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# Waikato Region Economy-Environment Futures Report

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# Executive Summary

## Methodology

In order to meet the project's objectives, Market Economics Ltd has collected a raft of economic and environmental data for both the Waikato Region and New Zealand. This data has been used to set up an input-output table for the Waikato Region's economy, incorporating various environment-economy linkages. A scenario based environment-economy futures model has also been developed to assess the possible implications of future economic change within the Waikato Region. Although only a BAU scenario has been assessed in this project, it is envisaged that the model could be used to assess other scenarios of future economic change for the Region. In order to construct the BAU scenario, a detailed analysis was undertaken of the potential growth in the Waikato Region's population and key industries under BAU conditions. The flow-on effects within the Region resulting from this growth were then determined by applying appropriate growth rates to the Region's input-output table. Through this process, the potential economic and environmental outcomes for the Waikato Region under the BAU scenario were determined.

## The Waikato Region's Economy and Environment

Importantly, the information collected as part of this project provides us with a 'snapshot' of the existing Waikato economy and its associated environmental linkages; this information can be used as a point of comparison when assessing the outcomes of possible economic change. The estimated 2004 GRP for the Waikato Region is $12.5 billion with the number of Full Time Equivalent Employees (FTEs) estimated at 152,000. This is the fourth largest regional economy in New Zealand being responsible for some 9.0 percent of GDP in 2004.

The Waikato Region clearly has a comparative strength in Dairy Cattle Farming and this is notably the largest industry contributor to GRP (10.9 percent of total 2004 GRP). Other industries that are particularly important within the Waikato economy include Electricity Generation and Distribution, Mining and Quarrying, Forestry and Logging and Education and Research Services. In terms of consumption and balance of trade, the Waikato has seen a significant increase in exports over the recent years indicating an increasing international focus for the Region's economy.

The Waikato Region's economy is also closely tied to the resources and waste assimilation services provided by its environment. Three of the Region's major industries (Livestock and Cropping Farming, Dairy Cattle Farming and Forestry and Logging), for example, occupy 83 percent of the Region's productive land. It is estimated that some 36,546 terrajoules (TJ) of energy were consumed by the Waikato Region economy in the year ending March 2004. Related to this energy use are a number of pollutant emissions such as carbon dioxide ($CO_2$), nitrous oxide ($N_2O$) and methane ($CH_4$). In the 2003-04 period it is estimated that 2.7 million tonnes of $CO_2$ were released as a result of energy consumption within the Waikato Region, with the largest industry emitters being Paper and Paper Product Manufacturing (18 percent) Road Transport (14 percent) and Wood and Wood Product Manufacturing (12 percent).

## Growth Projections for the Waikato Region Economy

The economic growth projections developed in the BAU model for the Waikato Region are based on a combination of quantitative projections (i.e. econometric forecasting) and qualitative assessments (i.e. literature reviews and interviews with key industry

stakeholders). From these initiatives, potential growth for the Waikato Region, particularly in relation to key industries, has been identified. It is anticipated that Dairy Cattle Farming, Dairy Manufacturing, Transport, Utilities and Tourism will continue to grow in the Waikato Region. In the case of the dairying industries, productivity gains and the incorporation of niche value added production are thought to be particularly important for future growth.

Potential barriers to growth include Kyoto Protocol obligations, nitrate leaching controls, and overseas investment and competition. In the case of the Wood and Wood Product Manufacturing industry, a particular need has been identified for diversification into higher value added products. Export projections for this industry are relatively strong at 2.8 percent. Notably, negative growth is projected for Paper and Paper Product Manufacturing with the industry being particularly in need of investment.

# Waikato Region's Economy 2026

Using the results from the above qualitative and quantitative projections, key economic outcomes have been determined for the Waikato Region under a BAU scenario. The results are reported at 5 yearly intervals covering the period 2006-2026 and cover low, medium and high population projections. For reporting purposes, the 48 economic industries have also been aggregated so that results can be provided at the level of 16 key industries plus households.

Under a medium projection series, population growth in the Waikato Region is forecast at 0.5 percent per annum resulting in a total population of around 427,000 in 2026. Similarly, employment is forecast to grow at an annual average rate of 1.2 percent to 192,490 FTEs. Overall, Waikato GRP growth is forecast at 1.1 percent per annum to a total of $\$_{2004}$15.6 billion. Furthermore, Business Services (20.2 percent), Extensive Farming (17.3 percent), Trade and Accommodation (11.7 percent) and Other Services (11.3 percent) will continue to provide the largest contributions to total GRP in 2026.

# Waikato Region's Environment 2026

A number of environmental outcomes are associated with this BAU scenario. Under the medium growth projection series land in productive use is for example estimated to grow at an average annual rate of 1.7 percent to 2.3 million hectares in 2026. Notably, this is more than the available productive land within the Region and thus productivity gains are required. Adopting the medium projection series for growth, total energy consumption is also forecast to increase from 51,215 (TJ) in 2006 to 61,123 TJ in 2026. Households are projected to remain the largest consumers of energy followed by the combined Wood and Paper Manufacturing industries. Although growth in all energy types is predicted over the period, fossil fuels will remain the dominant form of energy (67 percent of total delivered energy in 2026).

In terms of pollutants, $CO_2$ emitted as a result of energy consumption is forecast to increase under the medium growth series by 19 percent over the period to a total of 4.4 million tonnes. The largest emitters of $CO_2$ will continue to be households (26.1 percent), and Wood and Paper Manufacturing (21.2 percent). Similarly, energy related $N_2O$ and $CH_4$ emissions are predicted to grow by a total of 21 and 17 percent respectively over the period (using the medium growth projection series). With respect to solid waste, a total increase of 114,000 tonnes is predicted (15 percent) with the Construction industry and households remaining the largest contributors (51.8 percent and 20.9 percent respectively in 2026).

# 1 Introduction

Environment Waikato has a critical role in managing the Waikato Region's natural and physical resources. These include air, biodiversity, biosecurity, coastal, geothermal, land, soil and water resources. The Council is also responsible for managing natural hazards and hazardous substances, and planning and coordinating the Region's transport.

Environment Waikato is also tasked, under the Local Government Act 2002, to work with its communities to identify their needs and options for the future. The community outcomes identified to date by Waikato residents include sustainable land management practices, high water quality, preserved coastal environments and improvements in air, soil and water quality.

One key mechanism by which Environment Waikato may fulfil these roles is the development of a Long Term Council Community Plan (LTCCP) covering a 10-year planning horizon. To aid in development of this plan the Council requires information on the Region's economy, society and environment. Of particular importance is the understanding of possible economy-environment tradeoffs.

## 1.1 Objectives

Market Economics Ltd has been commissioned to identify the key economic-environment linkages that exist within the Waikato Region. This information will aid the Council in policy making by allowing the Council to anticipate the environmental pressures which might result from various economic pathways. Explicit objectives include:

- The calculation of the Region's GDP, and the contribution to GDP by industries and final demand categories. This analysis includes comparison with national patterns.
- The generation of input-output tables that permit analysis of economic inter-linkages in terms of direct, indirect and induced value added and employment.
- A discussion of the trends and prospects within the major industries within the Waikato Region in relation to increases in activity (i.e. tourism growth) and in changes in style of operation (i.e. intensification of agriculture).
- Estimation of the impacts made by major industries on natural resources, and discussion in relation to trends identified. This includes both resource use and disposal of waste impacts.
- Assessment of future environmental pressures relating to economic activity within the Waikato Region.

## 1.2 Issues

Over the preceding 20 years the GDP indicator has been severely criticised on the grounds that it does not measure all aspects of life valued by communities, including nature's provision of clean air, water and other critical biogeochemical processes. In the short term, it is likely that regional GDP would rise if there was a net depletion/degradation of the Waikato's environmental base. In the long term, however, it is likely that regional GDP would gradually fall in response to a depleted/degraded regional environment.

Economic activities such as farming and tourism contribute substantially to the local economy, but they may also have detrimental impacts on the natural environment. Irrigation of grassland for dairying, for example, creates pressure on water resources and releases nitrogen-enriched run-off into waterways reducing water quality and in the extreme leading to eutrophication of waterways.

Often the environmental implications of economic change are hidden or indirect in nature. The environmental implications of tourism, for example, are often far removed from the activities tourists are directly involved in. This is due to the presence of indirect 'upstream' or 'backward linkage' effects within the economy. While there may be no direct effect associated with a tourist dining out, there are however indirect environmental effects associated with providing the energy to cook food, the provision of the food itself and so on. The indirect impacts associated with an industry are often greater than its direct impacts.

Understanding the relationships between economic activity and the environment, particularly with regard to future trends and prospects, is essential if policy trade-offs are to be understood. Such relationships may be easily analysed using input-output tables. These tables describe, in monetary terms, flows of (1) factor inputs (e.g. labour, capital), (2) commodities (i.e. goods and services) within an economy, and (3) final consumption of commodities (e.g. by households or export markets). The implications of economic activity on the environment are studied by augmenting the input-output table, in physical terms, with natural resource use and environment degradation (e.g. pollution, waste, emissions) on an industry-by-industry basis. Using the extended input-output tables it is possible to study the direct, and also the indirect, impacts of economic change.

# 2 Approach

Market Economics Limited's approach to meet this project's objectives is summarised in the Figure 2.1 below, with a full explanation provided in the following sections.

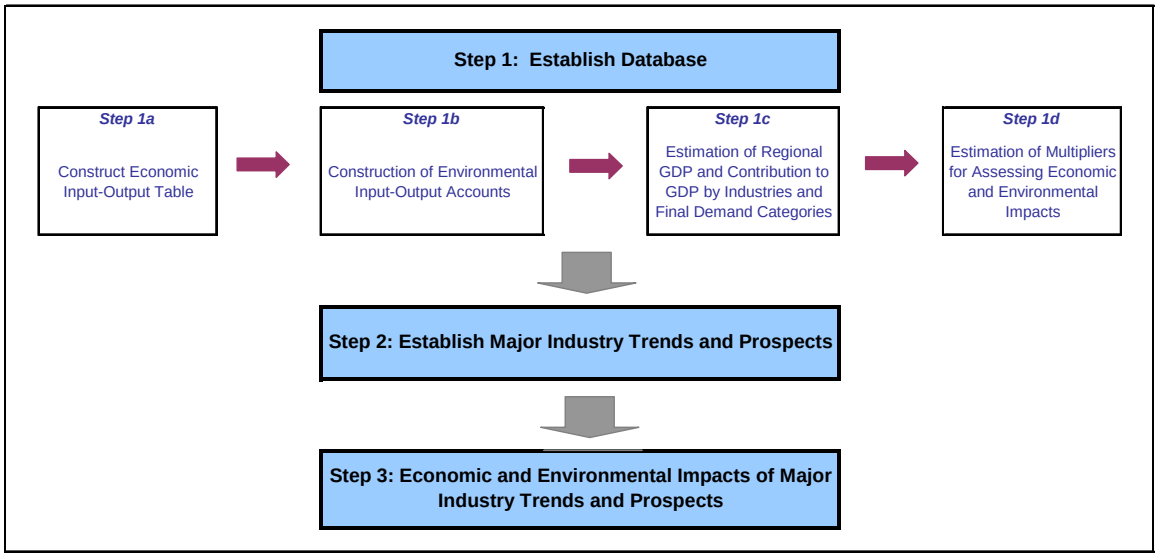


**Figure 2-1: Methodology**

## 2.1 Establish Database

To complete the first step, a database of economy-environment linkages has been generated for the Waikato. This database takes the form of a set of economic and environmental accounts presented in an input-output format. For each industry and final demand category (e.g. household consumption, exports and gross fixed capital formation) of the economy, the economic accounts cover intermediate inputs (i.e. as provided by other economic industries), primary inputs (e.g. wages and salaries, operating surplus and depreciation of fixed capital) and imports. The economic accounts also cover key economic indicators including gross output, Gross Regional Product (GRP) and full time equivalent employment (FTEs). Similarly, for each economic industry (and for household consumption) environmental accounts have been presented for land-use, energy-use (by delivered energy type), energy related

emissions ($CO_2$, $CH_4$ and $N_2O$ by delivered energy type) and solid waste (by type). The development of these accounts required completion of the following steps.

*Step 1A Construction of Input-Output Table*

An input-output table for the Waikato Region economy was constructed for the financial year ending 31 March 2004. The table was generated by following the GRIT (Generating Regional Input-Output Tables) procedure as developed at the University of Queensland by Jensen *et al.* (1979); which, in brief consists of the following two steps:

First, Statistics New Zealand's 1995-96 Inter-Industry Study of the New Zealand Economy (the latest national input-output table available) is updated to the 2004 financial year. Updating is conducted on a per industry basis accounting for volume, price, and productivity changes over the intervening eight year period.

Second, the 2004 national input-output table is 'regionalised'. Regionalisation is undertaken by estimating the degree of regional self-sufficiency relative to the nation as a whole. Simple Location Quotients (SLQs)[1] are used for this purpose.

The 2004 Waikato Region input-output table covers 123 industries, 8 primary inputs and 8 final demands. To ensure compatibility with the environmental input-output accounts constructed in Step 1B (described below), a 48 industry version of Waikato Region input-output Table has also been produced. Appendix A provides a concordance relating standard industrial classifications (ANZSIC) to the 123 input-output industries (Table A.1), and in turn, the 123 to 48 industries (Table A.2). A further aggregation of the 48 industries to 16 industries is also provided in Appendix A (Table A.3).

*Step 1B Construction of Environmental Input-Output Accounts*

To evaluate the environmental implications of economic change a set of environmental accounts covering resource use and residual (i.e. waste, pollution, emissions) generation was constructed for the Region. Market Economics Ltd, as part of the Environment Waikato Ecological Footprinting project, constructed 2004 environmental accounts for land, delivered energy (petrol, diesel, fuel oil, geothermal, wood, aviation fuel, black liquor, natural gas and LPG), energy related air emissions (by delivered energy type for $CO_2$, $CH_4$, $N_2O$), and cleanfill and landfill solid waste (construction and demolition waste, and landfill waste including metal, glass, plastic paper, potentially hazardous, organic matter and other solid waste) Due to data paucity these accounts are only available for 48 industries.

The possibility of constructing accounts for other natural resources and emissions was investigated. This included:

1. *Water takes and discharges*. Water takes include surface and ground water from lakes, rivers, streams, wetlands and underground aquifers. Water discharges may be made into water bodies (as listed above) or onto land. A major administrative responsibility of Regional Council's is to regulate, by way of resource consents, the manner in which people take or discharge water. The consents authorise people to undertake activities that would otherwise contravene restrictions on water use and

[1] In this context SLQs are a measure of the relative self-sufficiency of an industry in comparison with its national equivalent. Mathematically speaking, the SLQ for a given industry, $i$, is calculated as:

$$SLQ_i = \left( \frac{\left( Emp_i^r / Emp_i^n \right)}{\left( Emp^r / Emp^n \right)} \right)$$

where $r$ is the region, $n$ the nation and $Emp$ employment measured in FTE equivalents. If the SLQ is less than 1 the region is considered to be unable to satisfy local demand for its products and imports will be required. Conversely, if greater than 1 then is able to meet local demand and possibly export demand.

discharge as set out in ss.14 and 15 of the Resource Management Act 1991 (RMA). Resource consents, however, record consented rather than actual water take and discharge amounts. Moreover, there are a number of impediments to using resource consent information contained within the Resource Use Authorisation Management System (RUAMS), including: (1) seasonality, (2) irregularity or infrequency of takes/discharges, (3) matching consent numbers with predecessor consents, (4) estimation takes discharges from general authorisations/permitted activities, (5) difficulties with coding to input-output definitions, and (6) estimation of non-point source uses. A range of possibilities exists which might be useful in overcoming these impediments, including the use of monitoring records[2], standard values as taken from scientific literature and industry sources. The development of such methods is beyond the scope of this project.

2. *Ecosystem service valuation*. Crude estimates of the value derived from Waikato Region's biodiversity have previously been made by Patterson and Cole (1999). Unfortunately, this study was undertaken economy-wide and therefore has no associated industry breakdown. McDonald and Patterson (2003), using the methodology developed in Patterson and Cole, and superior data on ecosystem type from the Land Cover Database of New Zealand (LCDB), have undertaken a spatial valuation of ecosystem services for the Canterbury Region. 'Cookie cuts' of GIS layers including the LCDB, Agriquality New Zealand Limited's Agribase database and Council DCDBs have permitted coding to industry and thus development of ecosystem service accounts. Time and cost constraints have precluded the development of such accounts in this study.

3. *Other environmental accounts*. Environment Waikato has developed a number of environmental indicators (as per http://www.ew.govt.nz/enviroinfo/indicators/index.htm) which may, with further refinement, be converted into environmental accounts compatible with the input-output framework developed here. These include air quality, biodiversity (as discussed in 2 above) and soil[3]. However, several technical barriers must be overcome before such accounts could be integrated into the framework. These include: (1) accurate coding to industry, (2) determining the best means to estimate annualised flows, and (3) development of protocols and processes within the Council for establishing such accounts. Once again, these tasks are beyond the scope of this project.

The environmental accounts constructed during the course of this project are presented in Appendix B.

*Step 1C Estimation of Gross Regional Product*

Estimates of GRP[4] and its contribution on an industry basis were made, along with historical comparisons with the New Zealand economy, on an industry-by-industry basis. A Microsoft Excel workbook recording GRP contribution on an industry-by-industry basis has been sent to Environment Waikato.

*Step 1D Estimation of Economic and Environmental Multipliers*

[2] Caution must be practised when using such records as a sample of the population, as monitoring is often undertaken following a complaint or likely breach of consent. Derivation of water and pollutant volumetric flows of water takes and discharges from such records would result in over-estimation.

[3] It is likely that soil accounts could be constructed using a similar process to that employed in generating the value of ecosystem services appropriated by industry. Rather than using a cookie cut of the LCDB, the analysis would rely on Landcare Research Ltd's Land Resources Inventory (LRI) and Council GIS databases.

[4] GRP is a measure of the total flows of goods and services produced by an economy over a year. It is obtained in input-output terms by summing the value of the primary inputs economy-wide and subtracting total imports. It excludes the value of intermediate goods and services as these are implicitly included in the price of final goods. The terms 'GRP' and 'value added' are synonymous in the context of this report and are often used interchangeably.

A full set of economic (output[5], value added, and employment) and environmental (for each natural resource and residual environmental account) multipliers have been produced and sent to Environment Waikato in Microsoft Excel format. Type I (direct and indirect) and Type II (direct, indirect and induced) economic multipliers have been produced along with direct and indirect environmental multipliers. An input-output multiplier shows the relationship between an additional unit of spending and an increase in economic output, value added or employment. Type I multipliers measure not only the direct, but also the indirect (i.e. 'upstream' linkage) impacts associated with the initial change. Type II multipliers measure not only the direct and indirect impacts, but also the induced (i.e. as brought about by consumer spending) impacts.

## 2.2 Establish Major Industry Trends and Prospects

As Step 2 in the project, a scenario based environment-economy futures model was developed to assess possible future implications of economic change within the Waikato Region. This model is based on the premise that environment-economy interactions are characterised by complex feedbacks, time lags and non-linearities, all of which are unpredictable. In this way, the futures model cannot 'predict' or 'foretell' the future, but rather assess the likely tradeoffs of simple scenarios characterised by limiting assumptions.

To date, the model has been set up to analyse only a BAU scenario with low, medium and high projections. It is anticipated that other scenarios, such as those being developed in the Environmental Waikato Choosing Regional Futures Project could be assessed by the model. Development of the BAU scenario was undertaken using an 'evidence based approach' which provided sufficient information to identify both short and medium (i.e. 20 year) outlooks. The following initiatives formed this approach:

1. *Qualitative projections of economic growth for key economic industries as derived from literature sources*. Prospects for the following key industries, as initially identified by Forgie and Patterson (2004), were investigated: dairy farming and processes; forestry, wood and paper product processing; transportation; construction; services and tourism[6]. Appendix C provides a list of all publications reviewed.

2. *Quantitative econometric projections of population and international export growth*. Growth in population was based on Statistics New Zealand's sub-national population projections for the Waikato Region. Both the employment and export growth projections were derived econometrically using time series data covering the time period 1987 to 2005. The export projections are based on data obtained from Statistics New Zealand's New Zealand Harmonised System (NZHS). Based on the above, projections have been established for: (a) employment by industry, and (b) final consumption i.e. household consumption, exports and gross fixed capital formation.

3. *Face-to-face interviews with key industry stakeholders*. A total of five, in-depth face-to-face interviews were conducted between July and August 2006 with senior representatives from the following organisations: the Katolyst Group (Waikato Region Economic Development Agency), Fonterra Limited, University of Waikato, Affco New Zealand, and the New Zealand Industry Training Organisation (NZITO). The main purpose of these interviews was to 'ground truth' the BAU.

[5] Output is a measure of the total flow of goods and services within an economy. This includes intermediate demand, primary inputs and final demands. It should not be confused with value added (i.e. GRP), which does not include intermediate demand.

[6] Under current national accounting conventions Tourism is not considered to be an industry *per se*, but instead is represented by an amalgam of industries including bars, restaurants and hotels; accommodation; and retail trade. For this reason any results derived for tourist related economic industries will include not only tourist related impacts, but also the impact derived from domestic growth.

In deriving the BAU it was necessary to assume the following: (a) the current economic interdependencies between industries within the Waikato Region would continue to prevail, (b) negligible or minimal technological progress[7], and (c) current use of natural resources and production of emissions will hold through time[8]. Based on these assumptions, the data triangulation and input-output mathematics growth rates by industries were determined for the 2006, 2011, 2016, 2021 and 2026 projection years.

## 2.3 Economic and Environmental Impacts of Major Industry Trends and Prospects

In the final step, the growth rates established in Step 2.2 were applied to the input-output table constructed in Step 1a. This enabled generation of estimates of future change in key economic (e.g. population, employment and GRP) and environmental (i.e. natural resource use and environmental degradation) variables.

[7] Black *et al*. (2003) estimated the Total Factor Productivity (TFP) within the New Zealand economy to be 0.8 percent per annum between 1988 and 2002. TFP is a measure of the productivity change from all factors of production i.e. labour, capital, materials etc. The exact rate of technological change is likely to be less than the TFP; this is because the TFP includes influences such as simply working harder or longer. Unfortunately, there is a severe shortage of detailed statistical data related to technical change and productivity both nationally and regionally.

[8] The model, however, has in-built functionality which allows the user to easily allow for technological improvements resulting in eco-efficiencies. Time and data constraints have prohibited the inclusion of such data.

# PART A: The Waikato Region Economy 2003-2004

# 3 The Waikato Region Economy 2003-2004

## 3.1 The Waikato Region Economy

This section presents a macro-level assessment of the Waikato Region economy based on a 48 industry model of the economy for the year ending March 2004. It includes comparisons with the New Zealand economy for the same period and with the Waikato economy for the year ending March 2001.

All data has been derived from input-output tables generated for the Waikato Region (see Section 2.1) and for New Zealand. Detailed tables showing economic activity within the Waikato Region for the year ending March 2004 at the 48 and 123 industry levels have also been supplied to Environment Waikato as Microsoft Excel worksheets as part of the project.

### 3.1.1 Gross Regional Product, Employment and Productivity by Key Industries

The Waikato economy is the fourth largest regional economy in New Zealand. Table 3.1 shows the performance of the total Waikato economy and that of the 10 largest industries in the Waikato over the period 2001-2004 in terms of Gross Regional Product (GRP), employment and labour productivity[9].

It is estimated that the total GRP of the Waikato Region for the year ending March 2004, was $12,493 million. This was a 20 percent increase on 2001 when GRP was estimated at $\$_{2004}$10,453 million. In employment terms, full time equivalent employees (FTEs) grew 7 percent over the same period, from 141,955 in 2001 to 152,225 in 2004.

The significantly faster growth in GRP (compared to employment) indicates that labour productivity in the Waikato Region economy grew by 11 percent (in GRP per FTE terms) over the 2001 to 2004 period.

Farming is of critical importance within the Waikato, with over three-quarters of the Region's productive land area devoted to this activity (Statistics New Zealand, 1998). High quality pasture coupled with an ample water supply makes the region ideal for dairy farming. In 2004 Dairy Cattle Farming accounted for $1,365 million of GRP, or 10.9 percent of total 2004 GRP. This represented a 51 percent increase from 2001 ($\$_{2004}$903 million). At the same time, employment in Dairy Cattle Farming decreased by 11 percent from 15,055 FTEs in 2001 to 13,355 FTEs in 2004. As a result, productivity in this industry increased by 70 percent - the greatest increase among the 10 largest industries in the Waikato economy.

[9] Ideally, a more 'complete' measure of productivity would be used. This would include not only labour, but also capital and other factors of production. Such productivity measures are not however collected with any reliability at the regional level in New Zealand.

Other significant industries in terms of GRP in 2004 were Ownership of Owner Occupied Dwellings[10] ($783 million), Business Services ($777 million), Retail Trade ($647 million) and Wholesale Trade ($646 million).

Growth in GRP between 2001 and 2004 was strongest in the Livestock and Cropping Farming (73 percent growth), Business Services (51 percent) and Dairy Cattle Farming (51 percent) industries.

The Waikato Region has 44,059 businesses employing 152,225 FTEs (as at February 2004). The largest employers in the Waikato in 2004 were the Retail Trade industry (17,104 FTEs, 11.2 percent of all FTEs in Waikato Region), the Dairy Cattle Farming industry (13,355 FTEs, 8.8 percent), the Business Services industry (12,166 FTEs, 8.0 percent) and the Health and Community Services industry (12,153 FTEs, 8.0 percent).

Among the 10 largest industries, employment growth between 2001 and 2004 was highest in the Business Services (22 percent), Livestock and Cropping Farming (18 percent) and the Wholesale Trade (16 percent) industries.

After Dairy Cattle Farming, growth in productivity among the top 10 industries was highest in Livestock and Cropping Farming (47 percent), Business Services (24 percent), and Construction (24 percent). Among the remaining top 10 industries productivity growth was either equal to or less than the regional average (11 percent).

