon sequestered by regenerating native forests (manuka & kanuka, gorse & broom, grey shrubs, mixed exotic shrubland and broadleaf indigenous hardwoods). The sequestration rates used for these calculations have been provided by Landcare Research in 2004 and have been reviewed and updated in 2015/16. In 2015/16 we also discussed our methodology and sequestration rates with the forestry team at the Ministry for the Environment responsible for the national inventory report. Again, due to lack of data of regional wood products harvested, we have estimated emissions from forests harvests using the 1996 IPCC Tier 1 approach, assuming that all carbon stored in forests are counted as emissions in the year of harvest. This approach provides a conservative estimate of the harvest emissions to ensure we are not underreporting the emission from forest harvests.

Our tool and methodology have been peer reviewed twice over the past 15 years. The first review was of the methodology and calculations developed as part of my [Maurice Marquardt, Team Leader - Sustainability & Resilience at AECOM] Master Thesis in 2004/05 (Marquardt, 2005, Lincoln University). The second review was undertaken by Andy Reisinger (an IPCC lead author) in 2016. We have also discussed and reviewed our approach and emission factors for forestry emissions and sequestration with MfE in 2016."

Since some of the emission factors used by AECOM are not publicly available, recalculations for the category 'Livestock' are limited and to be understood as a plausibility check. The results were recalculated twice using different sources for emission factors from the Ministry for the Environment (MfE). One source is the publication 'Measuring Emissions: A Guide for Organisations' (MfE I, 2019) containing data for the calendar year 2016, the second is the report 'New Zealand's Greenhouse Gas Inventory' (MfE II, 2019) covering data for the calendar year 2017.

Those emissions factors do not include climate change feedback as defined by IPCC AR5. Therefore, the emissions from Southland Regional Carbon Footprint were recalculated excluding climate change feedback, to make the results comparable. This plausibility review was not performed for the categories 'Land' and 'Aggregate sources and non-CO_2 emissions sources on land', due to minor contributions from these categories (3% of AFOLU).

For the category 'Livestock', which is the most significant contributor to AFOLU (97%) as well as to Southland's total emissions (66%), calculations for Methane (CH_4) are essentially in line with the

recalculated results of the Southland Regional Carbon Footprint. However, the Nitrous Oxide (N_2O) emissions result was significantly lower than AECOM's result (thinkstep: 6,745tCO_2, AECOM: 1,659,690tCO_2e). The MfE reports cited above include N_2O emissions from manure management for only few relevant animals. On the other hand, AECOM's internal tool contains emission factors for all relevant animals. According to AECOM these are based on a combination of prior MfE reports.

Due to insufficient data, the category 'Land' includes emissions from land use but not land use change as stipulated in the GPC BASIC+ methodology. Since no major land use changes are recorded for 2018 and data availability is low, the chosen approach is acceptable.

The emission data for harvested wood products are reported in the category 'Land' and not in category 'Aggregate sources and non-CO_2 emissions sources on land' as recommended by GPC, however this has no impact on the total emissions footprint. Apart from the above, the applied method aligns with the GPC guidelines for the sector AFOLU.

Assumptions and data sources seem comprehensible, appropriate and conservative.

For emissions from harvested wood products in the category 'Land' AECOM assumed that all carbon stored in tree biomass is released in the year of the tree harvest. To better reflect the actual emissions from harvested wood in Southland/New Zealand, data on carbon stored in wood products made from New Zealand wood can be applied. Our suggested approach is report on both the direct, single-release of biogenic carbon and in addition calculate emissions from a delayed-release, which shows the effect of biogenic carbon emissions released over the life time of the wood products. The delayed-release method results in harvesting emissions of: 1,229,292 tCO2e and total net sequestration of GHG emissions from forestry activities of -2,464,475 tCO2e. More details about the delayed-release method and calculations for Southland can be found in the report 'Southland Regional Carbon Footprint 2018 – Harvest Wood Products & Economic Breakdown' (thinkstep, 2019).

Sector: Stationary Energy

The values below are from the original report, which is the basis for the review.