**Table 3-1: Top 10 Industries in the Waikato Economy 2004**

| Sectors | Gross Regional Product ($m) | | | Employment (FTEs) | | | Productivity Shift |
|---|---|---|---|---|---|---|---|
| | 2001 | 2004 | Change | 2001 | 2004 | Change | |
| Dairy cattle farming | $ 903 | $ 1,365 | 51% | 15,055 | 13,355 | -11% | 70% |
| Ownership of owner-occupied dwellings | $ 688 | $ 783 | 14% | - | - | - | - |
| Business services | $ 514 | $ 777 | 51% | 10,004 | 12,166 | 22% | 24% |
| Retail trade | $ 615 | $ 647 | 5% | 16,660 | 17,104 | 3% | 2% |
| Wholesale trade | $ 576 | $ 646 | 12% | 6,137 | 7,093 | 16% | -3% |
| Health and community services | $ 490 | $ 617 | 26% | 10,743 | 12,153 | 13% | 11% |
| Construction | $ 438 | $ 611 | 40% | 10,683 | 11,982 | 12% | 24% |
| Education | $ 451 | $ 497 | 10% | 9,684 | 10,326 | 7% | 3% |
| Real estate | $ 410 | $ 450 | 10% | 2,272 | 2,341 | 3% | 7% |
| Livestock and cropping farming | $ 200 | $ 347 | 73% | 4,744 | 5,583 | 18% | 47% |
| Other | $ 4,558 | $ 5,753 | 26% | 55,973 | 60,124 | 7% | 18% |
| Total | $ 10,453 | $ 12,493 | 20% | 141,955 | 152,225 | 7% | 11% |

Note: Total includes final demands

The overall growth in the Waikato economy between 2001 and 2004 mirrors the growth in the New Zealand economy over the same period. In 2001, Waikato Region GRP accounted for 8.8 percent of New Zealand Gross Domestic Product (GDP). In 2004, this share has increased fractionally to 9.0 percent (Table 3.2).

Table 3.2 puts the GRP of the top 10 industries in the Waikato Region in 2004 into the context of these same industries at a national level. It shows each industry's share of total national GDP and its corresponding SLQ. As mentioned previously, the SLQ is a measure of the under- or over-representativeness of an industry in a particular region when compared to its national equivalent. A SLQ in excess of 1 shows that a region's output in that industry is proportionally larger than at the national level i.e. the region is relatively strong in that industry. In this case, it is likely that the industry will be an exporter of commodities from the region. A SLQ of less than 1 shows that the region is relatively under-represented in that industry. Thus, the region will probably need to import commodities of the type developed by this industry from other regions or nations.

At $1,365 million, the Dairy Cattle Farming industry not only accounted for 10.9 percent of total GRP in the Waikato Region, but also just over a third (34.8 percent) of Gross National Product in that industry. This strength of Dairy Cattle Farming in the Waikato is further emphasised in the LQ of 3.87 which reflects its very high share of GRP in the Waikato compared to the industry's share of GDP (2.8 percent).

[10] The output of the Ownership of Owner Occupied Dwellings industry is the imputed rental value of owner-occupied dwellings

Other industries with relative strength in the Waikato are Livestock and Cropping Farming, with 11.2 percent of national production for this industry and a LQ of 1.25, and Construction, with 10.2 percent of Construction nationally, and a LQ of 1.13. Industries with relatively low LQs and therefore relatively under-represented in the Waikato economy (among the top 10 of Table 3.1) are Business Services (LQ 0.70), Wholesale Trade (0.74) and Real Estate (0.79)

**Table 3-2: Waikato GRP and New Zealand GDP, 2004**

| | Waikato | | New Zealand | | Waikato Share of NZ | Location Quotient |
|---|---|---|---|---|---|---|
| | $m | % | $m | % | % | % |
| Dairy cattle farming | $ 1,365 | 10.9% | $ 3,928 | 2.8% | 34.8% | 3.87 |
| Ownership of owner-occupied dwellings | $ 783 | 6.3% | $ 9,954 | 7.2% | 7.9% | 0.87 |
| Business services | $ 777 | 6.2% | $ 12,353 | 8.9% | 6.3% | 0.70 |
| Retail trade | $ 647 | 5.2% | $ 7,260 | 5.2% | 8.9% | 0.99 |
| Wholesale trade | $ 646 | 5.2% | $ 9,709 | 7.0% | 6.6% | 0.74 |
| Health and community services | $ 617 | 4.9% | $ 6,750 | 4.9% | 9.1% | 1.02 |
| Construction | $ 611 | 4.9% | $ 6,019 | 4.3% | 10.2% | 1.13 |
| Education | $ 497 | 4.0% | $ 5,382 | 3.9% | 9.2% | 1.03 |
| Real estate | $ 450 | 3.6% | $ 6,347 | 4.6% | 7.1% | 0.79 |
| Livestock and cropping farming | $ 347 | 2.8% | $ 3,097 | 2.2% | 11.2% | 1.25 |
| Other | $ 5,753 | 46.0% | $ 68,204 | 49.1% | 8.4% | 0.94 |
| Total | $ 12,493 | 100.0% | $ 139,003 | 100.0% | 9.0% | - |

Overall productivity (GRP/GDP per FTE) was 1 percent lower in the Waikato Region than at the national level in 2004. This small difference is reflected across most of the top 10 industries except Real Estate, where productivity in the Waikato was 15 percent lower than at the national level (Table 3.3)

Other industries within the Waikato economy that are important, at both a regional and national level, include Forestry and Logging ($\$_{2004}$ 213 million), Mining and Quarrying ($\$_{2004}$ 204 million) and Electricity Generation and Distribution ($\$_{2004}$ 23 million GRP contribution). The Waikato Region is the power generating base of the North Island with eight hydro stations on the Waikato River (>1200 megawatts of generating capacity), along with geothermal power stations (including Wairakei and Ohaaki) and the Huntly thermal power station. The Waikato Region is also mineral rich, particularly in the Coromandel – the Martha Mine, for example, has produced in excess of 70 million ounces of gold and silver. Finally, the Waikato Region forms part of the largest exotic forest plantation in the country with an estimated 192,000 ha.

**Table 3-3: Productivity (GRP/GDP per FTE) in Waikato and NZ 2004.**

| | Waikato 2004 | New Zealand 2004 | Difference |
|---|---|---|---|
| | $ per FTE | $ per FTE | % |
| Dairy cattle farming | 102,224 | 102,324 | -0.1% |
| Ownership of owner-occupied dwellings | NA | NA | NA |
| Business services | 63,849 | 65,094 | -1.9% |
| Retail trade | 37,829 | 37,829 | 0.0% |
| Wholesale trade | 91,023 | 91,023 | 0.0% |
| Health and community services | 50,751 | 49,705 | 2.1% |
| Construction | 51,037 | 49,812 | 2.5% |
| Education | 48,179 | 48,501 | -0.7% |
| Real estate | 192,196 | 226,320 | -15.1% |
| Livestock and cropping farming | 62,155 | 63,467 | -2.1% |
| Other | 95,685 | 96,577 | -0.9% |
| Total | 82,069 | 82,869 | -1.0% |

## 3.1.2 Consumption

The consumption of goods and services produced by the Waikato economy is discussed in this sub-section. Consumption can be broken down into the four categories: consumption by households; consumption by government services;

consumption for the purposes of gross fixed capital formation; and exports. Consumption patterns are often the key drivers of economic growth.

Table 3.4 shows consumption in the Waikato by the four main final demand categories in 2001 and 2004.

In 2001, almost 80 percent of total consumption of $\$_{2004}$18,291 million was accounted for by Exports (43.7 percent) and Households (34.7 percent). Provision of Government services (11.2 percent) and Capital formation (10.5 percent) made up the balance of total consumption.

In 2004 this overall pattern remained largely the same (dominance of households and exports) but with some important differences. Overall, consumption increased by 4.1 percent from 2001 to 2004, to $19,047 million. However, consumption by households ($314 million decrease) and capital formation ($231 million) dropped over this period. Counter to this, consumption through the provision of government services ($236 million increase) and in particular through exports ($1,065 million) increased over the same period. This significant increase in export consumption signals an increasing international focus for the Waikato Region economy.

**Table 3-4: Consumption in Waikato Region 2001 & 2004**

| | 2001 | | 2004 | | Change 01-04 | |
|---|---|---|---|---|---|---|
| | $m | % | $m | % | $m | % |
| Households | $ 6,340 | 34.7% | $ 6,026 | 31.6% | $ (314) | -5.0% |
| Government Services | $ 2,050 | 11.2% | $ 2,286 | 12.0% | $ 236 | 11.5% |
| Capital formation | $ 1,914 | 10.5% | $ 1,683 | 8.8% | $ (231) | -12.1% |
| Exports | $ 7,987 | 43.7% | $ 9,052 | 47.5% | $ 1,065 | 13.3% |
| Total | $ 18,291 | 100.0% | $ 19,047 | 100.0% | $ 756 | 4.1% |

When compared with consumption at the national level, total consumption in the Waikato Region in 2004 accounted for 9.8 percent of total New Zealand consumption (Table 3.5).

Exports accounted for a significantly higher share of Waikato consumption (44.5 percent) than New Zealand consumption (29.1 percent) in 2004 (Table 3.5). As a consequence, the share of consumption across the three remaining groups was noticeably lower in Waikato than in New Zealand. This was particularly apparent in the formation of capital which accounted for only 10.1 percent of Waikato consumption, but 18.2 percent of national consumption.

This relative strength of export consumption and relative weakness of capital formation consumption reflects the dominance of the export focussed primary industry in the Waikato Region.

**Table 3-5: Consumption in Waikato Region and New Zealand, 2004**

| | Waikato | | New Zealand | | Waikato Share of NZ | Difference in Shares |
|---|---|---|---|---|---|---|
| | $m | % | $m | % | % | % |
| Households | $ 6,050 | 34.4% | $ 70,051 | 39.1% | 8.6% | 87.9% |
| Government Services | $ 1,948 | 11.1% | $ 24,295 | 13.6% | 8.0% | 81.6% |
| Capital formation | $ 1,777 | 10.1% | $ 32,688 | 18.2% | 5.4% | 55.3% |
| Exports | $ 7,826 | 44.5% | $ 52,128 | 29.1% | 15.0% | 152.8% |
| Total | $ 17,601 | 100.0% | $ 179,162 | 100.0% | 9.8% | - |

## 3.1.3 Balance of Trade

The balance of trade reflects the relative importance of imports and exports, both internationally and interregionally. Table 3.6 shows the interregional and international balance of trade for the Waikato Region in 2001 and 2004.

In 2001, the overall balance of trade in the Waikato Region was relatively even with imports ($8,120 million) slightly higher than exports ($7,987 million), giving a balance of

trade deficit of $133 million. This was comprised of an interregional balance of trade deficit of $509 million, and international balance of trade surplus of $376 million.

In 2004, this pattern had changed, with an overall trade surplus of $2,498 million. This was driven primarily by a major change in interregional trade that saw imports decrease (to $3,336 million) and interregional exports increase (to $5,383 million). As a result, the interregional balance of trade tipped from a slightly negative result in 2001 (-$509 million) to a strongly positive one in 2004 ($2,047 million). Over the same period, the international balance of trade changed very little.

The significant increase in the Waikato Region's interregional balance of trade between 2001 and 2004 suggests an increasing dependence on the Waikato Region to provide goods and services; particularly the Auckland Region.

**Table 3-6: Waikato Region Balance of Trade, 2001 & 2004**

| | Imports | Exports | Balance of Trade |
|---|---|---|---|
| **2001** | | | |
| Interregional | $ 4,751 | $ 4,242 | $ (509) |
| International | $ 3,369 | $ 3,745 | $ 376 |
| Total | $ 8,120 | $ 7,987 | $ (133) |
| **2004** | | | |
| Interregional | $ 3,336 | $ 5,383 | $ 2,047 |
| International | $ 3,218 | $ 3,669 | $ 451 |
| Total | $ 6,554 | $ 9,052 | $ 2,498 |
| **Change 2001-2004** | | | |
| Interregional | $ (1,415) | $ 1,141 | $ 2,556 |
| International | $ (151) | $ (76) | $ 75 |
| Total | $ (1,566) | $ 1,065 | $ 2,631 |

# 4 The Waikato Region's Economic Dependence on the Environment 2003-2004

## 4.1 Introduction

This section presents data relating to the relationship between the Waikato Regional economy (based on a 48 industry model of the economy for the year ending March 2004) and the environment. This section is largely an update of the 1999 EcoLink Project funded by inter alia Environment Waikato and Ministry for the Environment's Sustainable Management Fund. The regional economic dependence on the environment as a source of natural resources (e.g. land and energy) and as a sink for wastes and emissions is described below. This dependence cannot be understated as it is the very basis for much of the economic wealth generated from within the Region, particularly the wealth gained from primary industries and their associated processing. Key accounts describing the economy-environment interface include:

- Land use (ha)
- Delivered energy by type (GJ). This includes aviation fuel, coal, fuel oil, diesel, petrol, black liquor, wood, natural gas, LPG and geothermal)
- Energy related emissions (tonnes)
  - Carbon dioxide ($CO_2$) by delivered energy type
  - Nitrous Oxide ($N_2O$) by delivered energy type
  - Methane ($CH_4$) by delivered energy type[11]

[11] Farm animal $CH_4$ emissions are not included in these estimates.

- Solid waste (tonnes) covering both cleanfill and landfill sites. Solid waste is decomposed into 8 types: construction and demolition; metal, glass; plastic; paper; potentially hazardous; organic matter; other.

These environmental accounts were derived from several data sources. Estimates of land use and delivered energy were developed as part of the Environment Waikato Ecological Footprint analysis (refer to McDonald and Smith (2006)), while the solid waste estimates were derived from McDonald (2006).

Refer to tables 1 to 6 in Appendix B for full environmental accounts for the industries and households in the Waikato Region economy.

## 4.2 Land Use

Table 4.1 shows the top 10 land using industries in the Waikato Region for the year ending March 2004.

In total, the Waikato Region economy covers some 1.7 million hectares of land (excluding non economic land such as that occupied by lakes, waterways and wetlands). The most dominant land users are Livestock and Cropping Farming (42 percent of all productive land) and Dairy Cattle Farming (30 percent). Other significant land users are the Forestry and Logging industry (11 percent) and the Cultural and Recreational Services industry (8 percent, comprising national parks, parks, reserves etc). These four industries account for 91 percent of all productive land area in the Waikato Region.

**Table 4-1: Top 10 Land Using Industries in Waikato Region 2003-2004**

| | Industry | $ha_{2004}$ | % |
|---|---|---|---|
| 1 | Livestock and cropping farming | 723,712 | 42% |
| 2 | Dairy cattle farming | 514,840 | 30% |
| 3 | Forestry and logging | 191,601 | 11% |
| 4 | Cultural and recreational services | 128,817 | 8% |
| 5 | Household Consumption | 78,718 | 5% |
| 6 | Other farming | 31,698 | 2% |
| 7 | Horticulture and fruit growing | 9,206 | 1% |
| 8 | Mining and quarrying | 8,473 | 0% |
| 9 | Water supply | 3,638 | 0% |
| 10 | Electricity generation and supply | 3,446 | 0% |
| | Other | 11,054 | 1% |
| | TOTAL | 1,705,203 | 100% |

## 4.3 Delivered Energy

Delivered energy is a measure of the total energy delivered (used in) to each industry of the Waikato Region economy. Energy use is measured in terrajoules (heat equivalents).

Table 4.2 shows the 10 industries which used the most energy in the Waikato Region in the year ending March 2004, by the main types of energy. For the purposes of reporting, these energy types have been aggregated into four categories: fossil fuels; electricity[12]; wood/black liquor; geothermal. A further breakdown of these delivered energy types (particularly fossil fuels) can be found in the Futures Calculator Model delivered to Environment Waikato as part of this project.

It is estimated that a total of 36,546 terrajoules (TJ) of energy was consumed by the Waikato Regional economy to the year ending March 2004. Two thirds (66.3 percent)

[12] It is important to note that the energy accounts do not include electricity production i.e. has undertaken by the Region's hydro, geothermal and thermal power stations.

of this energy was consumed as fossil fuels. Electricity accounted for 19.9 percent of energy consumed and wood/black liquor accounted for a relatively smaller share (13.7 percent). Geothermal energy comprised less than 1 percent of all energy consumed.

The 10 largest energy using industries accounted for 73 percent of all energy consumed in 2003-2004. Road Transport was the single largest consumer of energy at 5,628 TJ (15 percent of all energy consumed in the Waikato Region), almost all of which was from fossil fuels. Paper and Paper Product Manufacturing was the second largest consumer of energy at 4,781 TJ (13 percent) with over half of this energy (58 percent) provided from wood/black liquor. The third largest consumer of energy was Dairy Product Manufacturing (3,758 TJ, 10 percent) –predominantly from fossil fuels.

**Table 4-2: Top 10 Energy Consuming Industries by Energy Type**

| | Industry | Fossil Fuels | Electricity | Wood/Black Liquor | Geothermal | Total | Total |
|---|---|---|---|---|---|---|---|
| | | TJ, TOE | TJ, TOE | TJ, TOE | TJ, TOE | TJ, TOE | % |
| 1 | Road transport | 5,620 | 8 | 0 | 0 | 5,628 | 15% |
| 2 | Paper and paper product manufacturing | 1,175 | 835 | 2,771 | 0 | 4,781 | 13% |
| 3 | Dairy product manufacturing | 3,277 | 481 | 0 | 0 | 3,758 | 10% |
| 4 | Wood product manufacturing | 581 | 480 | 1,911 | 0 | 2,972 | 8% |
| 5 | Dairy cattle farming | 1,785 | 641 | 0 | 0 | 2,426 | 7% |
| 6 | Mining and quarrying | 1,441 | 376 | 0 | 0 | 1,817 | 5% |
| 7 | Household Consumption | 1,656 | 113 | 0 | 0 | 1,770 | 5% |
| 8 | Retail trade | 755 | 672 | 19 | 0 | 1,446 | 4% |
| 9 | Basic metal manufacturing | 358 | 687 | 0 | 0 | 1,044 | 3% |
| 10 | Accommodation, restaurants and bars | 434 | 392 | 0 | 67 | 893 | 2% |
| | Other | 7,137 | 2,585 | 289 | 0 | 10,012 | 27% |
| | TOTAL | 24,218 | 7,271 | 4,990 | 67 | 36,546 | 100% |

# 4.4 Energy Related Air Emissions

Energy related emissions are air borne emissions (or pollutants) that result from the consumption of energy (delivered energy). The three types of emissions that are most commonly measured are:

- Carbon dioxide ($CO_2$). The release of $CO_2$ is thought be a key contributing factor to global warming. The burning of fossil fuels and deforestation are the human activities in the Waikato contributing to the release of $CO_2$ emissions. The big increases in $CO_2$ levels reported overseas have also been seen in New Zealand. Scientists have been measuring $CO_2$ concentrations at Baring Head in Wellington since 1973 and have noted that concentrations have risen from 320 parts per million in 1973 to 374 parts per million in 2003, more than twice the increase in the preceding 20 years. However, only energy related $N_2O$ emissions resulting from the combustion of fossil fuels and biomass are captured in the analysis below.
- Nitrous oxide ($N_2O$). Like $CO_2$, $N_2O$ is a potent greenhouse gas which contributes to climate change. Only energy related $N_2O$ emissions are considered in this analysis.
- Methane ($CH_4$). Methane is also a potent greenhouse gas. This is New Zealand's most significant anthropogenic greenhouse gas emission. The dominant source is farmed livestock (90 percent) with the remaining emissions made up of primarily degradation of organic material at landfills. Once again, only energy related $CH_4$ emissions resulting from the combustion of fuels are captured in the analysis below.

The sub-sections below describe the top 10 emitting industries for each emission type.

## 4.4.1 Carbon dioxide ($CO_2$)

Table 4.3 shows the 10 largest $CO_2$ emitting industries in the Waikato Region for the year ending March 2004. Over the 2003-2004 period, it is estimated that 2.7 million tonnes of $CO_2$ was released as a result of energy consumed in the Waikato Region. The Paper and Paper Product Manufacturing industry was the largest emitter of $CO_2$ (18 percent of all $CO_2$ emitted in the Waikato Region), followed by Road Transport (14 percent) and Wood and Wood Product Manufacturing (12 percent). In total, the top 10

$CO_2$ emitting industries in the Waikato Region accounted for 76 percent of all $CO_2$ emissions.

**Table 4-3: Top 10 $CO_2$ Emitting Industries in Waikato Region 2003-2004**

| | Industry | tonnes | % |
|---|---|---|---|
| 1 | Paper and paper product manufacturing | 478,478 | 18% |
| 2 | Road transport | 383,643 | 14% |
| 3 | Wood product manufacturing | 314,741 | 12% |
| 4 | Dairy product manufacturing | 261,170 | 10% |
| 5 | Dairy cattle farming | 158,452 | 6% |
| 6 | Mining and quarrying | 124,905 | 5% |
| 7 | Household Consumption | 119,611 | 4% |
| 8 | Retail trade | 88,092 | 3% |
| 9 | Basic metal manufacturing | 59,560 | 2% |
| 10 | Air transport, services to transport and storage | 57,036 | 2% |
| | Other | 656,449 | 24% |
| | TOTAL | 2,702,138 | 100% |

## 4.4.2 Nitrous Oxide ($N_2O$)

Table 4.4 shows the 10 largest $N_2O$ emitting industries in the Waikato Region for the year ending March 2004. In 2003-2004, it is estimated that 240 tonnes of $N_2O$ were emitted as a result of energy consumed in the Waikato Region. The Dairy Product Manufacturing industry accounted for the largest share of $N_2O$ emissions (17 percent of all $N_2O$ emitted in the Waikato Region), followed by the Road Transport industry (16 percent) and the Paper and Paper Product Manufacturing industry (9 percent). In total, the top 10 $N_2O$ emitting industries in the Waikato Region accounted for 76 percent of all $N_2O$ emissions.

**Table 4-4: Top 10 $N_2O$ Emitting Industries in Waikato Region 2003-2004**

| | Industry | tonnes | % |
|---|---|---|---|
| 1 | Dairy product manufacturing | 40 | 17% |
| 2 | Road transport | 38 | 16% |
| 3 | Paper and paper product manufacturing | 21 | 9% |
| 4 | Mining and quarrying | 16 | 7% |
| 5 | Dairy cattle farming | 15 | 6% |
| 6 | Wood product manufacturing | 15 | 6% |
| 7 | Household Consumption | 12 | 5% |
| 8 | Non-metallic mineral product manufacturing | 10 | 4% |
| 9 | Retail trade | 8 | 3% |
| 10 | Meat and meat product manufacturing | 7 | 3% |
| | Other | 58 | 24% |
| | TOTAL | 240 | 100% |

## 4.4.3 Methane ($CH_4$)

Table 4.5 shows the 10 largest $CH_4$ emitting industries in the Waikato Region for the year ending March 2004. In the year ending March 2004, it is estimated that 580 tonnes of $CH_4$ were emitted as a result of energy consumed in the Waikato Region. As with $CO_2$, the Paper and Paper Product Manufacturing industry produced the largest share of $CH_4$ emissions (14 percent of all $CH_4$ emitted in the Waikato Region), followed by the Road Transport industry (12 percent) and the Dairy Product Manufacturing industry (10 percent). In total, the top 10 $CH_4$ emitting industries in the Waikato Region accounted for 72 percent of all $CH_4$ emissions.

**Table 4-5: Top 10 $CH_4$ Emitting Industries in Waikato Region 2003-2004**

| | Industry | tonnes | % |
|---|---|---|---|
| 1 | Paper and paper product manufacturing | 84 | 14% |
| 2 | Road transport | 72 | 12% |
| 3 | Dairy product manufacturing | 55 | 10% |
| 4 | Wood product manufacturing | 49 | 8% |
| 5 | Dairy cattle farming | 39 | 7% |
| 6 | Retail trade | 34 | 6% |
| 7 | Household Consumption | 27 | 5% |
| 8 | Basic metal manufacturing | 21 | 4% |
| 9 | Mining and quarrying | 20 | 4% |
| 10 | Accommodation, restaurants and bars | 18 | 3% |
| | Other | 160 | 28% |
| | TOTAL | 580 | 100% |

# 4.5 Solid Waste

The final measure of the link between the economy and the environment is the production of solid waste. Values of solid waste output are uncertain due to difficulties in matching wastes to industry types and converting volumes to tonnages. For the purposes of reporting, types of solid waste have been aggregated to land fill and clean fill solid waste. Detailed results relating to the land fill (broken down into metal, glass, plastic, paper etc) can be found within the Futures Calculator Model delivered to Environment Waikato as part of this project.

Table 4.6 shows the 10 industries that produced the largest amount of solid waste for the year ending March 2004.

It is estimated that just under 568,000 tonnes of solid waste was produced in the Waikato Region over the 2003-2004 period. Nearly two thirds (62 percent) was cleanfill waste produced by the Construction industry. In total, the Construction Industry was far and away the largest producer of solid waste accounting for 68 percent of all solid waste produced in the Waikato Region. All other industries each accounted for less than 5 percent of solid waste production.

**Table 4-6: Top 10 Solid Waste Producing Industries in Waikato Region, 2003-2004**

| | Industry | Landfill | Cleanfill | Total | Total |
|---|---|---|---|---|---|
| | | 000s tonnes | 000s tonnes | 000s tonnes | % |
| 1 | Construction | 36 | 352 | 387 | 68% |
| 2 | Petroleum & industrial chemical man | 0 | 0 | 23 | 4% |
| 3 | Wholesale trade | 22 | 0 | 22 | 4% |
| 4 | Wood product manufacturing | 20 | 0 | 20 | 3% |
| 5 | Retail trade | 12 | 0 | 12 | 2% |
| 6 | Other food manufacturing | 12 | 0 | 12 | 2% |
| 7 | Rubber, plastic & other chem prdct man | 0 | 0 | 11 | 2% |
| 8 | Dairy product manufacturing | 10 | 0 | 10 | 2% |
| 9 | Accommodation, restaurants and bars | 9 | 0 | 9 | 2% |
| 10 | Meat and meat product manufacturing | 8 | 0 | 8 | 1% |
| | Other | 88 | 0 | 54 | 10% |
| | TOTAL | 216 | 352 | 568 | 100% |

# PART B Qualitative and Quantitative Projections for the Waikato Region 2006-2026

In Part B the future prospects for the Waikato Region are discussed. As mentioned in Section 2.2, these prospects were derived from three main initiatives: (1) quantitative projections of population and export growth (refer Section 5); (2) qualitative projections of economic growth taken from various literature sources (refer Section 6); and (3) face-to-face interviews (refer Section 7). These initiatives were used to generate projections of economic growth on an industry-by-industry basis covering the period 2006 to 2026. Each initiative, along with the employment projections, is discussed in full below.

# 5 Quantitative Projections of Economic Growth

## 5.1 Introduction

In this Section, quantitative projections of domestic household consumption and international exports are produced. Growth in domestic household consumption is based on Statistics New Zealand sub-national population projections for the Waikato Region. Growth in international exports is based on statistical time series analysis of commodity production.

To project export growth into the future, it was necessary to follow two pathways. Firstly, for the goods producing industries of the economy, export data obtained from the New Zealand Harmonised System (NZHS) was used to project export growth. The NZHS records exports for more than 10,000 commodities. Using a concordance provided by Statistics New Zealand, it was possible to match these commodity exports to the 48 industries contained within the Waikato Region input-output table. Projections based on constant price FOB values for the period 1994 to 2005 were then projected to determine a long run average growth for each industry. Secondly, in the service industries where exports are intangible, growth rates were based on FTE projections covering the period 1987 to 2004.

## 5.2 Time Series Analysis

There are various ways to forecast future values of one variable from its time series data. The selection of the appropriate forecasting technique depends on the underlying time series dynamic behaviour of the variable over time.

There are typically two types of time series: stationary and non-stationary. Statistical properties for stationary time series, such as mean and variance, are constant over time. That is, historical observations fluctuate around a long run mean. In these situations it appropriate to apply the AMRA process to forecast. Other methods are required to deal with non-stationary behaviour, i.e. when the historical observations indicate a consistent movement up or down. In these cases we have opted to use Holt's exponential smoothing[13] although other possibilities exist.

[13] Holt's method is a form of smoothing which reveals the existence of trends, so that forecast values allow for the effect of that trend.

## 5.3 Population Projections

The population projections used in this study were obtained from Statistics New Zealand. Statistics New Zealand's sub-national population projections record estimates for the 2001 to 2006, 2006 to 2011, 2011 to 2016, 2016 to 2021, and 2021 to 2026 periods. All projections are derived from the 2001 usually resident population as released in 2002. Moreover, the projections are available under three scenarios: low, medium and high series. Each series is designed using different fertility, mortality, and migration assumptions. The high projection series is, for example, based on high fertility, low mortality and high migration. These assumptions are based on both short and long term historical trend analysis, government policy and other relevant information.

Figure 9.1 (Section 9) records the low, medium and high population projections series for the Waikato Region, along with period growth rates and annual average geometric growth. The overall growth rate for the period 2006 to 2026 is also included. In summary, under the medium projection series the Waikato Region is expected to grow to 426,800 people by 2026, an increase of 10.4 percent since 2001. The growth rate between periods is, however, declining over time, with an annual average geometric growth rate approximating zero.

## 5.4 Export Projections

Quantitative estimates of export growth on an industry-by-industry basis were developed using time series analysis of commodity outputs taken from Statistics New Zealand's Harmonised System (HS). Given that this data is only available at the national level, rather than by source region, it was necessary to assume that national export trends were representative of regional export trends.

The following procedures were employed in deriving the growth rates for physical and intangible exports. Future estimates of physical commodity exports were determined in two steps. Firstly, the HS data was aggregated from 13,000 commodities into a single homogenous commodity per industry. This was undertaken for every year covering the period 1988 to 2005. Secondly, the trends in each industry were then determined through time series analysis. Future estimates of intangible (primarily service) exports were assumed to equate to FTE growth rates in each industry. The FTE growth rates were determined from a time series analysis covering the period 1987 to 2005.

The resulting long-run average export growth rates are depicted in Table 5.1.

**Table 5-1: Annual Average Percentage Growth in Exports, 2006 to 2006**

| | Industry | Annual Average Growth (%) |
|---|---|---|
| 1 | Horticulture and fruit growing | 2.3% |
| 2 | Livestock and cropping farming | 0.0% |
| 3 | Dairy cattle farming | 2.1% |
| 4 | Other farming | 3.4% |
| 5 | Services to agriculture, hunting and trapping | 0.0% |
| 6 | Forestry and logging | -1.8% |
| 7 | Fishing | -1.1% |
| 8 | Mining and quarrying | 0.0% |
| 9 | Oil and gas exploration and extraction | 5.6% |
| 10 | Meat and meat product manufacturing | 1.4% |
| 11 | Dairy product manufacturing | 2.1% |
| 12 | Other food manufacturing | 1.3% |
| 13 | Beverage, malt and tobacco manufacturing | 4.0% |
| 14 | Textile and apparel manufacturing | -1.0% |
| 15 | Wood product manufacturing | 2.8% |
| 16 | Paper and paper product manufacturing | -2.1% |
| 17 | Printing , publishing and recorded media | 1.0% |
| 18 | Petroleum and industrial chemical manufacturing | -1.3% |
| 19 | Rubber, plastic and other chemical product manufacturing | 0.4% |
| 20 | Non-metallic mineral product manufacturing | -0.5% |
| 21 | Basic metal manufacturing | 0.4% |
| 22 | Structural, sheet, and fabricated metal product manufacturing | 1.6% |
| 23 | Transport equipment manufacturing | 4.1% |
| 24 | Machinery and equipment manufacturing | 3.2% |
| 25 | Furniture and other manufacturing | 0.0% |
| 26 | Electricity generation and supply | -2.9% |
| 27 | Gas supply | 0.0% |
| 28 | Water supply | 0.0% |
| 29 | Construction | 0.6% |
| 30 | Wholesale trade | 0.6% |
| 31 | Retail trade | 0.6% |
| 32 | Accommodation, restaurants and bars | 1.6% |
| 33 | Road transport | 0.1% |
| 34 | Water and rail transport | -2.3% |
| 35 | Air transport, services to transport and storage | 1.0% |
| 36 | Communication services | -0.1% |
| 37 | Finance | -1.0% |
| 38 | Insurance | -1.4% |
| 39 | Services to finance and investment | 1.7% |
| 40 | Real estate | 4.3% |
| 41 | Ownership of owner-occupied dwellings | 0.0% |
| 42 | Business services | 1.9% |
| 43 | Central government administration, defence, public order and safety services | -0.3% |
| 44 | Local government administration services and civil defence | -1.4% |
| 45 | Education | 1.6% |
| 46 | Health and community services | 1.7% |
| 47 | Cultural and recreational services | 2.5% |
| 48 | Personal and other community services | 1.7% |

# 6 Literature Search on Waikato Futures

This section describes the future prospects for growth in the Waikato Region as recorded in the wider literature. Refer to Appendix C for a list of the literature reviewed.

# 6.1 The Dairy Industry

The dairy industry is a dominant industry in the Waikato Region. It comprises two main industries, namely Dairy Cattle Farming and Dairy Product Manufacturing.

The Waikato Region is endowed with a warm climate and fertile soils. It has arguably the best pasture of any region. Several impediments to growth of the dairy industry have been identified. These include land-use restrictions due to severe water pollution and the expansion of other industries, and increased compliance costs associated with meeting Kyoto Protocol requirements from 2012.

Dairy products are not only the Waikato Region's major export, but also New Zealand's. Production is therefore driven by international demand and supply while domestic demand for dairy products is relatively small and insignificant to growth. In the short term, it is envisaged that international prices will be very competitive due to both the European Union and United States' markets increasing their supply as a result of favourable tariffs. One can however note that the viability of these subsidies has been under discussion in the World Trade Organisation (WTO) forum. A two percent annual increase in international demand is forecasted over the longer term, but this will depend on international price fluctuations.

It is also anticipated that global vertical integration in dairy processing will reduce transaction costs. The Waikato Region is one of the most significant dairy industry regions in New Zealand and Fonterra Ltd has its third largest base in the Region. A potential partnership between Fonterra Ltd and Nestle with the view of obtaining greater shares in world markets has been muted. However, this partnership is uncertain as are the benefits of selling locally manufactured goods under other brand names. Nevertheless, there are many other opportunities for innovation within the dairy manufacturing industry, in spite of a recent trend of higher wages in other regions leading to a net outflow of skilled workers.

Overall, the growth of the dairy industry in the Waikato Region will continue on an upward trend, but at a decreasing rate.

# 6.2 The Forestry Industry

The forestry industry in the Waikato Region consists of three main industries: Forestry and Logging; Wood and Wood Product Manufacturing; and Paper and Paper Product Manufacturing. There is no clear consensus on the potential for growth in the first two industries. For the latter industry a clear downward trend has been revealed.

## 6.2.1 Forestry and Logging

The Waikato Region has the largest area of forestry in New Zealand. The Region's climate is suitable for only certain types of timber. This means that the Waikato Region's forestry industry is less competitive than in other countries, particularly in supplying a full range of products. The Region's plantation forestry is also vulnerable to pests and disease. Current areas of research include forestry management, disease control and methods to reduce growing cycles.

Shorter growing cycles would be particularly advantageous to the Waikato Region, making more wood available to meet increasing international demand. An 83 percent increase in harvest in New Zealand is projected for the 1998 to 2010 period. Australia and Chile are expected to be strong competitors during this period.

## 6.2.2 Wood and Wood Products Manufacturing

Large investment is required to stimulate growth in the Wood and Wood Product Manufacturing industry. More investment is essential for expansion, in particular new processing plants to manufacture high quality finished products to meet the increased international demand, e.g. as required for the Beijing Olympics. Current tariffs imposed

by Japan, the USA and Taiwan also restrict growth potential. High energy costs and the possibility of a future carbon tax are further impediments to potential growth. In addition, with cheaper skilled labour in Asia and significant vertical integration occurring abroad, it is likely that investors may look elsewhere. In the long term, a forecasted increase in international demand, coupled with a likely reduction in tariff or non-tariff barriers, may advance the industry.

### 6.2.3 Paper and Paper Products Manufacturing

Paper and Paper Product Manufacturing in New Zealand has only a minor position in the international market. Arguably, a non-competitive localised market has lead to a lack of innovation and a resultant decline in exports, while international over-supply of paper products has led to deflated paper prices. As with the Wood and Wood Product Manufacturing industry, high energy costs and the possibility of a carbon tax may further reduce market competitiveness. Overall, without significant capital investment it is likely that the processing of paper and paper products within the Waikato Region will steadily decline over the next decade, and possibly further into the future.

## 6.3 Transport

The Waikato Region has transport linkages with the Auckland and Bay of Plenty regions and several other lower North Island regions. These linkages result in the second-highest traffic volumes in the country and indicate the importance of the Region's transport network both nationally and regionally.

Transportation needs are closely linked to the economic movements of major industries in the Region. These movements show an increasing association with forestry products, but lesser growth in the case of other primary products. Cost-effective transport to ports is important for primary product exports and increasing road congestion is impacting on this.

Transport needs will be closely related to the increasing demand for private transport as a result of the following two factors: (1) The projected population increase of 11.2 percent will result in larger numbers of local trips and increases in the number of motor vehicles; and (2) projected growth in employment and thus vehicle trips to the workplace. Furthermore, pressures on the transportation network cannot be divorced from the projected increases in car ownership in other regions, particularly Auckland and the Bay of Plenty, although continued development of the Waikato Expressway and proposed rezoning may ease congestion.

A reduction in rail services and increasing demand from a growing number of international tourists and export education students may also increase pressure on the Region's road transport network.

## 6.4 Other Service Industries

The economic futures for Education, Utilities and Other Business Services industries were also considered in the literature review.

### 6.4.1 Education

In recent years education, in particular export education (i.e. international students), has been an area of significant growth. This industry is one of Hamilton's most significant employers, with the University of Waikato and many other tertiary institutions and language schools. Education will continue to grow in the long term based on projected increases in international demand; due in part to the perceived higher standards of living obtained in New Zealand. A lack of regulation in the education industry, resulting in some unsuccessful language schools, may slow that industry's growth. Furthermore, increases in international tuition fees, tight immigration policy and a relatively small job market may detract from international demand. More

positively, Hamilton's innovation park, which was built in cooperation with Government, may help to simulate further growth in the industry through synergistic activities.

### 6.4.2 Utilities

The Waikato Region's wealth in natural resources, including geothermal fields, coal deposits and the Waikato River, offers a myriad of utility services. A projected 1.1 percent annual increase in energy consumption coupled with a possible increase in the share of coal-generating capacity may facilitate growth in energy industries over the next 10 to15 years. However, contraction in Maui gas field (post-2007) may lead to an energy shortage and higher domestic prices impacting on local industries. The Government's obligations under the Kyoto Protocol, and the possible imposition of carbon taxes may also result in higher electricity generation costs. Furthermore, resource depletion from inefficient- and over-use in the longer term may constrain growth in the energy industry.

## 6.5 Mining and Quarrying

The Waikato Region is endowed with valuable minerals supporting mining and quarrying industries. With the possible closure of the Martha Mine on the horizon, this industry may follow a downtrend trend. In the case of coal mining, higher production costs associated with signing the Kyoto Protocol may affect longer term growth.

## 6.6 Construction

Construction activity is typically cyclical. It is driven by a number of factors including interest rates and business confidence. Construction activity also mirrors the combined effect of growth in other major Waikato industries and residential housing. Factors that are likely to significantly impact on construction are reinvestment and capital upgrading in the dairy industry, transport network expansions, new utility industry developments, and higher housing demands from an increasing population.

## 6.7 Tourism

Tourism in not represented by one specific industry the Waikato Region input-output model. Instead, the 'tourism effect' is captured in several industries including Transportation, Recreation and Culture, Retail, Accommodation, Hotels and Restaurants. Tourism is nevertheless a dominant industry in the Waikato Region. Attractions such as the beaches of the Coromandel Peninsula, the Waitomo Caves and Lake Taupo, together with the Region's proximity to Auckland, Tauranga and Rotorua make the Waikato Region popular for domestic and international tourists alike.

Data from the 2006-2012 Tourism Forecasts by the Ministry of Tourism show that in 2005 an estimated 11.4 million visitor nights were spent by tourists in the Waikato Region[14]. This figure was dominated by domestic visitor nights (8.1 million visitor nights representing 71 percent), with international visitor nights providing the balance (3.3 million visitor nights representing 29 percent). In addition, the Waikato Region is a popular destination for day visits – predominantly domestic.

It is forecast that growth in international visitor nights in the Waikato Region will outstrip growth in the domestic market by a factor of four – although the domestic market will remain dominant. By 2012 it is estimated that domestic visitor nights in the Waikato Region will have increased to 8.7 million nights at an annual average of 1 percent growth (Figure 6.1). International visitor nights are forecast to increase to 4.4 million; an annual average growth rate of 4 percent. The forecast result is a total of 13.1 million visitor nights in the Waikato Region in 2012.

[14] Data for the Waikato Region has been derived by combining data for the Coromandel, Waikato and Lake Taupo Regional Tourism Organisation areas.

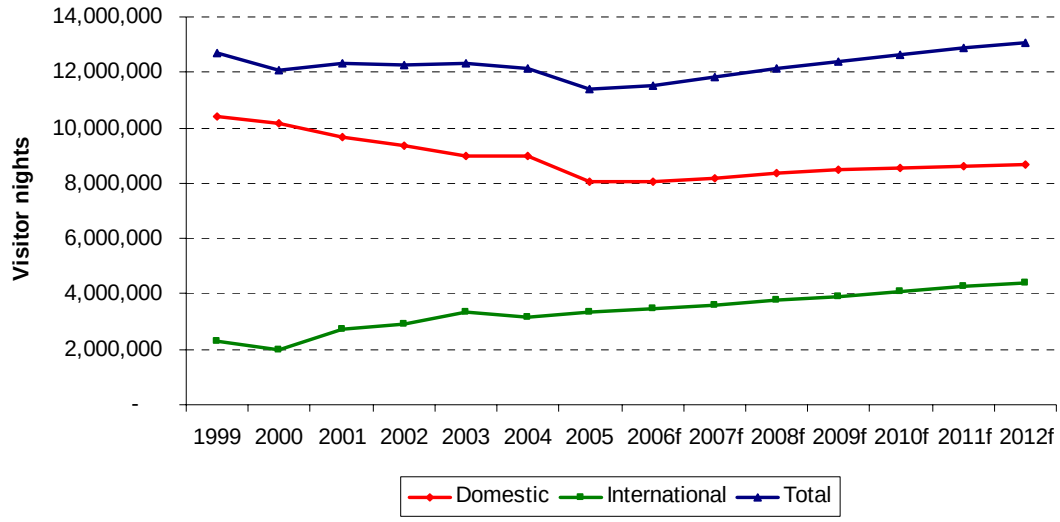


**Figure 6-1: Growth in Waikato Region Visitor Nights, 1999-2012. Source: Ministry of Tourism.**

The key markets for visitor nights in the Waikato Region are domestic. Due to its major population and close proximity, Auckland is the key market for visitor nights in the Waikato Region, accounting for an estimated 29 percent of all visitor nights in 2005 (41 percent of domestic nights) (Table 6.1). Residents of the Waikato Region itself account for the second largest share of visitor nights (12 percent) followed by residents of the Wellington Region (9 percent). In total, North Island residents dominate domestic visitor nights in the Waikato accounting for 95 percent.

Among international visitors, Australia is the largest single market, accounting for 7 percent of all visitor nights. It is followed by UK/Nordic/Iceland (6 percent), Americas (5 percent), and Rest of Europe (5 percent).

By 2012 it is forecast that although the domestic share of total visitor nights will have dropped to 66 percent, the overall distribution of domestic origins will have remained much the same. Growth is expected to be strongest from the Waikato's two dominant neighbouring regions, Auckland and the Bay of Plenty. In the international market, it is forecast that growth will be particularly strong from the UK/Nordic/Iceland and the Rest of the World markets and that these will account for the largest shares of international visitor nights in 2012.

**Table 6-1: Waikato Region Visitor Nights by Market, 2005 & 2012 Source: Ministry of Tourism**

| Origin | 2005 Visitor Nights | % | 2012 Visitor Nights | % | % Change | Ann. Av Cange |
|---|---|---|---|---|---|---|
| Auckland | 3,322,791 | 29% | 3,728,905 | 29% | 12% | 1.7% |
| Waikato | 1,418,790 | 12% | 1,488,644 | 11% | 5% | 0.7% |
| Bay of Plenty | 573,273 | 5% | 624,429 | 5% | 9% | 1.2% |
| Wellington | 1,074,362 | 9% | 1,121,234 | 9% | 4% | 0.6% |
| Rest of North Island | 1,276,315 | 11% | 1,290,758 | 10% | 1% | 0.2% |
| Canterbury | 270,236 | 2% | 283,746 | 2% | 5% | 0.7% |
| Otago | 97,996 | 1% | 100,486 | 1% | 3% | 0.4% |
| Rest of South Island | 44,573 | 0% | 46,418 | 0% | 4% | 0.6% |
| Total New Zealand | 8,078,336 | 71% | 8,684,620 | 66% | 8% | 1.0% |
| Australia | 761,420 | 7% | 933,459 | 7% | 23% | 3.0% |
| Americas | 518,876 | 5% | 620,959 | 5% | 20% | 2.6% |
| UK/Nordic/Iceland | 706,880 | 6% | 1,017,299 | 8% | 44% | 5.3% |
| Rest of Europe | 550,415 | 5% | 704,117 | 5% | 28% | 3.6% |
| Rest of World | 811,880 | 7% | 1,122,777 | 9% | 38% | 4.7% |
| Total International | 3,349,471 | 29% | 4,398,612 | 34% | 31% | 4.0% |
| TOTAL | 11,427,807 | 100% | 13,083,232 | 100% | 14% | 2.0% |

# 6.8 Summary of Growth Prospects

Table 6.2 below presents a summary of industry growth prospects based on the literature search undertaken. The following nomenclature is used to describe the direction of growth between each five year period (i.e. 2006 to 2011, 2011 to 2016, 2016 to 2021, and 2021 to 2026): '+' represents positive growth, '-' represents negative growth and '?' represents unknown. Of course, it is not possible to validate or verify these prospects. Furthermore, it is impossible from purely a literature review to assess the magnitude of the growth rates. This is instead left to the quantitative projections developed in Section 5. Nevertheless, some broad level directions can be identified as per Table 6.2:

- Both *Dairy Cattle Farming* and *Dairy Product Manufacturing* industries in the Waikato Region will show upward growth, but at a decreasing rate. Competition in international markets will be a key determinant of growth in these industries.
- The futures of the *Forestry and Logging* and W*ood Product Manufacturing* industries are ambiguous. To stimulate growth, large investment is required in order to localize value added processing, for example the processing of raw logs to high quality finished products to meet international demand. It is likely to be difficult for local industries to compete with cheaper labour costs found in some Asian countries. As a result, some existing international investment may be transferred overseas in the longer term. Possible tariff removals in the US and Europe as a result of WTO negotiations will also benefit the forestry industry in New Zealand and in the Waikato Region. In respect of the *Paper and Paper Product Manufacturing* industry, there is a clear decline in the Waikato Region. This is a result of a number of factors including a lack of innovation, excess international supply and competitive prices.
- The prospects for the *Transport* industry are closely related to other key industries in the Waikato Region. It is likely to be a growth industry meeting increasing demand for both private use and freight requirements.
- The *Education* related services have been growing in the recent years and this trend is likely to continue due to increasing international demand.
- The Waikato's rich natural resource base will facilitate growth in the *Utilities* and the *Mining and Quarrying* industries. However, contraction in the Maui gas field, obligations under the Kyoto Protocol, and the possible imposition of carbon taxes will result in higher production costs and electricity prices, which may, in turn, stifle growth.
- The movement of the *Construction* industry activity is cyclical and closely related to growth in other major industries.
- *Tourism* growth is likely to be considerable with international visitor nights experiencing an annual average growth rate of 4 percent. On the domestic front, it is forecast that by 2012 the domestic share of total visitor nights will drop to around 66 percent.

**Table 6-2: Summary of Industry Growth Prospects**

| | Dairy Industry | | | Forestry Industry | | | Services | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dairy Cattle Farming | Dairy Product Manuf | Other Food Manuf | Forestry and Logging | Wood Product Manuf | Paper and Paper Product Manuf | Transport Industries | Educ-ation | Utilities | Tourism Related | Const-ruction |
| 2006 | + | + | + | ? | ? | - | + | + | ? | + | ? |
| 2011 | + | + | + | ? | ? | - | + | + | ? | + | ? |
| 2016 | + | + | + | ? | ? | - | + | + | ? | + | ? |
| 2021 | + | + | + | ? | ? | - | + | + | ? | + | ? |
| 2026 | + | + | + | ? | ? | - | + | + | ? | + | ? |

# 7 In-Depth Interviews

## 7.1 Summary of In-depth Interviews

In this Section a summary of the five in-depth interviews conducted with key informants from the Waikato Region is provided. The main purpose of these interviews was to 'ground truth' the preceding quantitative analysis. Informants interviewed were senior representatives from

- The Katolyst Group
- Fonterra Limited
- University of Waikato
- Affco New Zealand
- New Zealand Industry Training Organisation

All interviews were pre-arranged and undertaken by telephone from mid July to mid August 2006. Interviews took between 30 and 60 minutes.

## 7.2 The Interview Process

Interviews began with a general discussion of the Waikato Region and it's strengths, weaknesses and prospects for the future. Discussion then turned to key industries within the Waikato Region with a focus on prospects into the future. Some informants forwarded views on a wide range of industries, while others focussed on the specific industries in which they held particular expertise.

## 7.3 Key Results

Key results from these interviews are outlined below:

*The Waikato Region*

Key strengths of the Waikato Region are seen as:

- geographic location and close proximity to a number of large centres of population in the upper central north island
- climate, soils and topography which provide a strong base for primary production – particularly dairy and meat
- the Waikato River
- strong population base providing plentiful labour supply
- a strong regional economy (based on agricultural platform)

Conversely, disadvantages or weaknesses of the Waikato Region are seen as:

- land use competition – particularly between rural and urban land uses
- size – limited domestic market
- large numbers of unskilled- semi-skilled workers
- high proportion of very small businesses
- prospect of large/international businesses leaving the region/country in the future
- distance from a major port
- pollution of waterways
- variable climate

*The Dairy Industry*

Dairy Cattle farming is clearly the largest industry in the Waikato Region. There is widespread consensus that this will remain the case in the foreseeable future. It is

estimated that dairy output will continue to grow at a rate of 3 to 4 percent per annum into the short and medium term future. Growth will come not from increased land in dairying, but from improved productivity.

It is generally foreseen that the total area of land used for dairying in the Waikato will remain relatively static into the future. It is forecast that there will be significant changes in the location of dairying over the next 10 to 20 years. Competition from other land uses, in particular urban encroachment, will see dairying displaced from much of its current urban periphery locations. Instead, dairying will move to more remote locations, such as currently occupied by forestry or other farming uses. Despite such land conversions it is not believed that any substantial productivity per hectare loss will be experienced.

A key change in dairy processing over the next 10 to 20 years will be the increased mechanisation of processing, packaging and laboratory work resulting in a possible reduction in local employment. This process is already well underway (an example was given of a dairy packaging plant that employed 18 workers eight years ago, and now, employs only one) and is likely to accelerate into the future.

Other areas in which it is seen further efficiencies can be achieved in the dairy industry over the next 10 to 20 years are:

- Improved farming practices as family farms move through the generations or are taken under the management of larger companies
- Improved herd output through continued genetic research
- Improved efficiencies in transportation through the introduction of larger tankers
- Improved transport efficiencies through on-site concentration
- Further specification of products directly to overseas markets
- Climate change may result in greater output

Potential threats to the continued growth of the dairy industries into the future will be:

- Fonterra Ltd's increasing emphasis on overseas producing markets (Asia and South America) will decrease the importance of the Waikato as a production base.
- Loss of prime dairying land to other uses e.g. lifestyle blocks, beef/maize farming
- Environmental issues such as nitrate leaching into waterways
- Allocation of water rights among increasing competition
- Increasing energy costs
- Inability to continue to be both sustainable and low cost producers in the face of increasing overseas competition for export markets

*The Meat Industry*

Meat processing is an important industry in the Waikato. While those consulted are certain the meat industry will remain a major player in the Region and are reasonably optimistic about growth in the future, prospects are less certain than those envisaged for dairy.