Scope 1 Emissions: 711,804 tCO_2e
Scope 2 Emissions: 764,876 tCO_2e
Scope 3 Emissions: 57,948 tCO_2e
Scope 1, Scope 2 and Scope 3 Emissions: 1,534,628 tCO_2e
17% of 8,910,806 tCO_2e (Southland's gross emissions)

Global Protocol Categories

1. Residential buildings
2. Commercial and institutional buildings and facilities
3. Manufacturing industries and construction
4. Energy industries
5. Agriculture, forestry and fishing activities
6. Non-specified sources
7. Fugitive emissions from mining processing, storage and transportation of coal
8. Fugitive emissions from oil and natural gas systems

Global Protocol BASIC+ Scopes

Scope 1: Emissions from fuel combustion and fugitive emissions in the region
Scope 2: Emissions from the consumption of grid-supplied electricity, steam, heating and cooling in the region
Scope 3: Distribution losses from grid-supplied electricity, steam, heating and cooling in the region

Review and Results

The Southland Regional Carbon Footprint covers six out of the eight given categories in GPC for the sector Stationary Energy. The categories 'Non-specified sources' and 'Fugitive emissions' are excluded because they are not relevant to Southland. The category 'Energy industries', in general includes the following industries for Southland: wind farms, hydropower and biogas combustion at wastewater treatment plants. However, no emissions are included for the category 'Energy industries' in the Southland Regional Carbon Footprint. It is assumed that emissions from wind farms and hydropower are low due to the use of natural power. Information regarding the energy industries in the Southland region has been confirmed with Great South.

AECOM used emissions factors from the MfE publication 'Measuring Emissions: A Guide for Organisations' (MfE I, 2019) adjusted to include climate-carbon feedbacks for CH_4 according to IPCC AR5. thinkstep's recalculations match the results closely. Minimal deviations could be results of rounding differences. A minor error was identified in the category 'Manufacturing industries and construction' where the wrong emission factor was used for Liquefied Petroleum Gas. This would change the emissions from Liquefied Petroleum Gas from 11,712 tCO_2e to 21,543 tCO_2e but has no significant impact on the overall results. However, for accuracy the adjusted value was

applied in our recalculations of the total Southland regional carbon emissions. The activity data used in the sector Stationary Energy has not been verified due to time constraints. During our review Great South discovered that emissions from diesel used at Stewart Island was not included. The diesel is used to generate electricity for residential (574 tCO_2e) and commercial buildings and facilities (383 tCO_2e). For completion these emissions were included in our recalculation. Emissions from Stewart Island electricity consumption were provided by an internal Great South source. In addition, Great South also identified some biofuel inputs for the manufacturing sector that have not been included. The emissions have been identified as minor (24 tCO_2e) and due to time constrain it was decided not to include the emissions in 2018's inventory, but for completeness it is recommended to include them if the carbon footprint is renewed in future years.

Additionally, Great South confirmed that coal used for processing of agricultural and forestry products is included in category 'Manufacturing industries and construction'. Apart from that, coal is not used for any other activities in the agricultural, forestry and fishing industry. Therefore, relating coal emissions were removed from the 'Agriculture, forestry and fishing activities' category (4,330 tCO_2e).

The approaches used to estimate activity data for categories where no primary data was available are comprehensible.

Scope 1 emissions for 'Off-road vehicles and machinery' are included in the sector 'Transportation' and not in the Stationary Energy category 'Agriculture, forestry and fishing activities' as stipulated by the GPC guideline. This is a minor deviation from the GPC methodology but has no impact on the total emissions. In addition, no Scope 2 and Scope 3 emissions from grid electricity were reported for this category; this seems plausible as it is assumed that electricity use in this sector is low.

Sector: Transportation

The values below are from the original report, which is the basis for the review.

Scope 1 Emissions: 501,031 tCO_2e
Scope 3 Emissions: 46,456 tCO_2e
Scope 1 and Scope 3 Emissions: 547,487 tCO_2e
6% of 8,910,806 tCO_2e (Southland's gross emissions)

Global Protocol Transport Modes

1. On-road transportation
2. Railways
3. Water-borne transportation
4. Aviation
5. Off-road transportation

Global Protocol BASIC+ Scopes

Scope 1: Emissions from transportation occurring in the region
Scope 2: Emissions from grid-supplied electricity used in the region for transportation
Scope 3: Emissions from the portion of transboundary journeys occurring outside the region, and transmission and distribution losses from grid-supplied energy from electric vehicle use

Review and Results

The reported emissions for the sector Transportation do not include Scope 2 and Scope 3 emissions from 'On-Road transportation' and 'Off-Road transportation' which is a valid approach since transport emissions from electricity deemed to be low. All emissions from 'Aviation' and 'Water-borne transportation' are allocated to scope 3 - Emissions from portion of transboundary journeys occurring outside the city. This means applying the GPC methodology for 'Water-borne transportation' also to 'Aviation' and is a valid approach. Due to data gaps, no emissions are reported for the 'Railway' category.