In the Waikato, the focus of the meat industry is on prime stock and beef steers with little sheep/lamb production. This is primarily because of the high value nature of the land and the synergies with the dairy industry. While the national sheep flock has increased at the expense of beef, this trend has not occurred in the Waikato, where the beef herd has remained relatively static over the last few years.

It is generally felt that there are too many large and medium sized companies in the meat industry in New Zealand currently. The result is that margins are very tight and this, in combination with international protein cycles can lead to significant fluctuations in industry profitability. It is also felt that there will be a major 'shake down' in the industry in the near future (5 to 10 years) with some significant agglomeration/takeover

activity. Any such agglomeration will present opportunities for improved efficiencies in the industry through increased plant specialisation and the ability to smooth seasonal fluctuations through rationalisation of product distribution among plants.

On the farm, the meat industry experiences significant crossover benefits from the abundant research and development occurring in the dairy industry. However, at the processing end, the level of mechanisation in the meat industry is behind that in the dairy industry and remains relatively labour intensive. This is primarily because of the difficulty of mechanising the processing of live animals. Increased mechanisation is starting to occur, but it is generally recognised that there is more potential for further mechanisation, and therefore reduction of labour. This is foreseen as one of the key changes in the industry over the next 10 to 20 years.

The current relative labour intensity of meat processing (as compared with dairy) brings labour market related issues. Worker shortages, lack of worker motivation and labour market legislative changes can all impact on productivity and profitability. It is estimated that recent changes to the Holidays Act have impacted on productivity by 2 to 3 percent. While this will become less of an issue as increased mechanisation reduces employment, other such changes in the future may be a threat to continued growth in the industry.

The labour intensive nature of meat processing also means increased competition from overseas producers where labour is cheaper. This will continue to be an issue as increased mechanisation is adopted internationally. In addition, there is still significant potential to add value to export products.

*Forestry*

The overall outlook for the forestry industry is relatively negative. It is felt that unless there are significant changes in the industry in the medium to long term, major areas of forest in the Waikato will be harvested, and returned to dairy or other types of farming which add more value.

Key impediments to future growth in the forestry industry are:

- Lack of a coherent industry strategy
- Lack of value added
- Poor management of major processing sites
- Increased international competition which will continue to depress prices
- Newly emerging producers with high quality products

Carbon tax credits are seen as a potential saviour for the industry. Overall, it was felt that the industry needed to be significantly restructured if growth was to occur. One informant felt a “Forestry Fonterra” was required.

*Research and Development*

The Waikato Region currently holds a strong position in the field of research and development thanks to the presence of the University of Waikato and several Crown Research Institutes that have developed round the agricultural-based industries. In the future, the Waikato may experience growth in the agricultural and forestry industries as a result of research related innovation in such areas as processing and packaging, increased mechanisation, and as the meat and dairy industries strive for increased output from relatively static herds.

However, future growth is clearly threatened by:

- Competition for location of research and development facilities from larger centres and overseas. Fonterra Limited has recently commissioned a new research centre in Melbourne where significant state subsidies are available to attract such industry
- Poaching of New Zealand scientists by overseas research and development centres offering higher wages.

# 8 Analysis of Results

In this section the results from the three growth projection initiatives (quantitative econometric projections, literature review and in-depth interviews) are combined to provide an overall picture of the BAU future for Waikato, particularly in relation to the Region's key industries.

## 8.1 Dairy Cattle Farming

It is anticipated that the dairying industries will continue to grow in the Waikato Region. Dairy Cattle Farming, in particular, is projected to grow by 1.2 percent per annum above its current GRP contribution. It is expected that the growth in Dairy Cattle Farming will be predominately based on productivity gains rather than through land expansion. Barriers to growth include land use restrictions, compliance costs associated with the Kyoto Protocol, and nitrate leaching into aquatic environments.

## 8.2 Dairy Manufacturing

The growth in Dairy Manufacturing is projected at 1.9 percent per annum above its current contribution to GRP. Key factors contributing to this growth will be the possible removal of trade tariffs in the US and EU, vertical integration within the industry, increased mechanisation, and niche value added production. Capital for labour substitution will be critical to this growth. Several key threats to growth have been identified, including: overseas competition, Fonterra Limited investing abroad rather than locally, and water allocation issues.

## 8.3 Forestry and Logging

The Waikato Region will continue to contain the largest area of plantation forest in New Zealand. There is no clear indication of the direction of GRP growth in the Forestry and Logging industry. Drivers of growth include shorter growing cycles and carbon tax credits. Several restrictions to growth have been identified, including a lack of coherent industry strategy, a climate suitable for only certain forest species, pest and disease threats, and that without restructuring land will be converted to other farming types.

## 8.4 Wood and Paper Manufacturing

Obstacles to growth in the Wood and Paper Manufacturing industries include the need for investment, energy costs, possible future carbon taxes, poor management of processing sites, and cheaper labour and lower prices overseas, especially in Asia. For the Wood Manufacturing industry, positive growth is projected at approximately 2 per cent per annum above its current contribution to GRP. However, literature sources dispute this finding, suggesting uncertain growth. Factors that may promote growth are the reduction in trade barriers and increasing international demand, although vertical integration abroad is also seen as a significant threat. A need for diversification into higher value added products has been identified. Projections for the Paper Manufacturing industry indicate a negative GRP growth rate. In addition to those factors already described, the impediments to growth in this industry include a non-competitive localised market and an international oversupply of paper products.

## 8.5 Utilities

Compared to many New Zealand regions, the Waikato Region has a relative abundance of natural resources for the provision of energy. It is projected that energy consumption will mirror GRP growth from the industry, increasing at an annual average of approximately 1 percent. Growth in this industry is however particularly subject to governmental processes and energy policy, and thus uncertain. Impediments to growth in the energy industry include obligations under the Kyoto Protocol, imposition of carbon taxes, and in the case of natural gas and geothermal, inefficient- and over-use of resources.

## 8.6 Tourism

The Waikato Region has many natural attractions including the Waitomo Caves, Coromandel beaches and forests, and the recreational activities associated with Lake Taupo. Proximity to the populous Auckland and Bay of Plenty regions is a key driver of tourist activity. Growth in Trade and Accommodation is projected at 15.6 percent over the study period; an annual average of 1.4 percent. It is forecast that international visitor nights, driven predominately by UK/Nordic/Icelandic tourists, will grow at a rate four times that of domestic visitor nights. Nevertheless, domestic visitor nights will remain the dominant share of total visitor nights at 66 percent by 2026.

# PART C Scenario Projections for the Waikato Region 2006-2026

# 9 Scenario Results

## 9.1 Introduction

This section presents the BAU scenario results derived from the Waikato Futures Model. Results are presented for low, medium and high projection series. It is important to note that the results outlined below are only one set of results that could be derived from the Waikato Futures Model. The model is designed to test the impacts of a range of plausible scenarios on both the economy and the environment. The intention of the model is not to predict the future (by definition no model is able to do this), but rather to assess the likely economy-environment tradeoffs of plausible scenarios. Such an approach is directed at anticipating the eventualities of many given pathways.

The BAU scenario draws on the qualitative and quantitative projections developed in Part B to generate estimates of future economic growth at an industry level. The results presented below assess the impacts of the BAU scenario under two key categories:

- Impacts on population and the economy
- Impacts on the environment

Measures are reported for the BAU scenario at five yearly intervals covering the 2006 to 2026 period. Furthermore, measures are shown for each of the low, medium, and high projection series.

In addition, results are reported at a more disaggregated level into the future for the medium projection series only. In this analysis, the 48 economic industries of the Waikato Region input-output table are aggregated into the following 16 key industries and households for reporting purposes:

- Intensive Farming
- Extensive Farming
- Forestry & Logging
- Other Primary
- Dairy Manufacturing
- Other Food Manufacturing
- Wood & Paper Manufacturing
- Other Manufacturing
- Utilities
- Construction
- Trade & Accommodation
- Business Services
- Road Transport
- Other Transport
- Government
- Other Services
- Households

A concordance matching the 48 industries to the 16 industries may be found in Appendix A (Table A.3).

# 9.2 Impacts on Population and Economy

Three key measures are used to describe future impacts on the population and economy of the Waikato Region under the BAU scenario. These are:

- Population
- Employment
- Gross Regional Product

These are considered below.

# 9.3 Population

At 2006 the population base of the Waikato Region is estimated at 386,600. Into the future, population is forecast to remain relatively static under the low growth projection series. Under the medium projection series, an average annual rate of 0.5 percent per annum is forecast resulting in a 2026 population of 426,800. Under the high growth projection series, the Waikato Region population is forecast to increase to 473,100 people by 2026.

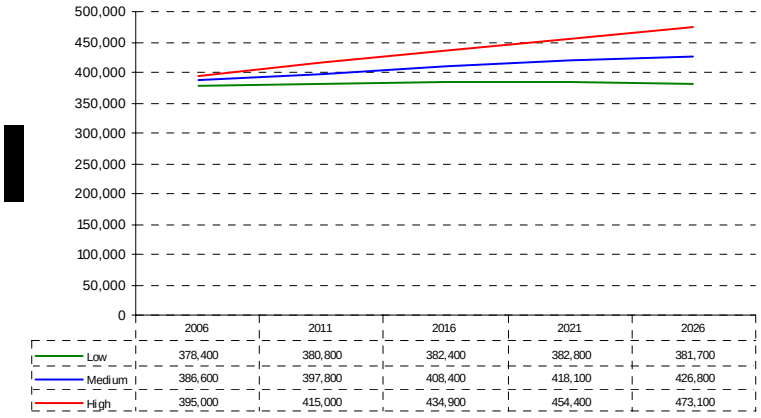


**Figure 9-1: Population Growth 2006-2026**

## 9.3.1 Employment

In 2006, it is estimated that there are 155,965 FTEs in the Waikato Region

Under the low growth projection series, employment is forecast to increase to 174,700 by 2026. Under the medium projection series, employment grows at an annual average rate of 1.2 percent to 192,500 FTEs. Under the high projection series it is forecast the Waikato Region will employ an additional 55,300 FTEs by 2026, an annual average growth rate of 1.7 percent.

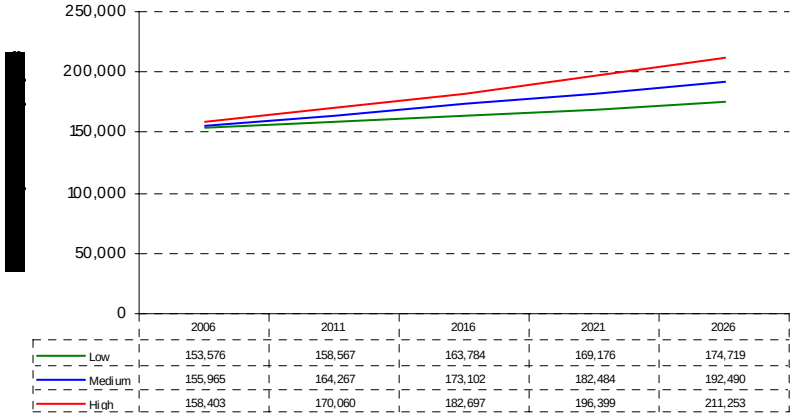

**Figure 9-2: Employment Growth 2006-2026**

Under the medium growth projection series, employment remains strongest over the 2006 to 2026 period in Trade and Accommodation, (including retail and wholesale, 18.9 percent of FTEs in 2026), Other services (17.5 percent), Extensive Farming (16.1 percent) and Business Services (11.9 percent). Growth in FTEs over the 2006 to 2026 period is forecast to be strongest in Dairy Manufacturing (1.9 percent annual average growth) Intensive Farming (1.8 percent) and Extensive Farming (1.8 percent), and slowest in Government (0.5 percent), Other Services (0.6 percent) and Construction (0.6percent).

**Table 9-1: Employment Growth by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | Full Time Equivalent Employees (FTEs) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 2,035 | 2,226 | 2,437 | 2,671 | 2,929 | 1.8% | 1.3% | 1.5% |
| Extnsve Frmng | 21,843 | 23,806 | 25,962 | 28,333 | 30,945 | 1.8% | 14.0% | 16.1% |
| Othr Prmry | 4,483 | 4,759 | 5,061 | 5,391 | 5,752 | 1.3% | 2.9% | 3.0% |
| Frstry & Lggng | 1,958 | 2,117 | 2,299 | 2,505 | 2,739 | 1.7% | 1.3% | 1.4% |
| Other Food Manf | 4,359 | 4,612 | 4,878 | 5,159 | 5,455 | 1.1% | 2.8% | 2.8% |
| Dairy Manf | 2,247 | 2,462 | 2,698 | 2,959 | 3,246 | 1.9% | 1.4% | 1.7% |
| Other Manf | 11,589 | 12,497 | 13,526 | 14,696 | 16,030 | 1.6% | 7.4% | 8.3% |
| Wood & Paper Manf | 4,342 | 4,700 | 5,113 | 5,585 | 6,127 | 1.7% | 2.8% | 3.2% |
| Utilities | 768 | 800 | 832 | 866 | 901 | 0.8% | 0.5% | 0.5% |
| Cnstrctin | 12,184 | 12,564 | 12,939 | 13,303 | 13,654 | 0.6% | 7.8% | 7.1% |
| Trade & Accmdtn | 31,201 | 32,473 | 33,772 | 35,089 | 36,425 | 0.8% | 20.0% | 18.9% |
| Road Trnsprt | 3,847 | 4,034 | 4,235 | 4,452 | 4,685 | 1.0% | 2.5% | 2.4% |
| Other Trnsprt | 976 | 1,012 | 1,051 | 1,093 | 1,137 | 0.8% | 0.6% | 0.6% |
| Business Srvcs | 18,956 | 19,865 | 20,822 | 21,823 | 22,875 | 0.9% | 12.2% | 11.9% |
| Gvrnmnt | 5,269 | 5,426 | 5,576 | 5,715 | 5,842 | 0.5% | 3.4% | 3.0% |
| Other Srvcs | 29,909 | 30,915 | 31,900 | 32,846 | 33,747 | 0.6% | 19.2% | 17.5% |
| Total | 155,965 | 164,267 | 173,102 | 182,484 | 192,490 | 1.1% | 100.0% | 100.0% |

# 9.4 Gross Regional Product

The GRP of the Waikato Region is currently (2006) estimated at $\$_{2004}$12,727 million.

GRP under the low growth projection series is forecast to increase to $\$_{2004}$14,170 million by 2026. Under the medium growth projection series GRP is forecast to grow at an average annual rate of 1.1 percent to $\$_{2004}$15,617 million by 2026. Under the high growth projection series, annual average growth of 1.7 percent is forecast reaching $\$_{2004}$17,143 million by 2026.

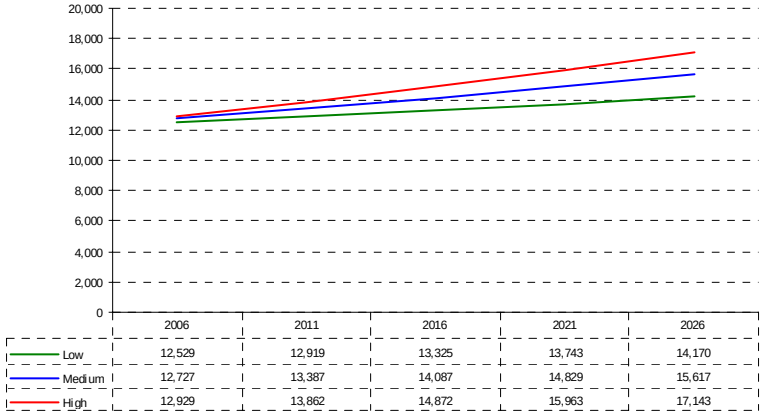


**Figure 9-3: Gross Regional Product Growth 2006-2026**

In 2026, the greatest contribution of GRP under the medium growth projection series will be generated in Business Services (20.2 percent of Waikato GRP), Extensive Farming (17.3 percent), Trade and Accommodation (11.7 percent) and Other Services (11.3 percent) (Table 9.2). These industries also have the highest GRP in 2006.

Annual average growth in GRP between 2006 and 2026 will be strongest in Dairy Manufacturing (1.9 percent), Extensive Farming (1.8 percent), Intensive Farming (1.8 percent) and Forestry and Logging (1.7 percent)

Annual average growth in GRP to 2026 will be slowest in Government (0.5 percent), Construction (0.6 percent) and Other Services (0.6 percent).

**Table 9-2: Gross Regional Product Growth by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | Gross Regional Product ($ million) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 112 | 122 | 134 | 146 | 161 | 1.8% | 0.9% | 1.0% |
| Extnsve Frmng | 1,861 | 2,032 | 2,221 | 2,427 | 2,655 | 1.8% | 14.8% | 17.3% |
| Othr Prmry | 330 | 344 | 360 | 376 | 394 | 0.9% | 2.6% | 2.6% |
| Frstry & Lggng | 220 | 238 | 258 | 281 | 308 | 1.7% | 1.8% | 2.0% |
| Other Food Manf | 340 | 360 | 381 | 403 | 426 | 1.1% | 2.7% | 2.8% |
| Dairy Manf | 302 | 330 | 362 | 397 | 436 | 1.9% | 2.4% | 2.8% |
| Other Manf | 824 | 886 | 955 | 1,033 | 1,122 | 1.6% | 6.6% | 7.3% |
| Wood & Paper Manf | 358 | 378 | 403 | 431 | 464 | 1.3% | 2.9% | 3.0% |
| Utilities | 408 | 424 | 441 | 459 | 477 | 0.8% | 3.3% | 3.1% |
| Cnstrctin | 622 | 641 | 660 | 679 | 697 | 0.6% | 5.0% | 4.5% |
| Trade & Accmdtn | 1,535 | 1,598 | 1,664 | 1,730 | 1,798 | 0.8% | 12.2% | 11.7% |
| Road Trnsprt | 211 | 221 | 232 | 244 | 256 | 1.0% | 1.7% | 1.7% |
| Other Trnsprt | 90 | 94 | 97 | 101 | 105 | 0.7% | 0.7% | 0.7% |
| Business Srvcs | 2,659 | 2,767 | 2,878 | 2,991 | 3,106 | 0.8% | 21.2% | 20.2% |
| Gvrnmnt | 419 | 432 | 444 | 455 | 465 | 0.5% | 3.3% | 3.0% |
| Other Srvcs | 1,545 | 1,597 | 1,649 | 1,699 | 1,746 | 0.6% | 12.3% | 11.3% |
| Hhlds | 699 | 720 | 739 | 756 | 772 | 0.0% | 5.6% | 5.0% |
| Total | 12,534 | 13,185 | 13,877 | 14,609 | 15,387 | 1.0% | 100.0% | 100.0% |

# 9.5 Impacts of the Economy on the Environment

A key feature of the futures model is that it analyses not only the economic impacts associated with growth, but also the resultant environmental effects. Unfortunately at this time these effects are currently limited to only a few selected natural resources and residuals. The BAU scenario as presented establishes a baseline against which other scenarios may be compared and evaluated. A range of measures have been used to describe future impacts of the economy on the environment of the Waikato Region under the BAU scenario. These are:

- Land use
- Delivered energy
- Energy related emissions
  - carbon dioxide ($CO_2$)
  - nitrous oxide ($N_2O$)
  - methane ($CH_4$)
- Solid waste

# 9.6 Land Use

It is estimated that approximately 1.7 million hectares of land in the Waikato Region are currently (2006) used for economically productive purposes. It is important to note that all the land use estimates reported in this section are expressed in 2006 hectare equivalents. Under a high projection series it is therefore possible that the land use requirements economy-wide may exceed actual available land area. In actuality this is infeasible – instead it indicates that land productivity increases (i.e. more output per ha), better land management practices, land conversion between farming types, or land scarcity.

Under the low growth projection series, it is estimated that by 2026, land in productive use will have increased to 2.13 million hectares (Figure 9.4). Under the medium growth projection series, land in productive use is estimated to grow at an average annual rate of 1.7 percent to 2.3 million hectares by 2026. The high growth projection series result puts average annual growth at 2.3 percent, resulting in 2.5 million hectares of economically productive land by 2026.

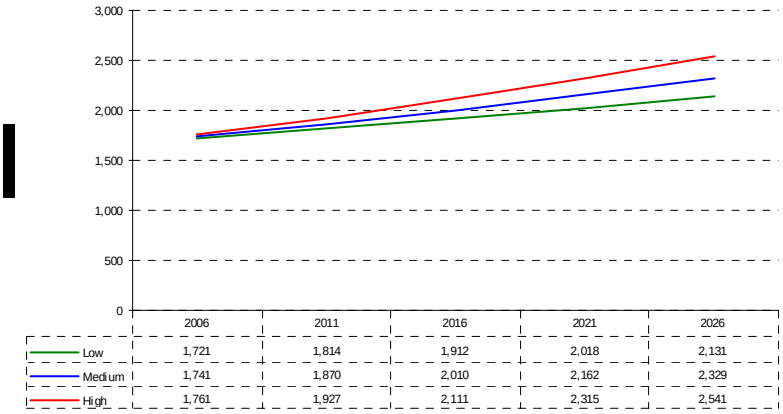


**Figure 9-4: Land Area Coverage 2006-2026**

Extensive farming currently dominates productive land coverage in the Waikato (77.9 percent of total productive land area in the Waikato Region in 2006) and will continue to do so through to 2026 (76.5 percent) under the medium growth projection series. Other major land users will remain Other Primary (11.9 percent in 2026), Other Services[15] (6.7 percent) and Households (3.2 percent).

Annual average growth in land area coverage will be strongest in Other Manufacturing (2.2 percent), Trade and Accommodation (1.8 percent) and Other Primary (1.8 percent). While, the slowest growth in terms of land area coverage will occur in Other Transport (0.2 percent), Utilities (0.1 percent) and. Forestry and Logging (-0.9 percent), the latter having negative growth.

**Table 9-3: Land Area by Industry 2006-2026 (BAY Medium Growth Projection Series)**

| Industry | Land Area (000s Hectares) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intensive Farming | 10 | 10 | 11 | 11 | 12 | 1.0% | 0.5% | 0.5% |
| Extensive Farming | 1,468 | 1,439 | 1,519 | 1,599 | 1,680 | 0.7% | 77.9% | 76.5% |
| Forestry & Logging | 9 | 8 | 8 | 8 | 8 | -0.9% | 0.5% | 0.3% |
| Other Primary | 185 | 202 | 222 | 242 | 261 | 1.8% | 9.8% | 11.9% |
| Dairy Manufacturing | 1 | 1 | 1 | 1 | 1 | 0.5% | 0.1% | 0.1% |
| Other Food Manufacturing | 0 | 0 | 0 | 0 | 0 | 1.3% | 0.0% | 0.0% |
| Wood & Paper Manufacturing | 1 | 1 | 1 | 1 | 1 | 0.4% | 0.1% | 0.1% |
| Other Manufacturing | 0 | 0 | 1 | 1 | 1 | 2.2% | 0.0% | 0.0% |
| Utilities | 8 | 8 | 8 | 8 | 8 | 0.1% | 0.4% | 0.4% |
| Construction | 0 | 0 | 0 | 0 | 0 | 0.7% | 0.0% | 0.0% |
| Trade & Accommodation | 1 | 1 | 2 | 2 | 2 | 1.8% | 0.1% | 0.1% |
| Road Transport | 0 | 0 | 0 | 0 | 0 | 0.5% | 0.0% | 0.0% |
| Other Transport | 2 | 2 | 2 | 2 | 2 | 0.2% | 0.1% | 0.1% |
| Business Services | 2 | 2 | 2 | 2 | 2 | 0.6% | 0.1% | 0.1% |
| Government | 0 | 0 | 0 | 0 | 0 | 0.6% | 0.0% | 0.0% |
| Other Services | 134 | 137 | 141 | 144 | 147 | 0.5% | 7.1% | 6.7% |
| Households | 63 | 66 | 67 | 69 | 70 | 0.5% | 3.4% | 3.2% |
| Total | 1,885 | 1,878 | 1,984 | 2,090 | 2,196 | 0.8% | 100.0% | 100.0% |

## 9.6.1 Delivered Energy

In 2006, it is estimated that 51,215 terrajoules (TJ) of energy will be consumed by the Waikato economy. Under a low growth projection series, this level of energy consumption is forecast to increase to 55,784 TJ in 2026 (Figure 9.5). This is an annual average increase in energy consumption of 0.5 percent or a total increase over the 20 year period of 9 percent. Adopting the medium growth projection series delivered energy is forecast to increase by 19 percent to 2026, to 61,123 TJ (an annual average growth of 1 percent). Under the high growth projection series, delivered energy is forecast to increase by an average of 1.5 percent annually to 66,770 TJ. This equates to a total increase of 30 percent to 2026.

[15] This includes economic land used for recreational activities such as camping grounds, golf courses, sports grounds and the like. It however excludes land used for national and forest parks.