All activity data used in the Transportation sector is based on estimations or extrapolations. The activity data used in the sector Transportation was not verified. Where available the emissions factors used were compared with the source report from MfE (MfE I, 2019). Minimal deviations could be results of rounding differences. The approaches used to estimate activity data and emissions for categories where no primary data was available are comprehensible.

Sector: Industrial Processes and Product Use (IPPU)

The values below are from the original report, which is the basis for the review.

Scope 1 Emissions: 657,588 tCO_2e
7% of 8,910,806 tCO_2e (Southland's gross emissions)

Global Protocol Categories

1. Industrial processes (Mineral industry emissions, chemical industry emissions, emissions from metal industry)
2. Product use (Non-energy products, electronics)

Global Protocol BASIC+ Scopes

Scope 1: Emissions from industrial processes and product use occurring within the region boundary

Review and Results

Emissions from IPPU include all GPC categories. 'Industrial processes' emissions are provided from a confidential source. Emissions from the category 'Product use' are limited to emissions from refrigerants, fire extinguishers, foam blowing, aerosols and metered dose inhalers as well as SF_6 in electrical equipment. The values are estimated based on New Zealand average per capita emissions and emission factors without climate carbon feedbacks, as these are not provided in IPCC AR5. This estimation was not verified. The approach used to estimate activity data and emissions for categories were no primary data was available is comprehensible.

Sector: Waste

The values below are from the original report, which is the basis for the review.

Scope 1 Emissions: 44,030 tCO_2e
1% of 8,910,806 tCO_2e (Southland's gross emissions)

Global Protocol Categories

1. Solid waste generated in the region disposed in landfills or open dumps
2. Solid waste generated in the region that is treated biologically
3. Solid waste generated in the region incinerated or burned in the open
4. Wastewater generated in the region

Global Protocol BASIC+ Scopes

Scope 1: Emissions from waste treated inside the region
Scope 3: Emissions from waste generated by the region but treated outside the region

Review and Results

Only Scope 1 emissions from categories 1 and 4 above are considered in the Southland Regional Carbon Footprint for this sector. No data was available for emissions from biological treatment of solid waste and this is therefore excluded. As emissions from incineration of waste represent only approximately 0.1% of the total waste on a national level, the approach to assume emissions from waste incineration are insignificant is deemed appropriate. Emissions from 'Solid waste generated in the region disposed in landfills or open dumps' were estimated using the methane commitment method described in the GPC. Emissions from 'Wastewater generated in the region' were calculated using CIRIS Wastewater calculator. thinkstep has not reviewed these estimations and calculations. The approaches used to estimate activity data and emissions were comprehensible.

Southland Regional Total Net and Gross Emissions

Total emissions for the Southland region are reported as net and gross emissions. Gross emissions exclude biogenic CO_2 emissions, whereas net emissions include biogenic CO_2 emissions. The definition of net emissions was changed from only including forestry emissions to including all biogenic CO_2 emissions.

Sources of biogenic CO_2 uptake in Southland are Forestry-related sequestration (- 3,693,767 tCO_2e). Biogenic CO_2 emissions are those that result from the combustion of biomass materials that naturally sequester CO_2, including materials used to make biofuels. Sources of biogenic CO_2 released in Southland are landfills, wastewater treatment plants, harvested wood products (delayed release method) and wood used as biofuel (1,242,960 tCO_2e). Since all wood used as biofuel in Southland is derived from wood harvested in Southland the biogenic CO_2 emissions are only accounted under harvested wood products (and not the biofuels) to avoid double counting of CO_2 emissions. The biogenic CO_2 emissions have been calculated in AECOMs in-house tool and could not be verified by thinkstep.

The change of definition for net emissions outlined above results in a change of total net emissions from to 6,679,154 tCO_2e to 6,466,458 tCO_2e; a reduction of 3.3%. Southland's total gross emissions including all adjusted values described in the previous sections are 8,917,265 tCO_2e this is an increase of ~0.1% compared to the initial value of 8,910,806 tCO_2e.

Emissions by Economic Sectors

The breakdown of the emissions into economic sectors was not part of this review.

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