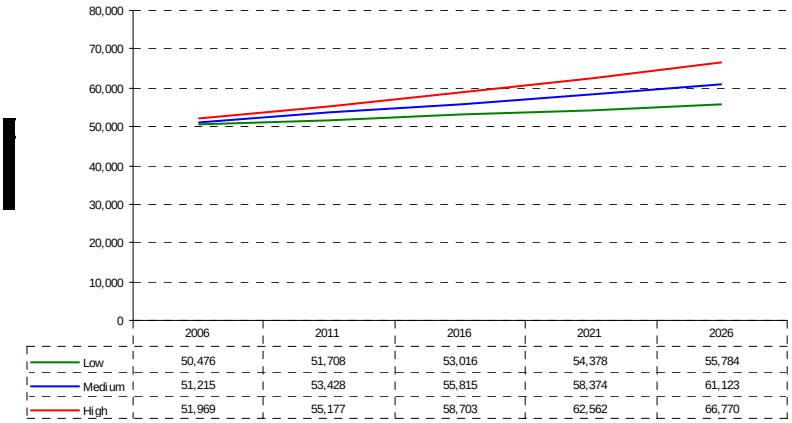


**Figure 9-5: Total Delivered Energy Growth 2006-2026**

Under the medium growth projection series, Households will remain the largest consumer of energy in 2026 but with a slightly lower share (28.4 percent of all delivered energy in 2026) (Table 9.4). Wood and Paper Manufacturing will be the second largest consumer of energy in 2026 (14.7 percent). Growth in energy consumption to 2026 will be highest in Dairy Manufacturing (1.9 percent annual average growth to 2026), Intensive Farming (1.8 percent) and Extensive Farming (1.8 percent).

**Table 9-4: Total Delivered Energy by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | Delivered Energy (Terra Joules) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 240 | 263 | 288 | 315 | 346 | 1.8% | 0.5% | 0.6% |
| Extnsve Frmng | 3,263 | 3,566 | 3,898 | 4,264 | 4,666 | 1.8% | 6.4% | 7.6% |
| Othr Prmry | 2,541 | 2,617 | 2,698 | 2,784 | 2,875 | 0.6% | 5.0% | 4.7% |
| Frstry & Lggng | 580 | 628 | 682 | 743 | 812 | 1.7% | 1.1% | 1.3% |
| Other Food Manf | 976 | 1,033 | 1,094 | 1,157 | 1,224 | 1.1% | 1.9% | 2.0% |
| Dairy Manf | 3,901 | 4,275 | 4,686 | 5,138 | 5,637 | 1.9% | 7.6% | 9.2% |
| Other Manf | 3,204 | 3,363 | 3,536 | 3,725 | 3,931 | 1.0% | 6.3% | 6.4% |
| Wood & Paper Manf | 7,824 | 8,011 | 8,267 | 8,596 | 9,002 | 0.7% | 15.3% | 14.7% |
| Utilities | 40 | 41 | 43 | 44 | 46 | 0.8% | 0.1% | 0.1% |
| Cnstrctin | 636 | 656 | 676 | 695 | 713 | 0.6% | 1.2% | 1.2% |
| Trade & Accmdtn | 2,899 | 3,018 | 3,141 | 3,265 | 3,390 | 0.8% | 5.7% | 5.5% |
| Road Trnsprt | 5,751 | 6,031 | 6,332 | 6,655 | 7,004 | 1.0% | 11.2% | 11.5% |
| Other Trnsprt | 1,282 | 1,304 | 1,331 | 1,363 | 1,400 | 0.4% | 2.5% | 2.3% |
| Business Srvcs | 895 | 939 | 985 | 1,034 | 1,085 | 1.0% | 1.7% | 1.8% |
| Gvrnmnt | 399 | 411 | 422 | 432 | 441 | 0.5% | 0.8% | 0.7% |
| Other Srvcs | 1,082 | 1,118 | 1,153 | 1,186 | 1,218 | 0.6% | 2.1% | 2.0% |
| Hhlds | 15,699 | 16,154 | 16,585 | 16,979 | 17,332 | 0.5% | 30.7% | 28.4% |
| Total | 51,215 | 53,428 | 55,815 | 58,374 | 61,123 | 0.9% | 100.0% | 100.0% |

For the purposes of reporting, fuels have been categorised as either fossil fuels, electricity, wood/black liquor or geothermal. A further breakdown of delivered energy fuel types (fossil fuels in particular) is available within the results produced by the Waikato Futures Model.

Figure 9.6 shows forecast total delivered energy under the medium growth projection series and its make up by fuel type. Energy consumed as a result of fossil fuel consumption comprises the highest share (67 percent over the period) of total delivered energy. Electricity requirements account for approximately 22 percent of delivered energy and wood/black liquor 10 percent. The consumption of geothermal generated fuel results in less than 1 percent of total delivered energy.

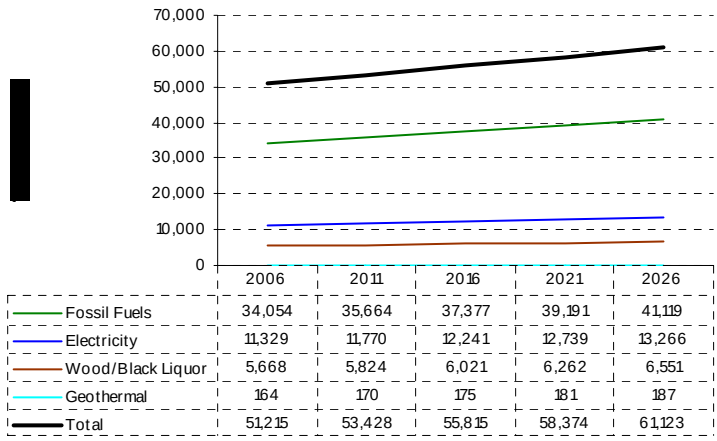


**Figure 9-6: Delivered Energy Growth by Fuel Type 2006-2026 (BAU Medium Growth Projection Series)**

Figures 9.7 to 9.10 show the forecasted growth of delivered energy by fuel type for each of the high, medium and low growth projection series.

It is estimated that 34,054 TJ of energy are currently (2006) consumed as a result of **fossil fuel** use (Figure 9.7). The medium growth projection series estimates growth at an annual average rate of 1 percent to 41,119 TJ in 2026. Under the high growth projections series, total fossil fuel use is forecast to increase by 32 percent to 44,993 TJ in 2026, an annual average increase of 1.6 percent.

**Electricity** Currently at 11,329 TJ, under the medium projection series, electricity use is forecast to grow at an average annual rate of 0.8 percent to 13,266 TJ in 2026 (Figure 9.8). Under the high projection series, electricity use is forecast to grow to 14,490 TJ in 2026, an annual average growth rate of 1.4 percent.

Energy consumed as a result of **wood/black liquor** use is currently estimated at 5,668 TJ (Figure 9.9). Under the medium growth projection series, use is forecast to increase to 6,551 TJ (an annual average rate of 0.8 percent.

**Geothermal** Estimates of the geothermal energy increase from 2006 to 2026 range from 0.15 percent annual average growth under the low scenario to 2.1 percent under the high growth scenario (Figure 9.10). Regardless of the growth series, geothermal remains an insignificant contributor to delivered energy through to 2026.

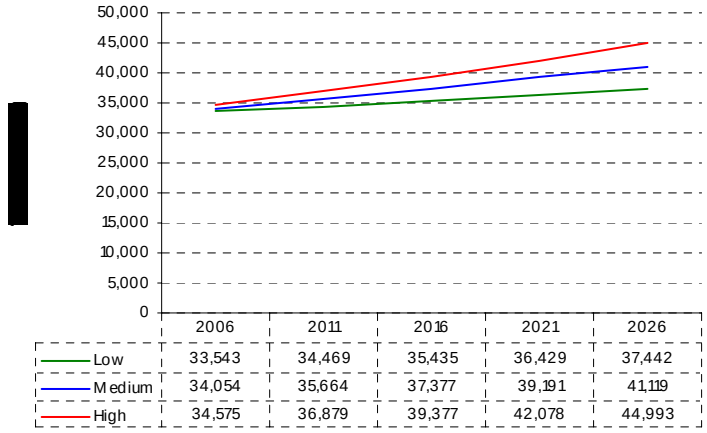


**Figure 9-7: Fossil Fuel Generated Delivered Energy 2006 – 2026**

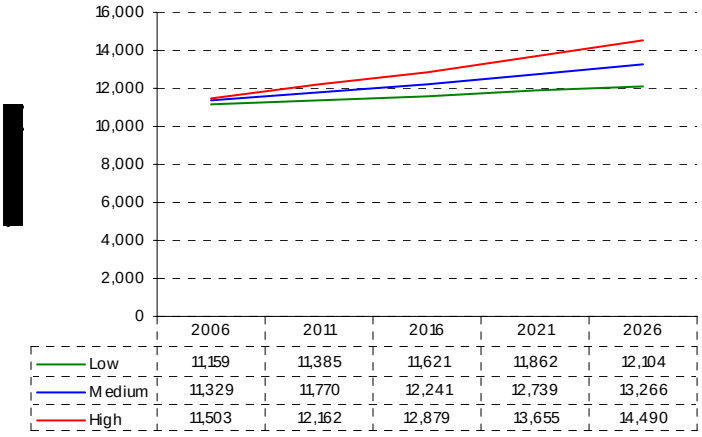


**Figure 9-8: Electricity Generated Delivered Energy 2006 - 2026**

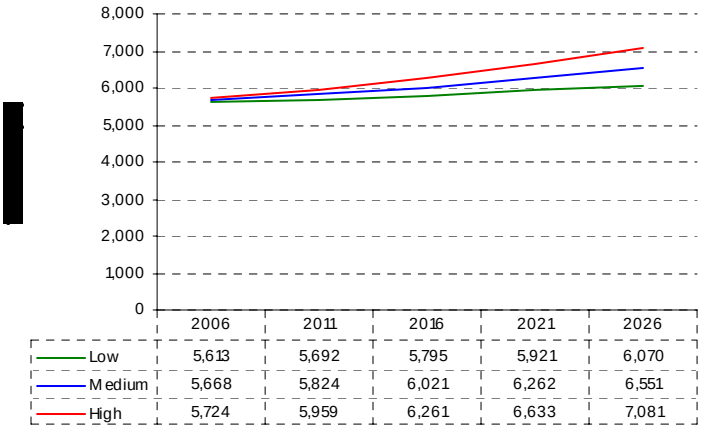


**Figure 9-9: Wood/Black Liquor Generated Delivered Energy 2006 – 2026**

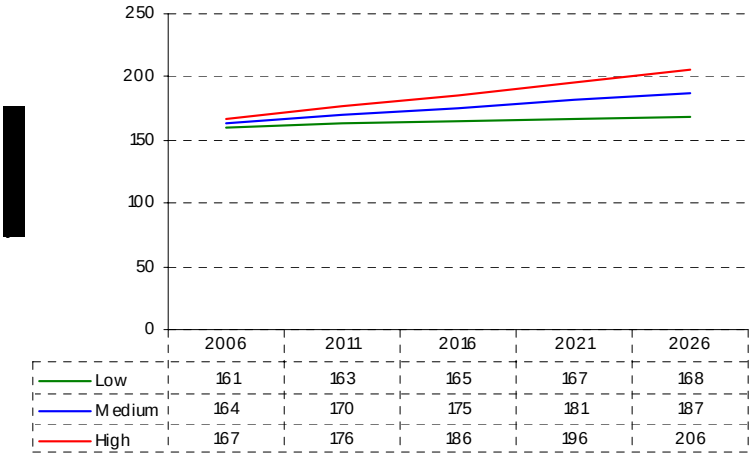


**Figure 9-10: Geothermal Generated Delivered Energy 2006 – 2026**

## 9.6.2 Energy Related Air Emissions

This section considers the future of energy related air emissions under the BAU. Specifically, this includes:

- Carbon dioxide ($CO_2$)
- Nitrous oxide ($N_2O$)

- Methane ($CH_4$)

*Carbon dioxide* ($CO_2$)

It is estimated that 3.7 million tonnes of carbon dioxide ($CO_2$) is currently (2006) emitted as a result of energy consumption in the Waikato Region (Figure 9.11). The medium growth projection series forecasts a total increase in $CO_2$ emissions of 19 percent to 4.4 million tonnes.

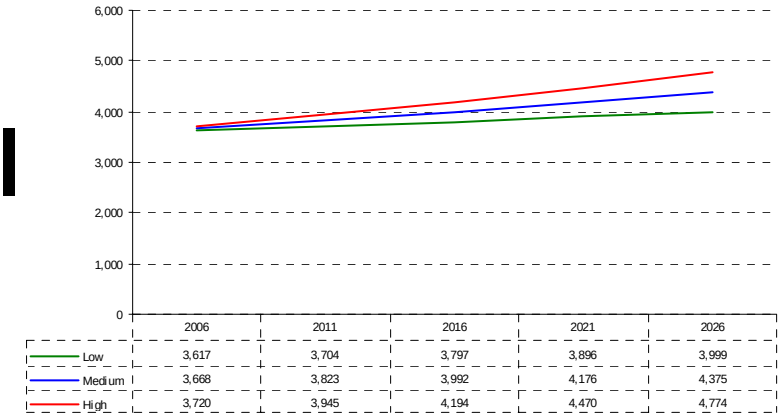


**Figure 9-11: Carbon Dioxide Emissions 2006 – 2026**

Households are currently the largest contributors to $CO_2$ emissions (28.2 percent of all $CO_2$ emissions in 2006), and will remain the largest out to 2026 (26.1 percent) under the medium growth projection series (Table 9.5). Wood and Paper Manufacturing will hold its place as the second largest contributor (21.2 percent in 2026)

Dairy Manufacturing (1.9 percent), Intensive Farming (1.8 percent), Extensive Farming (1.8 percent) and Forestry and Logging (1.7 percent) will experience the greatest annual average growth in emissions of $CO_2$ over the 2006-2026 period.

**Table 9-5: Carbon Dioxide Emissions by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | CO2 Emmisions (000s tonnes) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 16 | 18 | 19 | 21 | 23 | 1.8% | 0.4% | 0.5% |
| Extnsve Frmng | 215 | 235 | 257 | 281 | 307 | 1.8% | 5.9% | 7.0% |
| Othr Prmry | 174 | 179 | 184 | 190 | 196 | 0.6% | 4.7% | 4.5% |
| Frstry & Lggng | 38 | 41 | 44 | 48 | 53 | 1.7% | 1.0% | 1.2% |
| Other Food Manf | 64 | 68 | 72 | 76 | 80 | 1.1% | 1.7% | 1.8% |
| Dairy Manf | 271 | 297 | 326 | 357 | 392 | 1.9% | 7.4% | 9.0% |
| Other Manf | 223 | 233 | 245 | 257 | 271 | 1.0% | 6.1% | 6.2% |
| Wood & Paper Manf | 801 | 822 | 850 | 885 | 928 | 0.7% | 21.8% | 21.2% |
| Utilities | 2 | 2 | 2 | 3 | 3 | 0.8% | 0.1% | 0.1% |
| Cnstrctin | 42 | 43 | 45 | 46 | 47 | 0.6% | 1.1% | 1.1% |
| Trade & Accmdtn | 170 | 177 | 184 | 191 | 199 | 0.8% | 4.6% | 4.5% |
| Road Trnsprt | 392 | 411 | 432 | 454 | 477 | 1.0% | 10.7% | 10.9% |
| Other Trnsprt | 84 | 86 | 88 | 90 | 93 | 0.5% | 2.3% | 2.1% |
| Business Srvcs | 53 | 55 | 58 | 61 | 64 | 1.0% | 1.4% | 1.5% |
| Gvrnmnt | 24 | 24 | 25 | 26 | 26 | 0.5% | 0.6% | 0.6% |
| Other Srvcs | 66 | 68 | 70 | 73 | 74 | 0.6% | 1.8% | 1.7% |
| Hhlds | 1,033 | 1,063 | 1,092 | 1,118 | 1,141 | 0.5% | 28.2% | 26.1% |
| Total | 3,668 | 3,823 | 3,992 | 4,176 | 4,375 | 0.9% | 100.0% | 100.0% |

*Nitrous oxide* ($N_2O$)

In 2006, it is estimated that 324,000 tonnes of nitrous oxide ($N_2O$) will be emitted as a result of energy consumption in the Waikato Region (Figure 9.12).

An annual average increase of 1 percent (or total growth of 21 percent) is expected under the medium growth projection series resulting in total emissions of 392,000 tonnes in 2026. The high growth projection series forecasts a total increase of 30 percent, which would result in emissions of 429,000 tonnes of $N_2O$ in 2026.

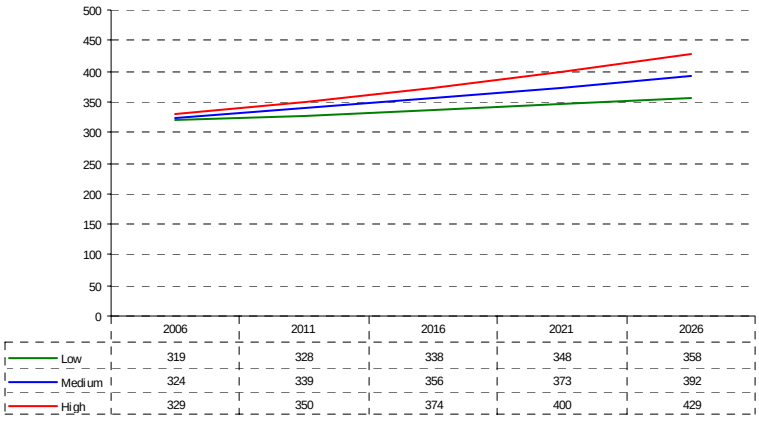


**Figure 9-12: Nitrous Oxide Emissions 2006 – 2026 (000 tonnes)**

As is the case with $CO_2$ emissions, households are currently the largest contributors of $N_2O$ emissions (27.8 percent of all emissions in 2006) and this will remain the case through to 2026 (25.4 percent) (Table 9.6). Dairy Manufacturing and Road Transport are currently the second and third largest producing industries of $N_2O$ (12.9 percent and 12.0 percent respectively) and will remain so through to 2026.

Dairy Manufacturing (1.9 percent), Extensive Farming (1.8 percent) and Intensive Farming (1.8 percent) will experience the greatest annual average growth in emissions of $N_2O$ over the 2006 to 2026 period. This is a very similar pattern to $CO_2$ emissions. Over the same period, Other Transport is forecast to decline in $N_2O$ emissions (-0.1 percent average annual growth rate), although Road Transport grows by 1 percent.

**Table 9-6: Nitrous Oxide Emissions by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | N2O Emmisions (000s tonnes) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 2 | 2 | 2 | 2 | 2 | 1.8% | 0.5% | 0.6% |
| Extnsve Frmng | 21 | 23 | 25 | 27 | 30 | 1.8% | 6.4% | 7.6% |
| Othr Prmry | 23 | 23 | 24 | 25 | 25 | 0.6% | 7.0% | 6.5% |
| Frstry & Lggng | 4 | 4 | 4 | 5 | 5 | 1.7% | 1.1% | 1.3% |
| Other Food Manf | 8 | 9 | 9 | 10 | 11 | 1.1% | 2.6% | 2.7% |
| Dairy Manf | 42 | 46 | 50 | 55 | 60 | 1.9% | 12.9% | 15.4% |
| Other Manf | 23 | 25 | 26 | 27 | 29 | 1.0% | 7.2% | 7.3% |
| Wood & Paper Manf | 36 | 37 | 39 | 40 | 42 | 0.8% | 11.3% | 10.8% |
| Utilities | 0 | 0 | 0 | 0 | 0 | 0.8% | 0.1% | 0.1% |
| Cnstrctin | 4 | 4 | 4 | 4 | 5 | 0.6% | 1.2% | 1.1% |
| Trade & Accmdtn | 14 | 15 | 15 | 16 | 17 | 0.8% | 4.4% | 4.2% |
| Road Trnsprt | 39 | 41 | 43 | 45 | 47 | 1.0% | 12.0% | 12.1% |
| Other Trnsprt | 4 | 4 | 4 | 4 | 4 | -0.1% | 1.2% | 1.0% |
| Business Srvcs | 4 | 5 | 5 | 5 | 5 | 1.0% | 1.4% | 1.4% |
| Gvrnmnt | 2 | 2 | 2 | 2 | 2 | 0.5% | 0.7% | 0.6% |
| Other Srvcs | 7 | 7 | 8 | 8 | 8 | 0.6% | 2.2% | 2.1% |
| Hhlds | 90 | 93 | 95 | 98 | 100 | 0.5% | 27.8% | 25.4% |
| Total | 324 | 339 | 356 | 373 | 392 | 1.0% | 100.0% | 100.0% |

*Methane* ($CH_4$)

It is estimated that 1.05 million tonnes of methane ($CH_4$) is currently (2006) emitted as a result of energy consumption in the Waikato Region. The medium growth projection series forecasts a total increase in $CH_4$ emissions of 17 percent to 1.23 million tonnes.

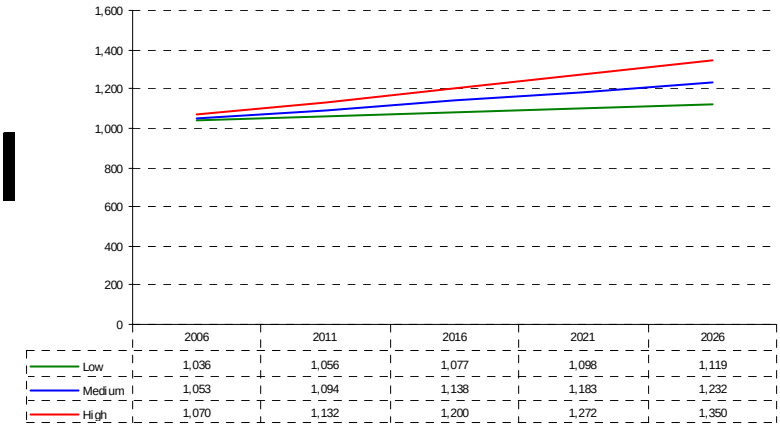


**Figure 9-13: Methane Emissions 2006 – 2026**

Like the other emission types considered, households are the greatest producers of $CH_4$ emissions and will remain so through to 2026 (43.8 percent of all $CH_4$ emissions in 2026). Wood and Paper Manufacturing will be the second largest contributor in 2026, but at less than a third of the volume output by households (12.4 percent, 153,000 tonnes).

Road Transport (90,000 tonnes), Dairy Manufacturing (83,000 tonnes), Trade and Accommodation (79,000 tonnes) and Extensive Farming (73,000 tonnes) are the next major contributors to CH4 output in 2026.

**Table 9-7: Methane Emissions by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | CH4 Emmisions (000s tonnes) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 4 | 4 | 4 | 5 | 5 | 1.8% | 0.3% | 0.4% |
| Extnsve Frmng | 51 | 56 | 61 | 67 | 73 | 1.8% | 4.9% | 6.0% |
| Othr Prmry | 29 | 30 | 31 | 32 | 33 | 0.7% | 2.7% | 2.7% |
| Frstry & Lggng | 10 | 10 | 11 | 12 | 13 | 1.7% | 0.9% | 1.1% |
| Other Food Manf | 18 | 19 | 20 | 21 | 23 | 1.1% | 1.7% | 1.8% |
| Dairy Manf | 57 | 63 | 69 | 75 | 83 | 1.9% | 5.4% | 6.7% |
| Other Manf | 52 | 55 | 57 | 60 | 64 | 1.0% | 5.0% | 5.2% |
| Wood & Paper Manf | 134 | 137 | 141 | 146 | 153 | 0.7% | 12.7% | 12.4% |
| Utilities | 1 | 1 | 1 | 1 | 1 | 0.8% | 0.1% | 0.1% |
| Cnstrctin | 11 | 11 | 11 | 12 | 12 | 0.6% | 1.0% | 1.0% |
| Trade & Accmdtn | 67 | 70 | 73 | 76 | 79 | 0.8% | 6.4% | 6.4% |
| Road Trnsprt | 74 | 78 | 81 | 86 | 90 | 1.0% | 7.0% | 7.3% |
| Other Trnsprt | 9 | 9 | 9 | 9 | 9 | -0.3% | 0.9% | 0.7% |
| Business Srvcs | 18 | 19 | 20 | 21 | 22 | 1.0% | 1.8% | 1.8% |
| Gvrnmnt | 9 | 9 | 9 | 9 | 9 | 0.5% | 0.8% | 0.8% |
| Other Srvcs | 21 | 22 | 22 | 23 | 24 | 0.6% | 2.0% | 1.9% |
| Hhlds | 488 | 502 | 516 | 528 | 539 | 0.5% | 46.4% | 43.8% |
| Total | 1,053 | 1,094 | 1,138 | 1,183 | 1,232 | 0.8% | 100.0% | 100.0% |

## 9.6.3 Solid Waste

Solid waste output is the final measure of environmental impacts of the economy. It is estimated that the Waikato Region economy currently (2006) produces 739,000 tonnes of solid waste (figure 9.14).

Under a medium growth projection series output is forecast to increase by 114,000 tonnes to 853,000 tonnes (total growth of 15 percent) while under a high growth projection series, output is forecast to increase by almost a quarter to 931,000 tonnes (total growth of 26 percent).

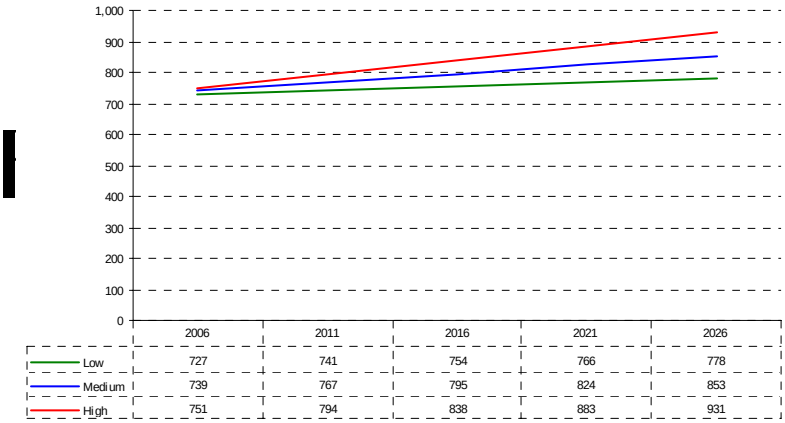


**Figure 9-14: Solid Waste Output 2006 – 2026 (000 tonnes)**

The Construction industry is clearly the most significant producer of solid waste and under the medium growth projection series, this is forecast to remain the case through to 2026 (51.8 percent of all solid waste production in 2026) (Table 9.8). Households contribute the second largest share (20.9 percent in 2026). Other Manufacturing and Trade and Accommodation are forecast to produce 9.5 and 6.0 percent respectively in 2026.

Growth in output of solid waste between 2006 and 2026 is forecast to occur fastest in the Dairy Manufacturing industry (1.9 percent annual average growth), and Intensive Farming (1.8 percent). Only the Forestry and Logging industry is expected to experience no increase in the volume of solid waste output.

**Table 9-8: Solid Waste Output by Industry 2006-2026 (BAU Medium Growth Projection Series)**

| Industry | Solid Waste (000s tonnes) | | | | | Ann. Av. | Share | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | 2011 | 2016 | 2021 | 2026 | Growth | 2006 | 2026 |
| Intnsve Frmng | 0 | 0 | 0 | 0 | 0 | 1.8% | 0.0% | 0.0% |
| Extnsve Frmng | 0 | 0 | 0 | 0 | 0 | 1.6% | 0.0% | 0.0% |
| Othr Prmry | 0 | 0 | 0 | 0 | 0 | 1.0% | 0.0% | 0.0% |
| Frstry & Lggng | 0 | 0 | 0 | 0 | 0 | 0.0% | 0.0% | 0.0% |
| Other Food Manf | 24 | 25 | 27 | 28 | 30 | 1.1% | 3.2% | 3.5% |
| Dairy Manf | 10 | 11 | 12 | 13 | 15 | 1.9% | 1.4% | 1.7% |
| Other Manf | 63 | 67 | 71 | 76 | 81 | 1.3% | 8.5% | 9.5% |
| Wood & Paper Manf | 27 | 29 | 32 | 34 | 37 | 1.6% | 3.7% | 4.4% |
| Utilities | 0 | 0 | 0 | 0 | 0 | 0.8% | 0.1% | 0.1% |
| Cnstrctin | 394 | 406 | 418 | 430 | 441 | 0.6% | 53.3% | 51.8% |
| Trade & Accmdtn | 44 | 46 | 48 | 50 | 52 | 0.8% | 5.9% | 6.0% |
| Road Trnsprt | 4 | 4 | 4 | 4 | 4 | 1.0% | 0.5% | 0.5% |
| Other Trnsprt | 4 | 4 | 4 | 4 | 4 | 0.9% | 0.5% | 0.5% |
| Business Srvcs | 1 | 1 | 1 | 1 | 2 | 1.0% | 0.2% | 0.2% |
| Gvrnmnt | 1 | 1 | 1 | 1 | 1 | 0.5% | 0.2% | 0.2% |
| Other Srvcs | 6 | 6 | 6 | 6 | 7 | 0.6% | 0.8% | 0.8% |
| Hhlds | 161 | 166 | 170 | 174 | 178 | 0.5% | 21.8% | 20.9% |
| Total | 739 | 767 | 795 | 824 | 853 | 0.7% | 100.0% | 100.0% |

Solid Waste is comprised of landfill and cleanfill waste. Figure 9.15 shows the relative contributions of landfill and cleanfill waste to the total output of solid waste. In 2000 landfill represents the highest share of solid waste at 52 percent, while cleanfill comprises the balance. By 2026 the share of landfillis expected to increase marginally to 53 percent.

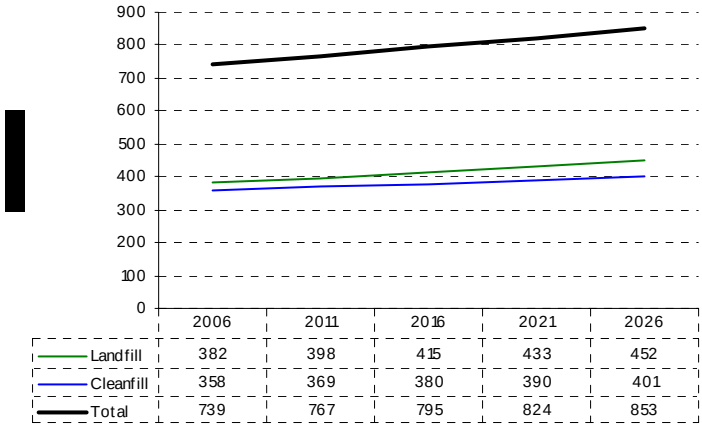


**Figure 9-15: Solid Waste Output by Type 2006 – 2026 (BAU Medium Growth Projection Series)**

Figures 9.16 and 9.17 show the expected growth of landfill and cleanfill waste output under the low, medium and high growth projection series.

It is estimated that the Waikato Region economy currently outputs 382,000 tonnes of landfill solid waste in 2026 (Figure 9.16). Under the medium growth projection series, increase in landfill waste is expected to occur at an annual average growth rate of 0.9 percent to 452,000 tonnes (total growth of 18 percent). Under the same series, growth in cleanfill waste is expected to be slightly lower at 0.6 percent per annum (total growth of 12 percent) (Figure 9.17).

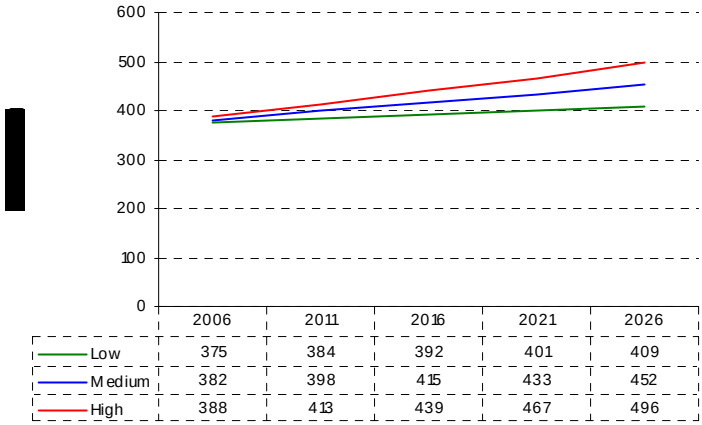


**Figure 9-16: Landfill Solid Waste 2006-2026**

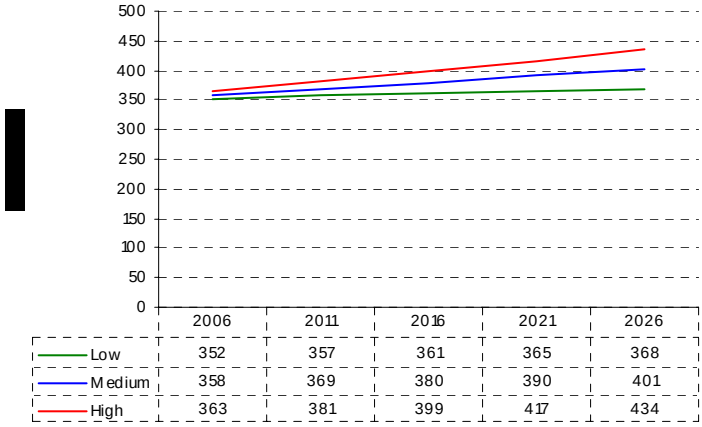


**Figure 9-17: Cleanfill Solid Waste 2006-2026**

# 10 Policy Implications and Recommendations

## 10.1 Policy Implications

The Waikato Futures Model represents one of the first attempts to identify and evaluate fundamental interconnections between the Waikato environment and its economy. One of the central tenets of the model is that all human activity is ultimately dependent upon the environment's production of natural resources and assimilation of wastes. A particular strength of the model is its ability to reveal not only direct environmental consequences, but also the far reaching indirect environmental implications of economic change. It is argued that understanding environment-economy relationships is paramount to making informed policy decisions.

At present the Waikato Futures Model has been set up to analyse only a BAU economic growth scenario for the Waikato Region. This scenario assumes current interrelationships within the economy will remain constant over time and that future consumption will follow existing trends. In essence, this scenario reveals the outcomes associated with a continuation of current production practices and consumption preferences. In this way, the BAU scenario provides a benchmark against which other plausible scenarios may be compared. It is envisaged, for example, that the Waikato Futures Model will be utilised to quickly compare the implications of various scenarios developed in the Choosing Regional Futures project along with other relevant council initiatives.

The Waikato Region Futures Model, under the BAU scenario, has highlighted several major policy issues, including:

- *Land use change*. Under the BAU scenario significant increases in agricultural land use are envisaged. It is estimated, for example, that the extensive farming industry (which includes both Dairy Cattle Farming and Sheep and Beef Farming) will grow some 212,000 hectares by 2026 or 11 percent of total productive land. Based on this growth, land requirements will exceed available land. To avoid this anomaly, in addition to land conversions a significant increase in the productivity of the existing land base will be required. Land conversions may alter current hydrological flows, while efforts to increase productivity will require additional inputs such as animal feeds, fertilizers and so on. As farms intensify it is likely that environmental degradation will also increase and potentially become more concentrated.
- *Consequences without decoupling*. The BAU scenario illustrates that if current environment-economic relations continue, future growth in the economy will translate into equivalent increases in resource use and environmental degradation. To negate this trend, it is imperative that production processes and consumption preferences are modified in order to decouple economic growth from environmental effects. This will require, for example, a reduction in the current dependence on fossil fuels through implementation of eco-efficiency measures.
- *Throughput rather than circular economy*. The Waikato economy is typical of many western economies which are characterised by material throughput rather than re-use and recycling of materials.

## 10.2 Recommendations

It is recommended that the following extensions be made to the Waikato Region Futures Model:

- *Inclusion of additional resource and residual accounts*. This report provides a first step in the analysis of the interconnected economy-environment system. To gain a more comprehensive picture of economy-environment interactions the following

resource inputs would at least be needed to be added to the model: water, soil, ecosystem services and recycled solid waste. Similarly, a more complete study would need to incorporate at least the following residuals: $CH_4$ production from farm animals, water discharge and water based pollution (e.g. $NO_3^-$ fertiliser leachate)

- *Development of relevant plausible scenarios*. To date, only a BAU scenario has been established for the Waikato Region. From a policy perspective the model's most useful feature is its ability to reveal critical environment-economy tradeoffs under plausible policy options and future pathways. Ideally, the model will be used in the future to analyse the implications of specific relevant issue driven scenarios. For example, the economic and environmental implications of possible conversion of plantation forestry into dairy farms could be assessed using the model.
- *Thresholds*. While the model has established current resources requirements and quantified future resource requirements under the BAU scenario, it does not provide information on critical environmental thresholds and whether they will be exceeded e.g. whether conversions of forestry into dairying will lead to nitrate leaching that may ultimately induce eutrophication of water bodies. Of course, the analysis of such complexities is very much in its infancy.
- *Dynamics*. Critical feedbacks within the environment and between the environment and economy are omitted from the model, e.g. $NO_3$ pollution of waterways induced by dairying may, through feedback, ultimately constrain the growth in dairying industry itself. The analysis of such complexities is probably beyond our current scientific capability, particularly given that they are characterised by non-linear and time lagged behaviours. Nevertheless, if policy implications are to be fully understood then such dynamics cannot be ignored. Environment Waikato's 'Choosing Regional Futures' project represents a first step towards addressing this issue.
- *Aggregate indicators*. There is a need for aggregate level indicators and summary measures to be developed from the model. For example, a 'cumulative effects indicator' capturing the relationship between direct and indirect economic effect, and direct and indirect ecological effect, could be developed to assess holistically economic change at an industry level. Other indicators such as total material throughput per unit of economic activity (i.e. as measured in mass terms), total recycling per unit of economic activity, GRP contribution per unit of energy consumption (or emission production) could be developed.

# Appendix A

## TABLE A.1 CONCORDANCE MATCHING 123 INDUSTRIES TO 6-DIGIT ANZSIC CLASSIFICATIONS

| | Industry Description | ANZSIC Code |
|---|---|---|
| 1 | Other horticulture | A01110-A01130 |
| 2 | Apple and pear growing | A01150 |
| 3 | Kiwifruit growing | A01170 |
| 4 | Other fruit growing | A01140, A01160, A01191-A01199 |
| 5 | Mixed livestock and cropping | A01210-A01220, A01591-A01592 |
| 6 | Sheep and beef cattle farming | A01230-A01250 |
| 7 | Dairy cattle farming | A01300 |
| 8 | Other farming | A01410-A01530, A01593-A01699 |
| 9 | Services to agriculture, hunting and trapping | A02120-A02200 |
| 10 | Forestry | A03010 |
| 11 | Services to forestry | A03030 |
| 12 | Logging | A03020 |
| 13 | Fishing | A04110-A04200 |
| 14 | Coal mining | B11010-B11020 |
| 15 | Services to mining | B15140-B15200 |
| 16 | Other mining and quarrying | B13110-B14200 |
| 17 | Oil & gas extraction | B12000 |
| 18 | Oil & gas exploration | B15110-B15120 |
| 19 | Meat processing | C21110 |
| 20 | Poultry processing | C21120 |
| 21 | Bacon, ham and smallgood manufacturing | C21130 |
| 22 | Dairy product manufacturing | C21210-C21290 |
| 23 | Fruit and vegetable, oil and fat, cereal and flour manufacturing | C21300-C21520 |
| 24 | Bakery, sugar and confectionery manufacturing | C21610-C21720 |
| 25 | Seafood processing | C21730 |
| 26 | Other food manufacturing | C21740-C21790 |
| 27 | Soft drink, cordial and syrup manufacturing | C21810 |
| 28 | Beer, wine, spirit and tobacco manufacturing | C21820-C21900 |
| 29 | Textile manufacturing | C22110-C22390 |
| 30 | Clothing manufacturing | C22400 |
| 31 | Footwear manufacturing | C22500 |
| 32 | Other leather product manufacturing | C22611-C22620 |
| 33 | Log sawmilling and timber dressing | C23110-C23130 |
| 34 | Other wood product manufacturing | C23210-C23290 |
| 35 | Paper and paper product manufacturing | C23310-C23390 |
| 36 | Printing and services to printing | C24110-C24130 |
| 37 | Publishing and recorded media manufacturing | C24210-C24300 |
| 38 | Petroleum refining | C25100 |
| 39 | Petroleum & coal product manufacturing nec | C25200 |
| 40 | Fertiliser manufacturing | C25310 |
| 41 | Other industrial chemical manufacturing | C25320 |
| 42 | Medicinal, detergent and cosmetic manufacturing | C25430, C25450-C25460 |
| 43 | Other chemical product manufacturing | C25410-C25420, C25440, C25470-C25490 |
| 44 | Rubber manufacturing | C25510-C25590 |
| 45 | Plastic product manufacturing | C25610-C25660 |
| 46 | Glass and glass product and ceramic manufacturing | C26100-C26290 |
| 47 | Other non-metallic mineral product manufacturing | C26310-C26400 |
| 48 | Basic metal manufacturing | C27110-C27330 |
| 49 | Structural, sheet and fabricated metal product manufacturing | C27410-C27690 |
| 50 | Motor vehicle and part manufacturing | C28110-C28190 |
| 51 | Ship and Boat Building | C28210-C28220 |
| 52 | Other transport equipment manufacturing | C28230-C28290 |
| 53 | Photographic and scientific equipment manufacturing | C28310-C28390 |
| 54 | Electronic equipment and appliance manufacturing | C28410-C28590 |
| 55 | Agricultural machinery manufacturing | C28610 |
| 56 | Other industrial machinery and equipment manufacturing | C28620-C28690 |
| 57 | Prefabricated building manufacturing | C29110-C29190 |
| 58 | Furniture manufacturing | C29210-C29290 |
| 59 | Other manufacturing | C29410-C29490 |
| 60 | Electricity | D36100 |
| 61 | Gas supply | D36200 |
| 62 | Water supply | D37010 |

## TABLE A.1 CONCORDANCE MATCHING 123 INDUSTRIES TO 6-DIGIT ANZSIC CLASSIFICATIONS (CONTINUED)

| | Industry Description | ANZSIC Code |
|---|---|---|
| 63 | Residential building construction (incl owner builders) | E41110-E41120 |
| 64 | Non-residential building construction | E41130 |
| 65 | Non-building construction | E41210-E41220 |
| 66 | Site preparation services | E42100 |
| 67 | Building structure services | E42210-E42240 |
| 68 | Plumbing services | E42310 |
| 69 | Installation trade services | E42320-E42340 |
| 70 | Building completion services | E42410-E42450 |
| 71 | Other construction services | E42510-E42590 |
| 72 | Wholesale trade | F45110-F47990 |
| 73 | Retail trade | G51101-G53290 |
| 74 | Accommodation | H57100-H57109 |
| 75 | Bars, clubs, cafes and restaurants | H57200-H57400 |
| 76 | Road Freight transport | I61100 |
| 77 | Road passenger transport | I61210-I61230, I66110-I66190 |
| 78 | Water and rail transport | I62000-I63030, I66210-I66290 |
| 79 | Air transport, services to transport and storage | I64010-I65090, I66300-I67090 |
| 80 | Communication services | J71110-J71200 |
| 81 | Finance | K73100-K73400 |
| 82 | Life insurance | K74110 |
| 83 | Superannuation fund operation | K74120 |
| 84 | Health insurance | K74210 |
| 85 | General insurance | K74220 |
| 86 | Services to finance and insurance | K75110-K75200 |
| 87 | Residential property operators | L77110-L77119 |
| 88 | Commercial property operators | L77120-L77129 |
| 89 | Real estate agents | L77200 |
| 90 | Ownership of owner-occupied dwellings | N/A |
| 91 | Investors in other property | L77300-L77309 |
| 92 | Vehicle and equipment hire | L77410-L77430 |
| 93 | Scientific research | L78100 |
| 94 | Technical services | L78210-L78290 |
| 95 | Computer services | L78310-L78340 |
| 96 | Legal services | L78410 |
| 97 | Accounting services | L78420 |
| 98 | Advertising and marketing services | L78510-L78530 |
| 99 | Business administrative and management services | L78540-L78550 |
| 100 | Employment, security and investigative services | L78610-L78640 |
| 101 | Pest control and cleaning services | L78650-L78660 |
| 102 | Other business services | L78670-L78690 |
| 103 | Central government administration | M81110, M81300 |
| 104 | Defence | M82000 |
| 105 | Public order and safety services | M81200, Q96310-Q96330 |
| 106 | Local government administration services and civil defence | M81130 |
| 107 | Pre-school education | N84100 |
| 108 | Primary and secondary education | N84210-N84240 |
| 109 | Post school education | N84310-N84320 |
| 110 | Other education | N84400 |
| 111 | Hospitals and nursing homes | O86110-O86130 |
| 112 | Medical, dental and other health services | O86210-O86390 |
| 113 | Veterinary services | O86400 |
| 114 | Child care services | O87100 |
| 115 | Accommodation for the aged | O87210 |
| 116 | Other community care services | O87220-O87290 |
| 117 | Motion picture, radio and TV services | P91110-P91220 |
| 118 | Libraries, museums and the arts | P92100-P92590 |
| 119 | Horse and dog racing | P93110-P93112 |
| 120 | Lotteries, casinos and other gambling | P93210-P93290 |
| 121 | Other sport and recreational services | P93120-P93190, P93300 |
| 122 | Personal and other community services | Q95110-Q96290, Q97000 |
| 123 | Waste disposal, sewerage and drainage services | D37020, Q96340 |

## TABLE A.2 CONCORDANCE MATCHING 123 INDUSTRIES TO 48 INDUSTRIES

| 123IO_coden | 123IO_name | 48IO_coden | 48IO_name |
|---|---|---|---|
| 1 | Other horticulture | 1 | Horticulture and fruit growing |
| 2 | Apple and pear growing | 1 | Horticulture and fruit growing |
| 3 | Kiwifruit growing | 1 | Horticulture and fruit growing |
| 4 | Other fruit growing | 1 | Horticulture and fruit growing |
| 5 | Mixed livestock and cropping | 2 | Livestock and cropping farming |
| 6 | Sheep and beef cattle farming | 2 | Livestock and cropping farming |
| 7 | Dairy cattle farming | 3 | Dairy cattle farming |
| 8 | Other farming | 4 | Other farming |
| 9 | Services to agriculture, hunting and trapping | 5 | Services to agriculture, hunting and trapping |
| 10 | Forestry | 6 | Forestry and logging |
| 11 | Services to forestry | 6 | Forestry and logging |
| 12 | Logging | 6 | Forestry and logging |
| 13 | Fishing | 7 | Fishing |
| 14 | Coal mining | 8 | Mining and quarrying |
| 15 | Services to mining | 8 | Mining and quarrying |
| 16 | Other mining and quarrying | 8 | Mining and quarrying |
| 17 | Oil & gas extraction | 9 | Oil and gas exploration and extraction |
| 18 | Oil & gas exploration | 9 | Oil and gas exploration and extraction |
| 19 | Meat processing | 10 | Meat and meat product manufacturing |
| 20 | Poultry processing | 10 | Meat and meat product manufacturing |
| 21 | Bacon, ham and smallgood manufacturing | 10 | Meat and meat product manufacturing |
| 22 | Dairy product manufacturing | 11 | Dairy product manufacturing |
| 23 | Fruit and vegetable, oil and fat, cereal and flour manufacturing | 12 | Other food manufacturing |
| 24 | Bakery, sugar and confectionery manufacturing | 12 | Other food manufacturing |
| 25 | Seafood processing | 12 | Other food manufacturing |
| 26 | Other food manufacturing | 12 | Other food manufacturing |
| 27 | Soft drink, cordial and syrup manufacturing | 13 | Beverage, malt and tobacco manufacturing |
| 28 | Beer, wine, spirit and tobacco manufacturing | 13 | Beverage, malt and tobacco manufacturing |
| 29 | Textile manufacturing | 14 | Textile and apparel manufacturing |
| 30 | Clothing manufacturing | 14 | Textile and apparel manufacturing |
| 31 | Footwear manufacturing | 14 | Textile and apparel manufacturing |
| 32 | Other leather product manufacturing | 14 | Textile and apparel manufacturing |
| 33 | Log sawmilling and timber dressing | 15 | Wood product manufacturing |
| 34 | Other wood product manufacturing | 15 | Wood product manufacturing |
| 35 | Paper and paper product manufacturing | 16 | Paper and paper product manufacturing |
| 36 | Printing and services to printing | 17 | Printing , publishing and recorded media |
| 37 | Publishing and recorded media manufacturing | 17 | Printing , publishing and recorded media |
| 38 | Petroleum refining | 18 | Petroleum and industrial chemical manufacturing |
| 39 | Petroleum & coal product manufacturing nec | 18 | Petroleum and industrial chemical manufacturing |
| 40 | Fertiliser manufacturing | 18 | Petroleum and industrial chemical manufacturing |
| 41 | Other industrial chemical manufacturing | 18 | Petroleum and industrial chemical manufacturing |
| 42 | Medicinal, detergent and cosmetic manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 43 | Other chemical product manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 44 | Rubber manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 45 | Plastic product manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 46 | Glass and glass product and ceramic manufacturing | 20 | Non-metallic mineral product manufacturing |
| 47 | Other non-metallic mineral product manufacturing | 20 | Non-metallic mineral product manufacturing |
| 48 | Basic metal manufacturing | 21 | Basic metal manufacturing |
| 49 | Structural, sheet and fabricated metal product manufacturing | 22 | Structural, sheet, and fabricated metal product manufacturing |
| 50 | Motor vehicle and part manufacturing | 23 | Transport equipment manufacturing |
| 51 | Ship and Boat Building | 23 | Transport equipment manufacturing |
| 52 | Other transport equipment manufacturing | 23 | Transport equipment manufacturing |
| 53 | Photographic and scientific equipment manufacturing | 24 | Machinery and equipment manufacturing |
| 54 | Electronic equipment and appliance manufacturing | 24 | Machinery and equipment manufacturing |
| 55 | Agricultural machinery manufacturing | 24 | Machinery and equipment manufacturing |
| 56 | Other industrial machinery and equipment manufacturing | 24 | Machinery and equipment manufacturing |
| 57 | Prefabricated building manufacturing | 25 | Furniture and other manufacturing |
| 58 | Furniture manufacturing | 25 | Furniture and other manufacturing |
| 59 | Other manufacturing | 25 | Furniture and other manufacturing |
| 60 | Electricity | 26 | Electricity generation and supply |
| 61 | Gas supply | 27 | Gas supply |
| 62 | Water supply | 28 | Water supply |

## TABLE A.2 CONCORDANCE MATCHING 123 INDUSTRIES TO 48 INDUSTRIES (CONTINUED)

| 123IO_coden | 123IO_name | 48IO_coden | 48IO_name |
|---|---|---|---|
| 1 | Other horticulture | 1 | Horticulture and fruit growing |
| 2 | Apple and pear growing | 1 | Horticulture and fruit growing |
| 3 | Kiwifruit growing | 1 | Horticulture and fruit growing |
| 4 | Other fruit growing | 1 | Horticulture and fruit growing |
| 5 | Mixed livestock and cropping | 2 | Livestock and cropping farming |
| 6 | Sheep and beef cattle farming | 2 | Livestock and cropping farming |
| 7 | Dairy cattle farming | 3 | Dairy cattle farming |
| 8 | Other farming | 4 | Other farming |
| 9 | Services to agriculture, hunting and trapping | 5 | Services to agriculture, hunting and trapping |
| 10 | Forestry | 6 | Forestry and logging |
| 11 | Services to forestry | 6 | Forestry and logging |
| 12 | Logging | 6 | Forestry and logging |
| 13 | Fishing | 7 | Fishing |
| 14 | Coal mining | 8 | Mining and quarrying |
| 15 | Services to mining | 8 | Mining and quarrying |
| 16 | Other mining and quarrying | 8 | Mining and quarrying |
| 17 | Oil & gas extraction | 9 | Oil and gas exploration and extraction |
| 18 | Oil & gas exploration | 9 | Oil and gas exploration and extraction |
| 19 | Meat processing | 10 | Meat and meat product manufacturing |
| 20 | Poultry processing | 10 | Meat and meat product manufacturing |
| 21 | Bacon, ham and smallgood manufacturing | 10 | Meat and meat product manufacturing |
| 22 | Dairy product manufacturing | 11 | Dairy product manufacturing |
| 23 | Fruit and vegetable, oil and fat, cereal and flour manufacturing | 12 | Other food manufacturing |
| 24 | Bakery, sugar and confectionery manufacturing | 12 | Other food manufacturing |
| 25 | Seafood processing | 12 | Other food manufacturing |
| 26 | Other food manufacturing | 12 | Other food manufacturing |
| 27 | Soft drink, cordial and syrup manufacturing | 13 | Beverage, malt and tobacco manufacturing |
| 28 | Beer, wine, spirit and tobacco manufacturing | 13 | Beverage, malt and tobacco manufacturing |
| 29 | Textile manufacturing | 14 | Textile and apparel manufacturing |
| 30 | Clothing manufacturing | 14 | Textile and apparel manufacturing |
| 31 | Footwear manufacturing | 14 | Textile and apparel manufacturing |
| 32 | Other leather product manufacturing | 14 | Textile and apparel manufacturing |
| 33 | Log sawmilling and timber dressing | 15 | Wood product manufacturing |
| 34 | Other wood product manufacturing | 15 | Wood product manufacturing |
| 35 | Paper and paper product manufacturing | 16 | Paper and paper product manufacturing |
| 36 | Printing and services to printing | 17 | Printing , publishing and recorded media |
| 37 | Publishing and recorded media manufacturing | 17 | Printing , publishing and recorded media |
| 38 | Petroleum refining | 18 | Petroleum and industrial chemical manufacturing |
| 39 | Petroleum & coal product manufacturing nec | 18 | Petroleum and industrial chemical manufacturing |
| 40 | Fertiliser manufacturing | 18 | Petroleum and industrial chemical manufacturing |
| 41 | Other industrial chemical manufacturing | 18 | Petroleum and industrial chemical manufacturing |
| 42 | Medicinal, detergent and cosmetic manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 43 | Other chemical product manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 44 | Rubber manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 45 | Plastic product manufacturing | 19 | Rubber, plastic and other chemical product manufacturing |
| 46 | Glass and glass product and ceramic manufacturing | 20 | Non-metallic mineral product manufacturing |
| 47 | Other non-metallic mineral product manufacturing | 20 | Non-metallic mineral product manufacturing |
| 48 | Basic metal manufacturing | 21 | Basic metal manufacturing |
| 49 | Structural, sheet and fabricated metal product manufacturing | 22 | Structural, sheet, and fabricated metal product manufacturing |
| 50 | Motor vehicle and part manufacturing | 23 | Transport equipment manufacturing |
| 51 | Ship and Boat Building | 23 | Transport equipment manufacturing |
| 52 | Other transport equipment manufacturing | 23 | Transport equipment manufacturing |
| 53 | Photographic and scientific equipment manufacturing | 24 | Machinery and equipment manufacturing |
| 54 | Electronic equipment and appliance manufacturing | 24 | Machinery and equipment manufacturing |
| 55 | Agricultural machinery manufacturing | 24 | Machinery and equipment manufacturing |
| 56 | Other industrial machinery and equipment manufacturing | 24 | Machinery and equipment manufacturing |
| 57 | Prefabricated building manufacturing | 25 | Furniture and other manufacturing |
| 58 | Furniture manufacturing | 25 | Furniture and other manufacturing |
| 59 | Other manufacturing | 25 | Furniture and other manufacturing |
| 60 | Electricity | 26 | Electricity generation and supply |
| 61 | Gas supply | 27 | Gas supply |
| 62 | Water supply | 28 | Water supply |

## TABLE A.2 CONCORDANCE MATCHING 123 INDUSTRIES TO 48 INDUSTRIES (CONTINUED)

| 123IO_coden | 123IO_name | 48IO_coden | 48IO_name |
|---|---|---|---|
| 63 | Residential building construction (incl owner builders) | 29 | Construction |
| 64 | Non-residential building construction | 29 | Construction |
| 65 | Non-building construction | 29 | Construction |
| 66 | Site preparation services | 29 | Construction |
| 67 | Building structure services | 29 | Construction |
| 68 | Plumbing services | 29 | Construction |
| 69 | Installation trade services | 29 | Construction |
| 70 | Building completion services | 29 | Construction |
| 71 | Other construction services | 29 | Construction |
| 72 | Wholesale trade | 30 | Wholesale trade |
| 73 | Retail trade | 31 | Retail trade |
| 74 | Accommodation | 32 | Accommodation, restaurants and bars |
| 75 | Bars, clubs, cafes and restaurants | 32 | Accommodation, restaurants and bars |
| 76 | Road Freight transport | 33 | Road transport |
| 77 | Road passenger transport | 33 | Road transport |
| 78 | Water and rail transport | 34 | Water and rail transport |
| 79 | Air transport, services to transport and storage | 35 | Air transport, services to transport and storage |
| 80 | Communication services | 36 | Communication services |
| 81 | Finance | 37 | Finance |
| 82 | Life insurance | 38 | Insurance |
| 83 | Superannuation fund operation | 38 | Insurance |
| 84 | Health insurance | 38 | Insurance |
| 85 | General insurance | 38 | Insurance |
| 86 | Services to finance and insurance | 39 | Services to finance and investment |
| 87 | Residential property operators | 40 | Real estate |
| 88 | Commercial property operators | 40 | Real estate |
| 89 | Real estate agents | 40 | Real estate |
| 90 | Ownership of owner-occupied dwellings | 41 | Ownership of owner-occupied dwellings |
| 91 | Investors in other property | 42 | Business services |
| 92 | Vehicle and equipment hire | 42 | Business services |
| 93 | Scientific research | 42 | Business services |
| 94 | Technical services | 42 | Business services |
| 95 | Computer services | 42 | Business services |
| 96 | Legal services | 42 | Business services |
| 97 | Accounting services | 42 | Business services |
| 98 | Advertising and marketing services | 42 | Business services |
| 99 | Business administrative and management services | 42 | Business services |
| 100 | Employment, security and investigative services | 42 | Business services |
| 101 | Pest control and cleaning services | 42 | Business services |
| 102 | Other business services | 42 | Business services |
| 103 | Central government administration | 43 | Central government administration, defence, public order and safety services |
| 104 | Defence | 43 | Central government administration, defence, public order and safety services |
| 105 | Public order and safety services | 43 | Central government administration, defence, public order and safety services |
| 106 | Local government administration services and civil defence | 44 | Local government administration services and civil defence |
| 107 | Pre-school education | 45 | Education |
| 108 | Primary and secondary education | 45 | Education |
| 109 | Post school education | 45 | Education |
| 110 | Other education | 45 | Education |
| 111 | Hospitals and nursing homes | 46 | Health and community services |
| 112 | Medical, dental and other health services | 46 | Health and community services |
| 113 | Veterinary services | 46 | Health and community services |
| 114 | Child care services | 46 | Health and community services |
| 115 | Accommodation for the aged | 46 | Health and community services |
| 116 | Other community care services | 46 | Health and community services |
| 117 | Motion picture, radio and TV services | 47 | Cultural and recreational services |
| 118 | Libraries, museums and the arts | 47 | Cultural and recreational services |
| 119 | Horse and dog racing | 47 | Cultural and recreational services |
| 120 | Lotteries, casinos and other gambling | 47 | Cultural and recreational services |
| 121 | Other sport and recreational services | 47 | Cultural and recreational services |
| 122 | Personal and other community services | 48 | Personal and other community services |
| 123 | Waste disposal, sewerage and drainage services | 48 | Personal and other community services |

## TABLE A.3 CONCORDANCE MATCHING 48 INDUSTRIES TO 16 AGGREGATED INDUSTRIES

| 48IO_coden | 48IO_name | Agg_coden | Agg_name |
|---|---|---|---|
| 1 | Horticulture and fruit growing | 1 | Intnsve Frmng |
| 2 | Livestock and cropping farming | 2 | Extnsve Frmng |
| 3 | Dairy cattle farming | 2 | Extnsve Frmng |
| 4 | Other farming | 2 | Extnsve Frmng |
| 5 | Services to agriculture, hunting and trapping | 3 | Othr Prmry |
| 6 | Forestry and logging | 4 | Frstry & Lggng |
| 7 | Fishing | 3 | Othr Prmry |
| 8 | Mining and quarrying | 3 | Othr Prmry |
| 9 | Oil and gas exploration and extraction | 3 | Othr Prmry |
| 10 | Meat and meat product manufacturing | 5 | Other Food Manf |
| 11 | Dairy product manufacturing | 6 | Dairy Manf |
| 12 | Other food manufacturing | 5 | Other Food Manf |
| 13 | Beverage, malt and tobacco manufacturing | 5 | Other Food Manf |
| 14 | Textile and apparel manufacturing | 7 | Other Manf |
| 15 | Wood product manufacturing | 8 | Wood & Paper Manf |
| 16 | Paper and paper product manufacturing | 8 | Wood & Paper Manf |
| 17 | Printing , publishing and recorded media | 7 | Other Manf |
| 18 | Petroleum and industrial chemical manufacturing | 7 | Other Manf |
| 19 | Rubber, plastic and other chemical product manufacturing | 7 | Other Manf |
| 20 | Non-metallic mineral product manufacturing | 7 | Other Manf |
| 21 | Basic metal manufacturing | 7 | Other Manf |
| 22 | Structural, sheet, and fabricated metal product manufacturing | 7 | Other Manf |
| 23 | Transport equipment manufacturing | 7 | Other Manf |
| 24 | Machinery and equipment manufacturing | 7 | Other Manf |
| 25 | Furniture and other manufacturing | 7 | Other Manf |
| 26 | Electricity generation and supply | 9 | Utilities |
| 27 | Gas supply | 9 | Utilities |
| 28 | Water supply | 9 | Utilities |
| 29 | Construction | 10 | Cnstrctin |
| 30 | Wholesale trade | 11 | Trade & Accmdtn |
| 31 | Retail trade | 11 | Trade & Accmdtn |
| 32 | Accommodation, restaurants and bars | 11 | Trade & Accmdtn |
| 33 | Road transport | 12 | Road Trnsprt |
| 34 | Water and rail transport | 13 | Other Trnsprt |
| 35 | Air transport, services to transport and storage | 13 | Other Trnsprt |
| 36 | Communication services | 14 | Business Srvcs |
| 37 | Finance | 14 | Business Srvcs |
| 38 | Insurance | 14 | Business Srvcs |
| 39 | Services to finance and investment | 14 | Business Srvcs |
| 40 | Real estate | 14 | Business Srvcs |
| 41 | Ownership of owner-occupied dwellings | 14 | Business Srvcs |
| 42 | Business services | 14 | Business Srvcs |
| 43 | Central government administration, defence, public order and safety services | 15 | Gvrnmnt |
| 44 | Local government administration services and civil defence | 15 | Gvrnmnt |
| 45 | Education | 16 | Other Srvcs |
| 46 | Health and community services | 16 | Other Srvcs |
| 47 | Cultural and recreational services | 16 | Other Srvcs |
| 48 | Personal and other community services | 16 | Other Srvcs |

# Appendix B

## ENVIRONMENTAL ACCOUNTS OF THE WAIKATO REGION, 2004

| | Account | Type | Units | 1 Horticulture and fruit growing | 2 Livestock and cropping farming | 3 Dairy cattle farming | 4 Other farming | 5 Services to agriculture, hunting and trapping | 6 Forestry and logging | 7 Fishing | 8 Mining and quarrying | 9 Oil and gas exploration and extraction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Land | | ha | 9,206 | 723,712 | 514,840 | 31,698 | 91 | 191,601 | 509 | 8,473 | 0 |
| 2 | Delivered Energy | Aviation Fuel | GJ | 2,231 | 5,448 | 18,378 | 1,494 | 1,803 | 4,419 | 631 | 0 | 0 |
| 3 | Delivered Energy | Black Liquor | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Delivered Energy | Coal | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 168,124 | 0 |
| 5 | Delivered Energy | Diesel | GJ | 173,977 | 424,933 | 1,433,319 | 116,533 | 140,884 | 322,790 | 306,726 | 1,042,768 | 0 |
| 6 | Delivered Energy | Electricity | GJ | 14,830 | 36,221 | 640,680 | 9,933 | 81,385 | 151,821 | 20,507 | 375,772 | 0 |
| 7 | Delivered Energy | Fuel Oil | GJ | 446 | 1,090 | 3,676 | 299 | 361 | 0 | 102,893 | 159,868 | 0 |
| 8 | Delivered Energy | Geothermal | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Delivered Energy | LPG | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Delivered Energy | Natural Gas | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | Delivered Energy | Petrol | GJ | 40,004 | 97,709 | 329,500 | 26,795 | 32,394 | 83,036 | 123 | 70,177 | 0 |
| 12 | Delivered Energy | Wood | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | Delivered Energy | Total, TOE | GJ | 231,487 | 565,401 | 2,425,553 | 155,054 | 256,827 | 562,067 | 430,880 | 1,816,709 | 0 |
| 14 | CO2 | Aviation Fuel | t | 153 | 374 | 1,263 | 103 | 124 | 304 | 43 | 0 | 0 |
| 15 | CO2 | Black Liquor | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | CO2 | Coal | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15,400 | 0 |
| 17 | CO2 | Diesel | t | 11,952 | 29,193 | 98,469 | 8,006 | 9,679 | 22,176 | 21,072 | 71,638 | 0 |
| 18 | CO2 | Electricity | t | 845 | 2,064 | 36,505 | 566 | 4,637 | 8,650 | 1,168 | 21,411 | 0 |
| 19 | CO2 | Fuel Oil | t | 33 | 80 | 271 | 22 | 27 | 0 | 7,583 | 11,782 | 0 |
| 20 | CO2 | Geothermal | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | CO2 | LPG | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | CO2 | Natural Gas | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | CO2 | Petrol | t | 2,664 | 6,507 | 21,945 | 1,785 | 2,157 | 5,530 | 8 | 4,674 | 0 |
| 24 | CO2 | Wood | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | CO2 | Total | t | 15,648 | 38,219 | 158,452 | 10,481 | 16,624 | 36,660 | 29,875 | 124,905 | 0 |
| 26 | N2O | Aviation Fuel | kg | 2 | 6 | 20 | 2 | 2 | 5 | 1 | 0 | 0 |
| 27 | N2O | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | N2O | Coal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,659 | 0 |
| 29 | N2O | Diesel | kg | 1,209 | 2,954 | 9,964 | 810 | 979 | 2,244 | 2,132 | 7,249 | 0 |
| 30 | N2O | Electricity | kg | 73 | 177 | 3,138 | 49 | 399 | 744 | 100 | 1,840 | 0 |
| 31 | N2O | Fuel Oil | kg | 9 | 22 | 74 | 6 | 7 | 0 | 2,064 | 3,207 | 0 |
| 32 | N2O | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | N2O | LPG | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | N2O | Natural Gas | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | N2O | Petrol | kg | 255 | 622 | 2,099 | 171 | 206 | 529 | 1 | 447 | 0 |
| 36 | N2O | Wood | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37 | N2O | Total | kg | 1,548 | 3,781 | 15,294 | 1,037 | 1,594 | 3,521 | 4,298 | 16,402 | 0 |
| 38 | CH4 | Aviation Fuel | kg | 3 | 8 | 28 | 2 | 3 | 7 | 1 | 0 | 0 |
| 39 | CH4 | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | CH4 | Coal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 575 | 0 |
| 41 | CH4 | Diesel | kg | 1,516 | 3,704 | 12,492 | 1,016 | 1,228 | 2,813 | 2,673 | 9,088 | 0 |
| 42 | CH4 | Electricity | kg | 280 | 684 | 12,103 | 188 | 1,537 | 2,868 | 387 | 7,099 | 0 |
| 43 | CH4 | Fuel Oil | kg | 2 | 5 | 17 | 1 | 2 | 0 | 487 | 757 | 0 |
| 44 | CH4 | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45 | CH4 | LPG | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | CH4 | Natural Gas | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 47 | CH4 | Petrol | kg | 1,694 | 4,137 | 13,952 | 1,135 | 1,372 | 3,516 | 5 | 2,972 | 0 |
| 48 | CH4 | Wood | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 49 | CH4 | Total | kg | 3,496 | 8,539 | 38,593 | 2,342 | 4,141 | 9,204 | 3,554 | 20,491 | 0 |
| 50 | Landfill | Cons & demo waste | t | 19 | 74 | 64 | 12 | 0 | 0 | 0 | 23 | 0 |
| 51 | Landfill | Metal | t | 3 | 13 | 13 | 3 | 3 | 0 | 0 | 4 | 0 |
| 52 | Landfill | Glass | t | 0 | 4 | 4 | 1 | 3 | 0 | 0 | 1 | 0 |
| 53 | Landfill | Plastic | t | 7 | 20 | 20 | 6 | 3 | 0 | 0 | 2 | 0 |
| 54 | Landfill | Paper | t | 49 | 4 | 3 | 8 | 6 | 0 | 0 | 3 | 0 |
| 55 | Landfill | Potentially hazardous | t | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 18 | 0 |
| 56 | Landfill | Organic matter | t | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 |
| 57 | Landfill | Other | t | 2 | 6 | 9 | 1 | 2 | 0 | 0 | 6 | 0 |
| 58 | Landfill | Total | t | 80 | 124 | 117 | 32 | 26 | 0 | 0 | 56 | 0 |
| 59 | Cleanfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | Landfill & Cleanfill | Total | t | 80 | 124 | 117 | 32 | 26 | 0 | 0 | 56 | 0 |

# APPENDIX B ENVIRONMENTAL ACCOUNTS OF THE WAIKATO REGION, 2004 (CONTINUED)

| | Account | Type | Units | 10 Meat and meat product manufacturing | 11 Dairy product manufacturing | 12 Other food manufacturing | 13 Beverage, malt and tobacco manufacturing | 14 Textile and apparel manufacturing | 15 Wood product manufacturing | 16 Paper and paper product manufacturing | 17 Printing , publishing and recorded media | 18 Petroleum and industrial chemical manufacturing | 19 Rubber, plastic and other chemical product manufacturing | 20 Non-metallic mineral product manufacturing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Land | | ha | 451 | 221 | 362 | 55 | 61 | 479 | 25 | 266 | 47 | 28 | 78 |
| 2 | Delivered Energy | Aviation Fuel | GJ | 516 | 2,140 | 210 | 23 | 132 | 0 | 742 | 1,097 | 47 | 214 | 326 |
| 3 | Delivered Energy | Black Liquor | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 1,929,796 | 0 | 0 | 0 | 0 |
| 4 | Delivered Energy | Coal | GJ | 225,580 | 1,445,269 | 10,203 | 597 | 4,941 | 49,160 | 0 | 26 | 783 | 6,630 | 386,129 |
| 5 | Delivered Energy | Diesel | GJ | 17,359 | 267,980 | 27,375 | 2,840 | 10,918 | 8,015 | 514 | 763 | 15,476 | 71,032 | 37,680 |
| 6 | Delivered Energy | Electricity | GJ | 243,228 | 481,040 | 8,062 | 1,213 | 16,430 | 480,417 | 835,439 | 78,856 | 23,779 | 88,994 | 90,881 |
| 7 | Delivered Energy | Fuel Oil | GJ | 1,671 | 8,889 | 1,449 | 157 | 2,290 | 10,441 | 11,163 | 15,035 | 1,243 | 9,582 | 2,936 |
| 8 | Delivered Energy | Geothermal | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Delivered Energy | LPG | GJ | 14,845 | 2,638 | 3,041 | 330 | 212 | 29,131 | 496 | 666 | 319 | 2,458 | 15,067 |
| 10 | Delivered Energy | Natural Gas | GJ | 238,070 | 1,550,155 | 81,365 | 6,215 | 51,971 | 483,812 | 1,161,616 | 1,771 | 144,200 | 2,556 | 135,376 |
| 11 | Delivered Energy | Petrol | GJ | 52,482 | 0 | 14,356 | 1,309 | 654 | 246 | 62 | 92 | 239 | 1,098 | 0 |
| 12 | Delivered Energy | Wood | GJ | 0 | 0 | 0 | 0 | 0 | 1,911,089 | 840,762 | 0 | 0 | 0 | 0 |
| 13 | Delivered Energy | Total, TOE | GJ | 793,750 | 3,758,110 | 146,062 | 12,685 | 87,548 | 2,972,310 | 4,780,589 | 98,305 | 186,085 | 182,563 | 668,395 |
| 14 | CO2 | Aviation Fuel | t | 35 | 147 | 14 | 2 | 9 | 0 | 51 | 75 | 3 | 15 | 22 |
| 15 | CO2 | Black Liquor | t | 0 | 0 | 0 | 0 | 0 | 0 | 256,663 | 0 | 0 | 0 | 0 |
| 16 | CO2 | Coal | t | 20,663 | 132,387 | 935 | 55 | 453 | 4,503 | 0 | 2 | 72 | 607 | 35,369 |
| 17 | CO2 | Diesel | t | 1,193 | 18,410 | 1,881 | 195 | 750 | 551 | 35 | 52 | 1,063 | 4,880 | 2,589 |
| 18 | CO2 | Electricity | t | 13,859 | 27,409 | 459 | 69 | 936 | 27,373 | 47,602 | 4,493 | 1,355 | 5,071 | 5,178 |
| 19 | CO2 | Fuel Oil | t | 123 | 655 | 107 | 12 | 169 | 769 | 823 | 1,108 | 92 | 706 | 216 |
| 20 | CO2 | Geothermal | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | CO2 | LPG | t | 897 | 159 | 184 | 20 | 13 | 1,759 | 30 | 40 | 19 | 148 | 910 |
| 22 | CO2 | Natural Gas | t | 12,594 | 82,003 | 4,304 | 329 | 2,749 | 25,594 | 61,449 | 94 | 7,628 | 135 | 7,161 |
| 23 | CO2 | Petrol | t | 3,495 | 0 | 956 | 87 | 44 | 16 | 4 | 6 | 16 | 73 | 0 |
| 24 | CO2 | Wood | t | 0 | 0 | 0 | 0 | 0 | 254,175 | 111,821 | 0 | 0 | 0 | 0 |
| 25 | CO2 | Total | t | 52,859 | 261,170 | 8,840 | 768 | 5,122 | 314,741 | 478,478 | 5,871 | 10,248 | 11,636 | 51,446 |
| 26 | N2O | Aviation Fuel | kg | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 27 | N2O | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 9,649 | 0 | 0 | 0 | 0 |
| 28 | N2O | Coal | kg | 4,910 | 31,455 | 222 | 13 | 108 | 1,070 | 0 | 1 | 17 | 144 | 8,404 |
| 29 | N2O | Diesel | kg | 121 | 1,863 | 190 | 20 | 76 | 56 | 4 | 5 | 108 | 494 | 262 |
| 30 | N2O | Electricity | kg | 1,191 | 2,356 | 39 | 6 | 80 | 2,353 | 4,092 | 386 | 116 | 436 | 445 |
| 31 | N2O | Fuel Oil | kg | 34 | 178 | 29 | 3 | 46 | 209 | 224 | 302 | 25 | 192 | 59 |
| 32 | N2O | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | N2O | LPG | kg | 40 | 7 | 8 | 1 | 1 | 79 | 1 | 2 | 1 | 7 | 41 |
| 34 | N2O | Natural Gas | kg | 662 | 4,312 | 226 | 17 | 145 | 1,346 | 3,231 | 5 | 401 | 7 | 377 |
| 35 | N2O | Petrol | kg | 334 | 0 | 91 | 8 | 4 | 2 | 0 | 1 | 2 | 7 | 0 |
| 36 | N2O | Wood | kg | 0 | 0 | 0 | 0 | 0 | 9,555 | 4,204 | 0 | 0 | 0 | 0 |
| 37 | N2O | Total | kg | 7,293 | 40,174 | 807 | 68 | 459 | 14,670 | 21,406 | 702 | 670 | 1,287 | 9,588 |
| 38 | CH4 | Aviation Fuel | kg | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 |
| 39 | CH4 | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 27,017 | 0 | 0 | 0 | 0 |
| 40 | CH4 | Coal | kg | 772 | 4,946 | 35 | 2 | 17 | 168 | 0 | 0 | 3 | 23 | 1,322 |
| 41 | CH4 | Diesel | kg | 151 | 2,336 | 239 | 25 | 95 | 70 | 4 | 7 | 135 | 619 | 328 |
| 42 | CH4 | Electricity | kg | 4,595 | 9,087 | 152 | 23 | 310 | 9,075 | 15,782 | 1,490 | 449 | 1,681 | 1,717 |
| 43 | CH4 | Fuel Oil | kg | 8 | 42 | 7 | 1 | 11 | 49 | 53 | 71 | 6 | 45 | 14 |
| 44 | CH4 | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45 | CH4 | LPG | kg | 437 | 78 | 90 | 10 | 6 | 858 | 15 | 20 | 9 | 72 | 444 |
| 46 | CH4 | Natural Gas | kg | 5,944 | 38,702 | 2,031 | 155 | 1,298 | 12,079 | 29,002 | 44 | 3,600 | 64 | 3,380 |
| 47 | CH4 | Petrol | kg | 2,222 | 0 | 608 | 55 | 28 | 10 | 3 | 4 | 10 | 46 | 0 |
| 48 | CH4 | Wood | kg | 0 | 0 | 0 | 0 | 0 | 26,755 | 11,771 | 0 | 0 | 0 | 0 |
| 49 | CH4 | Total | kg | 14,130 | 55,194 | 3,162 | 271 | 1,765 | 49,066 | 83,647 | 1,637 | 4,212 | 2,551 | 7,205 |
| 50 | Landfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 18,100 | 669 | 0 | 0 | 47 | 4,599 |
| 51 | Landfill | Metal | t | 107 | 87 | 115 | 384 | 32 | 134 | 50 | 62 | 244 | 205 | 70 |
| 52 | Landfill | Glass | t | 4 | 4 | 43 | 619 | 21 | 50 | 1 | 1 | 66 | 169 | 76 |
| 53 | Landfill | Plastic | t | 415 | 532 | 800 | 30 | 40 | 86 | 29 | 81 | 255 | 1,413 | 52 |
| 54 | Landfill | Paper | t | 34 | 31 | 147 | 421 | 32 | 48 | 5,346 | 4,167 | 525 | 522 | 95 |
| 55 | Landfill | Potentially hazardous | t | 644 | 827 | 258 | 96 | 498 | 1,369 | 666 | 109 | 22,243 | 7,732 | 227 |
| 56 | Landfill | Organic matter | t | 6,743 | 8,250 | 10,511 | 1,969 | 117 | 2 | 12 | 3 | 1 | 142 | 1 |
| 57 | Landfill | Other | t | 7 | 9 | 10 | 59 | 627 | 35 | 3 | 5 | 11 | 450 | 47 |
| 58 | Landfill | Total | t | 7,954 | 9,740 | 11,884 | 3,578 | 1,366 | 19,824 | 6,776 | 4,428 | 23,347 | 10,680 | 5,167 |
| 59 | Cleanfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | Landfill & Cleanfill | Total | t | 7,954 | 9,740 | 11,884 | 3,578 | 1,366 | 19,824 | 6,776 | 4,428 | 23,347 | 10,680 | 5,167 |

# APPENDIX B ENVIRONMENTAL ACCOUNTS OF THE WAIKATO REGION, 2004 (CONTINUED)

| | Account | Type | Units | 21 Basic metal manufacturing | 22 Structural, sheet, and fabricated metal product manufacturing | 23 Transport equipment manufacturing | 24 Machinery and equipment manufacturing | 25 Furniture and other manufacturing | 26 Electricity generation and supply | 27 Gas supply | 28 Water supply | 29 Construction | 30 Wholesale trade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Land | | ha | 26 | 115 | 47 | 157 | 215 | 3,446 | 15 | 3,638 | 332 | 108 |
| 2 | Delivered Energy | Aviation Fuel | GJ | 2,207 | 160 | 55 | 192 | 5 | 0 | 0 | 0 | 10,019 | 0 |
| 3 | Delivered Energy | Black Liquor | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Delivered Energy | Coal | GJ | 0 | 762 | 1,578 | 3,211 | 8,719 | 0 | 0 | 0 | 0 | 17,421 |
| 5 | Delivered Energy | Diesel | GJ | 15,073 | 105,092 | 37,835 | 132,329 | 5,224 | 0 | 0 | 0 | 374,913 | 52,398 |
| 6 | Delivered Energy | Electricity | GJ | 686,593 | 10,979 | 4,574 | 22,343 | 41,752 | 0 | 0 | 38,673 | 114,833 | 93,170 |
| 7 | Delivered Energy | Fuel Oil | GJ | 56,441 | 1,969 | 1,319 | 4,746 | 1,697 | 0 | 0 | 0 | 1,113 | 229 |
| 8 | Delivered Energy | Geothermal | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Delivered Energy | LPG | GJ | 7,594 | 2,625 | 1,759 | 6,327 | 4,580 | 0 | 0 | 0 | 10,683 | 8,907 |
| 10 | Delivered Energy | Natural Gas | GJ | 275,705 | 150,496 | 0 | 0 | 32,215 | 0 | 0 | 0 | 326 | 164,066 |
| 11 | Delivered Energy | Petrol | GJ | 735 | 2,691 | 925 | 3,226 | 963 | 0 | 0 | 0 | 113,977 | 153,211 |
| 12 | Delivered Energy | Wood | GJ | 0 | 0 | 0 | 0 | 279,172 | 0 | 0 | 0 | 0 | 10,027 |
| 13 | Delivered Energy | Total, TOE | GJ | 1,044,349 | 274,776 | 48,046 | 172,375 | 374,326 | 0 | 0 | 38,673 | 625,865 | 499,428 |
| 14 | CO2 | Aviation Fuel | t | 152 | 11 | 4 | 13 | 0 | 0 | 0 | 0 | 688 | 0 |
| 15 | CO2 | Black Liquor | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | CO2 | Coal | t | 0 | 70 | 145 | 294 | 799 | 0 | 0 | 0 | 0 | 1,596 |
| 17 | CO2 | Diesel | t | 1,036 | 7,220 | 2,599 | 9,091 | 359 | 0 | 0 | 0 | 25,756 | 3,600 |
| 18 | CO2 | Electricity | t | 39,121 | 626 | 261 | 1,273 | 2,379 | 0 | 0 | 2,204 | 6,543 | 5,309 |
| 19 | CO2 | Fuel Oil | t | 4,160 | 145 | 97 | 350 | 125 | 0 | 0 | 0 | 82 | 17 |
| 20 | CO2 | Geothermal | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | CO2 | LPG | t | 459 | 159 | 106 | 382 | 277 | 0 | 0 | 0 | 645 | 538 |
| 22 | CO2 | Natural Gas | t | 14,585 | 7,961 | 0 | 0 | 1,704 | 0 | 0 | 0 | 17 | 8,679 |
| 23 | CO2 | Petrol | t | 49 | 179 | 62 | 215 | 64 | 0 | 0 | 0 | 7,591 | 10,204 |
| 24 | CO2 | Wood | t | 0 | 0 | 0 | 0 | 37,130 | 0 | 0 | 0 | 0 | 1,334 |
| 25 | CO2 | Total | t | 59,560 | 16,370 | 3,273 | 11,618 | 42,837 | 0 | 0 | 2,204 | 41,323 | 31,275 |
| 26 | N2O | Aviation Fuel | kg | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 |
| 27 | N2O | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | N2O | Coal | kg | 0 | 17 | 34 | 70 | 190 | 0 | 0 | 0 | 0 | 379 |
| 29 | N2O | Diesel | kg | 105 | 731 | 263 | 920 | 36 | 0 | 0 | 0 | 2,606 | 364 |
| 30 | N2O | Electricity | kg | 3,363 | 54 | 22 | 109 | 204 | 0 | 0 | 189 | 562 | 456 |
| 31 | N2O | Fuel Oil | kg | 1,132 | 40 | 26 | 95 | 34 | 0 | 0 | 0 | 22 | 5 |
| 32 | N2O | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | N2O | LPG | kg | 21 | 7 | 5 | 17 | 12 | 0 | 0 | 0 | 29 | 24 |
| 34 | N2O | Natural Gas | kg | 767 | 419 | 0 | 0 | 90 | 0 | 0 | 0 | 1 | 456 |
| 35 | N2O | Petrol | kg | 5 | 17 | 6 | 21 | 6 | 0 | 0 | 0 | 726 | 976 |
| 36 | N2O | Wood | kg | 0 | 0 | 0 | 0 | 1,396 | 0 | 0 | 0 | 0 | 50 |
| 37 | N2O | Total | kg | 5,394 | 1,283 | 357 | 1,232 | 1,969 | 0 | 0 | 189 | 3,958 | 2,711 |
| 38 | CH4 | Aviation Fuel | kg | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 |
| 39 | CH4 | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | CH4 | Coal | kg | 0 | 3 | 5 | 11 | 30 | 0 | 0 | 0 | 0 | 60 |
| 41 | CH4 | Diesel | kg | 131 | 916 | 330 | 1,153 | 46 | 0 | 0 | 0 | 3,268 | 457 |
| 42 | CH4 | Electricity | kg | 12,970 | 207 | 86 | 422 | 789 | 0 | 0 | 731 | 2,169 | 1,760 |
| 43 | CH4 | Fuel Oil | kg | 267 | 9 | 6 | 22 | 8 | 0 | 0 | 0 | 5 | 1 |
| 44 | CH4 | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45 | CH4 | LPG | kg | 224 | 77 | 52 | 186 | 135 | 0 | 0 | 0 | 315 | 262 |
| 46 | CH4 | Natural Gas | kg | 6,883 | 3,757 | 0 | 0 | 804 | 0 | 0 | 0 | 8 | 4,096 |
| 47 | CH4 | Petrol | kg | 31 | 114 | 39 | 137 | 41 | 0 | 0 | 0 | 4,826 | 6,488 |
| 48 | CH4 | Wood | kg | 0 | 0 | 0 | 0 | 3,908 | 0 | 0 | 0 | 0 | 140 |
| 49 | CH4 | Total | kg | 20,510 | 5,084 | 519 | 1,932 | 5,760 | 0 | 0 | 731 | 10,606 | 13,264 |
| 50 | Landfill | Cons & demo waste | t | 41 | 255 | 34 | 1 | 3,252 | 0 | 0 | 0 | 30,771 | 1,189 |
| 51 | Landfill | Metal | t | 1,203 | 3,990 | 633 | 1,847 | 341 | 48 | 12 | 8 | 2,193 | 1,205 |
| 52 | Landfill | Glass | t | 114 | 131 | 341 | 475 | 28 | 3 | 0 | 71 | 1,285 | 441 |
| 53 | Landfill | Plastic | t | 14 | 199 | 19 | 303 | 107 | 7 | 1 | 52 | 773 | 791 |
| 54 | Landfill | Paper | t | 127 | 113 | 23 | 126 | 41 | 30 | 4 | 10 | 254 | 3,564 |
| 55 | Landfill | Potentially hazardous | t | 298 | 538 | 9 | 906 | 273 | 0 | 0 | 98 | 141 | 6,706 |
| 56 | Landfill | Organic matter | t | 3 | 3 | 1 | 12 | 2 | 0 | 0 | 0 | 0 | 4,188 |
| 57 | Landfill | Other | t | 4 | 25 | 116 | 46 | 168 | 0 | 0 | 33 | 190 | 3,934 |
| 58 | Landfill | Total | t | 1,804 | 5,253 | 1,175 | 3,715 | 4,211 | 88 | 18 | 272 | 35,607 | 22,019 |
| 59 | Cleanfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 351,695 | 0 |
| 60 | Landfill & Cleanfill | Total | t | 1,804 | 5,253 | 1,175 | 3,715 | 4,211 | 88 | 18 | 272 | 387,302 | 22,019 |

# APPENDIX B ENVIRONMENTAL ACCOUNTS OF THE WAIKATO REGION, 2004 (CONTINUED)

| | Account | Type | Units | 31 Retail trade | 32 Accommodation, restaurants and bars | 33 Road transport | 34 Water and rail transport | 35 Air transport, services to transport and storage | 36 Communication services | 37 Finance | 38 Insurance | 39 Services to finance and investment | 40 Real estate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Land | | ha | 530 | 340 | 95 | 978 | 435 | 225 | 116 | 44 | 68 | 142 |
| 2 | Delivered Energy | Aviation Fuel | GJ | 147 | 0 | 0 | 0 | 761,115 | 0 | 0 | 0 | 0 | 0 |
| 3 | Delivered Energy | Black Liquor | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Delivered Energy | Coal | GJ | 43,860 | 2,076 | 0 | 3,432 | 0 | 0 | 208 | 36 | 92 | 400 |
| 5 | Delivered Energy | Diesel | GJ | 98,024 | 20,395 | 4,856,458 | 66,713 | 62,541 | 30,302 | 0 | 0 | 0 | 0 |
| 6 | Delivered Energy | Electricity | GJ | 672,434 | 392,227 | 7,791 | 352,858 | 0 | 42,622 | 13,568 | 3,424 | 6,249 | 18,753 |
| 7 | Delivered Energy | Fuel Oil | GJ | 1,838 | 5,443 | 0 | 19,539 | 0 | 0 | 436 | 110 | 201 | 872 |
| 8 | Delivered Energy | Geothermal | GJ | 0 | 67,367 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Delivered Energy | LPG | GJ | 41,016 | 21,820 | 164,249 | 0 | 1,328 | 393 | 0 | 0 | 0 | 0 |
| 10 | Delivered Energy | Natural Gas | GJ | 296,349 | 353,537 | 19,513 | 0 | 70 | 602 | 12,837 | 3,489 | 6,518 | 28,329 |
| 11 | Delivered Energy | Petrol | GJ | 273,821 | 30,517 | 579,686 | 0 | 5,511 | 10,890 | 0 | 0 | 0 | 0 |
| 12 | Delivered Energy | Wood | GJ | 18,722 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | Delivered Energy | Total, TOE | GJ | 1,446,210 | 893,381 | 5,627,697 | 442,542 | 830,565 | 84,809 | 27,048 | 7,060 | 13,060 | 48,354 |
| 14 | CO2 | Aviation Fuel | t | 10 | 0 | 0 | 0 | 52,289 | 0 | 0 | 0 | 0 | 0 |
| 15 | CO2 | Black Liquor | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | CO2 | Coal | t | 4,018 | 190 | 0 | 314 | 0 | 0 | 19 | 3 | 8 | 37 |
| 17 | CO2 | Diesel | t | 6,734 | 1,401 | 333,639 | 4,583 | 4,297 | 2,082 | 0 | 0 | 0 | 0 |
| 18 | CO2 | Electricity | t | 38,314 | 22,348 | 444 | 20,105 | 0 | 2,429 | 773 | 195 | 356 | 1,069 |
| 19 | CO2 | Fuel Oil | t | 135 | 401 | 0 | 1,440 | 0 | 0 | 32 | 8 | 15 | 64 |
| 20 | CO2 | Geothermal | t | 0 | 748 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | CO2 | LPG | t | 2,477 | 1,318 | 9,921 | 0 | 80 | 24 | 0 | 0 | 0 | 0 |
| 22 | CO2 | Natural Gas | t | 15,677 | 18,702 | 1,032 | 0 | 4 | 32 | 679 | 185 | 345 | 1,499 |
| 23 | CO2 | Petrol | t | 18,236 | 2,032 | 38,607 | 0 | 367 | 725 | 0 | 0 | 0 | 0 |
| 24 | CO2 | Wood | t | 2,490 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | CO2 | Total | t | 88,092 | 47,141 | 383,643 | 26,443 | 57,036 | 5,291 | 1,503 | 391 | 724 | 2,668 |
| 26 | N2O | Aviation Fuel | kg | 0 | 0 | 0 | 0 | 822 | 0 | 0 | 0 | 0 | 0 |
| 27 | N2O | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | N2O | Coal | kg | 955 | 45 | 0 | 75 | 0 | 0 | 5 | 1 | 2 | 9 |
| 29 | N2O | Diesel | kg | 681 | 142 | 33,759 | 464 | 435 | 211 | 0 | 0 | 0 | 0 |
| 30 | N2O | Electricity | kg | 3,293 | 1,921 | 38 | 1,728 | 0 | 209 | 66 | 17 | 31 | 92 |
| 31 | N2O | Fuel Oil | kg | 37 | 109 | 0 | 392 | 0 | 0 | 9 | 2 | 4 | 17 |
| 32 | N2O | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | N2O | LPG | kg | 112 | 59 | 447 | 0 | 4 | 1 | 0 | 0 | 0 | 0 |
| 34 | N2O | Natural Gas | kg | 824 | 983 | 54 | 0 | 0 | 2 | 36 | 10 | 18 | 79 |
| 35 | N2O | Petrol | kg | 1,744 | 194 | 3,693 | 0 | 35 | 69 | 0 | 0 | 0 | 0 |
| 36 | N2O | Wood | kg | 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37 | N2O | Total | kg | 7,740 | 3,454 | 37,992 | 2,659 | 1,296 | 492 | 115 | 29 | 55 | 197 |
| 38 | CH4 | Aviation Fuel | kg | 0 | 0 | 0 | 0 | 1,142 | 0 | 0 | 0 | 0 | 0 |
| 39 | CH4 | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | CH4 | Coal | kg | 150 | 7 | 0 | 12 | 0 | 0 | 1 | 0 | 0 | 1 |
| 41 | CH4 | Diesel | kg | 854 | 178 | 42,327 | 581 | 545 | 264 | 0 | 0 | 0 | 0 |
| 42 | CH4 | Electricity | kg | 12,703 | 7,409 | 147 | 6,666 | 0 | 805 | 256 | 65 | 118 | 354 |
| 43 | CH4 | Fuel Oil | kg | 9 | 26 | 0 | 93 | 0 | 0 | 2 | 1 | 1 | 4 |
| 44 | CH4 | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45 | CH4 | LPG | kg | 1,208 | 643 | 4,837 | 0 | 39 | 12 | 0 | 0 | 0 | 0 |
| 46 | CH4 | Natural Gas | kg | 7,399 | 8,827 | 487 | 0 | 2 | 15 | 320 | 87 | 163 | 707 |
| 47 | CH4 | Petrol | kg | 11,595 | 1,292 | 24,546 | 0 | 233 | 461 | 0 | 0 | 0 | 0 |
| 48 | CH4 | Wood | kg | 262 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 49 | CH4 | Total | kg | 34,180 | 18,381 | 72,345 | 7,351 | 1,961 | 1,557 | 580 | 152 | 282 | 1,067 |
| 50 | Landfill | Cons & demo waste | t | 0 | 0 | 1,938 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| 51 | Landfill | Metal | t | 2,591 | 229 | 289 | 7 | 271 | 31 | 8 | 0 | 1 | 29 |
| 52 | Landfill | Glass | t | 565 | 526 | 349 | 2 | 174 | 2 | 1 | 0 | 0 | 6 |
| 53 | Landfill | Plastic | t | 945 | 204 | 395 | 6 | 210 | 2 | 1 | 0 | 1 | 3 |
| 54 | Landfill | Paper | t | 1,460 | 433 | 421 | 26 | 2,524 | 10 | 6 | 1 | 10 | 78 |
| 55 | Landfill | Potentially hazardous | t | 444 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 56 | Landfill | Organic matter | t | 5,284 | 7,266 | 0 | 0 | 119 | 0 | 2 | 0 | 0 | 0 |
| 57 | Landfill | Other | t | 772 | 88 | 83 | 8 | 289 | 1 | 0 | 0 | 0 | 52 |
| 58 | Landfill | Total | t | 12,061 | 8,768 | 3,474 | 49 | 3,587 | 46 | 19 | 2 | 12 | 198 |
| 59 | Cleanfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | Landfill & Cleanfill | Total | t | 12,061 | 8,768 | 3,474 | 49 | 3,587 | 46 | 19 | 2 | 12 | 198 |

# APPENDIX B ENVIRONMENTAL ACCOUNTS OF THE WAIKATO REGION, 2004 (CONTINUED)

| | Account | Type | Units | 41 Ownership of owner-occupied dwellings | 42 Business services | 43 Central government administration, defence, public order and safety services | 44 Local government administration services and civil defence | 45 Education | 46 Health and community services | 47 Cultural and recreational services | 48 Personal and other community services | 49 Households | GROSS OUTPUT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Land | | ha | 0 | 1,003 | 290 | 82 | 798 | 770 | 128,817 | 1,449 | 62,615 | 1,689,105 |
| 2 | Delivered Energy | Aviation Fuel | GJ | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 354 | 0 | 814,118 |
| 3 | Delivered Energy | Black Liquor | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,929,808 |
| 4 | Delivered Energy | Coal | GJ | 0 | 2,716 | 14,355 | 6,385 | 69,663 | 82,744 | 4,365 | 1,569 | 56,753 | 2,617,805 |
| 5 | Delivered Energy | Diesel | GJ | 0 | 90,914 | 5,188 | 31,413 | 0 | 0 | 0 | 33,669 | 1,160,606 | 11,600,990 |
| 6 | Delivered Energy | Electricity | GJ | 0 | 394,947 | 64,053 | 105,809 | 117,208 | 111,235 | 57,846 | 104,136 | 3,960,363 | 11,117,951 |
| 7 | Delivered Energy | Fuel Oil | GJ | 0 | 3,904 | 245 | 0 | 1,378 | 603 | 385 | 338 | 0 | 436,324 |
| 8 | Delivered Energy | Geothermal | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 93,112 | 160,511 |
| 9 | Delivered Energy | LPG | GJ | 0 | 15,464 | 0 | 0 | 0 | 0 | 0 | 252 | 234,257 | 590,493 |
| 10 | Delivered Energy | Natural Gas | GJ | 0 | 128,489 | 56,703 | 70,076 | 171,540 | 274,056 | 0 | 4 | 859,953 | 6,762,020 |
| 11 | Delivered Energy | Petrol | GJ | 0 | 57,520 | 4,425 | 33,150 | 0 | 15,511 | 0 | 14,686 | 8,441,030 | 10,492,794 |
| 12 | Delivered Energy | Wood | GJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 283 | 613,205 | 3,673,307 |
| 13 | Delivered Energy | Total, TOE | GJ | 0 | 693,960 | 144,969 | 246,833 | 359,791 | 484,148 | 62,597 | 155,291 | 15,419,280 | 50,195,868 |
| 14 | CO2 | Aviation Fuel | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 0 | 55,985 |
| 15 | CO2 | Black Liquor | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 256,723 |
| 16 | CO2 | Coal | t | 0 | 249 | 1,315 | 585 | 6,381 | 7,579 | 400 | 144 | 5,199 | 239,854 |
| 17 | CO2 | Diesel | t | 0 | 6,246 | 356 | 2,158 | 0 | 0 | 0 | 2,313 | 79,734 | 797,055 |
| 18 | CO2 | Electricity | t | 0 | 22,503 | 3,650 | 6,029 | 6,678 | 6,338 | 3,296 | 5,933 | 225,654 | 633,550 |
| 19 | CO2 | Fuel Oil | t | 0 | 288 | 18 | 0 | 102 | 44 | 28 | 25 | 0 | 32,231 |
| 20 | CO2 | Geothermal | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,034 | 1,861 |
| 21 | CO2 | LPG | t | 0 | 934 | 0 | 0 | 0 | 0 | 0 | 15 | 14,149 | 35,748 |
| 22 | CO2 | Natural Gas | t | 0 | 6,797 | 3,000 | 3,707 | 9,074 | 14,498 | 0 | 0 | 45,492 | 357,797 |
| 23 | CO2 | Petrol | t | 0 | 3,831 | 295 | 2,208 | 0 | 1,033 | 0 | 978 | 562,173 | 698,909 |
| 24 | CO2 | Wood | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 81,556 | 488,640 |
| 25 | CO2 | Total | t | 0 | 40,848 | 8,633 | 14,687 | 22,236 | 29,492 | 3,724 | 9,471 | 1,014,989 | 3,597,616 |
| 26 | N2O | Aviation Fuel | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 983 |
| 27 | N2O | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,757 |
| 28 | N2O | Coal | kg | 0 | 59 | 312 | 139 | 1,516 | 1,801 | 95 | 34 | 1,235 | 57,087 |
| 29 | N2O | Diesel | kg | 0 | 632 | 36 | 218 | 0 | 0 | 0 | 234 | 8,068 | 80,759 |
| 30 | N2O | Electricity | kg | 0 | 1,934 | 314 | 518 | 574 | 545 | 283 | 510 | 19,397 | 54,574 |
| 31 | N2O | Fuel Oil | kg | 0 | 78 | 5 | 0 | 28 | 12 | 8 | 7 | 0 | 8,876 |
| 32 | N2O | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 128 |
| 33 | N2O | LPG | kg | 0 | 42 | 0 | 0 | 0 | 0 | 0 | 1 | 638 | 1,740 |
| 34 | N2O | Natural Gas | kg | 0 | 357 | 158 | 195 | 477 | 762 | 0 | 0 | 2,392 | 18,943 |
| 35 | N2O | Petrol | kg | 0 | 366 | 28 | 211 | 0 | 99 | 0 | 94 | 53,776 | 66,988 |
| 36 | N2O | Wood | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3,066 | 18,510 |
| 37 | N2O | Total | kg | 0 | 3,470 | 853 | 1,282 | 2,595 | 3,219 | 386 | 881 | 88,572 | 317,128 |
| 38 | CH4 | Aviation Fuel | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1,373 |
| 39 | CH4 | Black Liquor | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27,173 |
| 40 | CH4 | Coal | kg | 0 | 9 | 49 | 22 | 238 | 283 | 15 | 5 | 194 | 9,119 |
| 41 | CH4 | Diesel | kg | 0 | 792 | 45 | 274 | 0 | 0 | 0 | 293 | 10,115 | 101,275 |
| 42 | CH4 | Electricity | kg | 0 | 7,461 | 1,210 | 1,999 | 2,214 | 2,101 | 1,093 | 1,967 | 74,814 | 210,194 |
| 43 | CH4 | Fuel Oil | kg | 0 | 18 | 1 | 0 | 7 | 3 | 2 | 2 | 0 | 2,239 |
| 44 | CH4 | Geothermal | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 |
| 45 | CH4 | LPG | kg | 0 | 455 | 0 | 0 | 0 | 0 | 0 | 7 | 6,898 | 17,568 |
| 46 | CH4 | Natural Gas | kg | 0 | 3,208 | 1,416 | 1,750 | 4,283 | 6,842 | 0 | 0 | 21,470 | 169,008 |
| 47 | CH4 | Petrol | kg | 0 | 2,436 | 187 | 1,404 | 0 | 657 | 0 | 622 | 357,425 | 444,490 |
| 48 | CH4 | Wood | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 8,585 | 51,618 |
| 49 | CH4 | Total | kg | 0 | 14,380 | 2,909 | 5,448 | 6,742 | 9,886 | 1,110 | 2,901 | 479,502 | 1,032,536 |
| 50 | Landfill | Cons & demo waste | t | 0 | 402 | 566 | 0 | 420 | 4 | 0 | 0 | 18,438 | 81,147 |
| 51 | Landfill | Metal | t | 0 | 30 | 74 | 5 | 26 | 22 | 19 | 92 | 12,136 | 29,077 |
| 52 | Landfill | Glass | t | 0 | 11 | 5 | 2 | 53 | 100 | 11 | 68 | 5,850 | 11,890 |
| 53 | Landfill | Plastic | t | 0 | 32 | 18 | 33 | 39 | 52 | 56 | 100 | 14,269 | 22,634 |
| 54 | Landfill | Paper | t | 0 | 453 | 114 | 21 | 156 | 317 | 240 | 213 | 31,149 | 53,578 |
| 55 | Landfill | Potentially hazardous | t | 0 | 29 | 0 | 256 | 8 | 2,524 | 0 | 0 | 1,842 | 49,011 |
| 56 | Landfill | Organic matter | t | 0 | 5 | 0 | 0 | 0 | 259 | 437 | 0 | 65,744 | 111,310 |
| 57 | Landfill | Other | t | 0 | 18 | 43 | 23 | 55 | 39 | 109 | 227 | 8,780 | 16,617 |
| 58 | Landfill | Total | t | 0 | 978 | 820 | 340 | 756 | 3,318 | 872 | 701 | 158,209 | 373,783 |
| 59 | Cleanfill | Cons & demo waste | t | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 351,931 |
| 60 | Landfill & Cleanfill | Total | t | 0 | 978 | 820 | 340 | 756 | 3,318 | 872 | 701 | 158,209 | 725,486 |

# Appendix C

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