

# Biotechnology in New Zealand

2004

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## Preface

This report presents a statistical picture of the state of biotechnology in New Zealand. The information in this report was derived from data collected by Statistics New Zealand in the Biotechnology Survey 2004, conducted in August 2004.

The purpose of the Biotechnology Survey is to collect information on the use, production and uptake of biotechnology in New Zealand. It also measures the size of the biotechnology sector and identifies barriers to biotechnology research and development.

The Government's Growth and Innovation Framework has spurred the need for detailed statistics on certain sectors of the New Zealand economy. The biotechnology sector can be associated with innovative activities, and innovation has been cited as a key factor in sustaining economic growth, and in developing a more flexible New Zealand economy capable of competing successfully on the international stage. This sector is seen as important, due to its high growth potential, and its ability to contribute technologies and services across the economy.

Statistics New Zealand is grateful for the cooperation of the enterprises that participated in the Biotechnology Survey.

A handwritten signature in black ink, appearing to read 'B. Pink', with a large, sweeping flourish extending from the end of the signature.

Brian Pink  
**Government Statistician**



## Information

This report was prepared by the Business Performance Unit of Statistics New Zealand.

Statistics New Zealand is grateful for the support of the Ministry of Research, Science and Technology, the Foundation of Research, Science and Technology, New Zealand Trade and Enterprise, and Dr Dan Marsh at the University of Waikato, who have assisted in the development of the biotechnology survey.

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### Changes of base

Where consecutive figures have been compiled on different bases and are not strictly comparable, a footnote is added indicating the nature of the difference.

### Source

All data is compiled by Statistics New Zealand, except where otherwise stated.

### Symbols

The interpretation of the symbols used throughout this report is as follows:

- figure(s) not available
- ... not applicable

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## Chapter 1

# Guide to Interpreting Data

The following summary highlights the main points to consider when analysing the Biotechnology Survey 2004 results. A full technical description is contained in chapter 9.

## 1.1 Definition of biotechnology

The definition of biotechnology used in this survey was the working definition used by the Organisation for Economic Co-operation and Development's (OECD) Biotechnology Statistical Framework (refer [www.oecd.org](http://www.oecd.org)).

The OECD defines biotechnology as “the application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services”.

The following list of techniques was published by the OECD in 2004 as an interpretative guideline of what biotechnology includes:

- **DNA – The coding:** genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering
- **Proteins and molecules – The functional blocks:** protein/peptide sequencing/synthesis, lipid/protein glyco-engineering, proteomics, hormones and growth factors, cell receptors/signalling/pheromones
- **Cell and tissue culture, and engineering:** cell/tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine/immune stimulants, embryo manipulation
- **Process biotechnologies:** bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurisation, bioremediation, and biofiltration
- **Sub-cellular organisms:** gene therapy, viral vectors.
- **Other:** bioinformatics, nanobiotechnologies, other.

## 1.2 Data collection

The Biotechnology Survey 2004 was conducted as a postal survey of all known New Zealand organisations that were thought to be involved in biotechnology. Of 563 forms posted out, 529 were returned. Further information on the selection of the population can be found in chapter 9.

The majority of the questionnaire uses a three-year reference period. Financial information was requested from respondents for the 2004 financial year. A copy of the questionnaire can be found at the end of this report.

## 1.3 Comparison between 1999 and 2004 surveys

A biotechnology survey was conducted by Statistics New Zealand in 1998/1999. A number of significant changes have been made to the Biotechnology Survey 2004 from the earlier survey. These changes were designed to enhance international comparability and follow international best practice. For more information about the changes, please refer to the technical documentation.

As a result, caution needs to be taken when making comparisons between the data from the Biotechnology Survey 2004 and the 1998/99 Biotechnology Survey.

Due to the methodological differences between the two surveys, including a change in the definition of biotechnology, comparisons will only be made in certain sections of this report. These comparisons will be in sections where the change in methodology is likely to have had the least effect on any comparisons being made. These sections are as follows:

- Strategic alliances and partnerships (5.1)
- Intellectual property sharing (5.2)
- Patents (5.3)
- Overseas recruitment (7.3)
- Problems affecting research and development (R&D) biotechnology (8.1).

#### **1.4 Presentations of numeric totals**

In order to preserve the confidentiality of respondents, counts used for this report were random rounded to base 3. When data in a table has been randomly rounded to base 3, every value in the table is a multiple of 3. The probabilities of rounding up or down are set so that in the long run the expected value, after rounding, equals the original count. The randomness of this kind of rounding may result in a total which differs slightly from the sum of the individual cells contributing to this total.

## Chapter 2

# Overview

### 2.1 Biotechnology use

In 2004, 129 organisations indicated in the survey that they have used one or more biotechnology techniques in the last three years.

Of the biotechnology techniques currently used by New Zealand organisations, 62 percent are being used at the research and development (R&D) stage, 24 percent are being used as part of a production process, and the remaining biotechnologies are used as part of products or services that organisations have sold.

Survey results show that the most common category of biotechnology application in New Zealand is Agricultural, at 22 percent. The Human Health, and Innovative Health and Human Nutrition areas of application follow this, with 20 percent and 18 percent, respectively.

### 2.2 Intellectual property

There has been an increase in the amount of patenting related to biotechnology in New Zealand. For the year ended 30 June 2004, 117 biotechnology-related patents were granted to New Zealand organisations. This compares with 56 patents in 1999.

In the five years to June 2004, 348 biotechnology-related patents were granted to New Zealand organisations. This compares with a five-year total of 156 patents in 1999.

### 2.3 Financial and trade information

Income that can be attributed to biotechnology in New Zealand for the 2004 financial year was valued at \$675 million (excluding universities). Of this, \$195 million can be attributed to the scientific research industry sector.

Biotechnology expenditure in New Zealand for the 2004 financial year was valued at \$430 million (excluding universities). Of this, \$225 million can be attributed to the scientific research sector.

Data captured from the Statistics New Zealand and Ministry of Research, Science and Technology Research and Development Survey 2004, indicates that universities accounted for \$85 million of biotechnology R&D expenditure in the 2004 calendar year.

### 2.4 Human resources

The New Zealand biotechnology sector (110 organisations) employed 2,464 people in 2004.

A large proportion of employees in the biotechnology sector are highly qualified. Thirty-eight percent of employees hold a doctorate, while a further 42 percent hold a postgraduate or undergraduate qualification.



## Chapter 3

# Use of Biotechnologies in New Zealand

A full set of statistical tables is available with this report. Please view tables 1 to 4 in conjunction with this chapter.

This chapter discusses the various types of biotechnologies that New Zealand organisations have used over the last three years. This includes showing the most common biotechnology techniques used and also which industry sectors are utilising these biotechnologies.

This chapter also discusses new and improved biotechnology products and processes that have been implemented by New Zealand organisations.

### 3.1 Use of biotechnologies

Respondents were asked a number of questions about whether they used biotechnology in the three-year period ending 30 June 2004. If they indicated that they currently use biotechnology, or intended to do so within the next three years, they were then asked to complete the rest of the questionnaire.

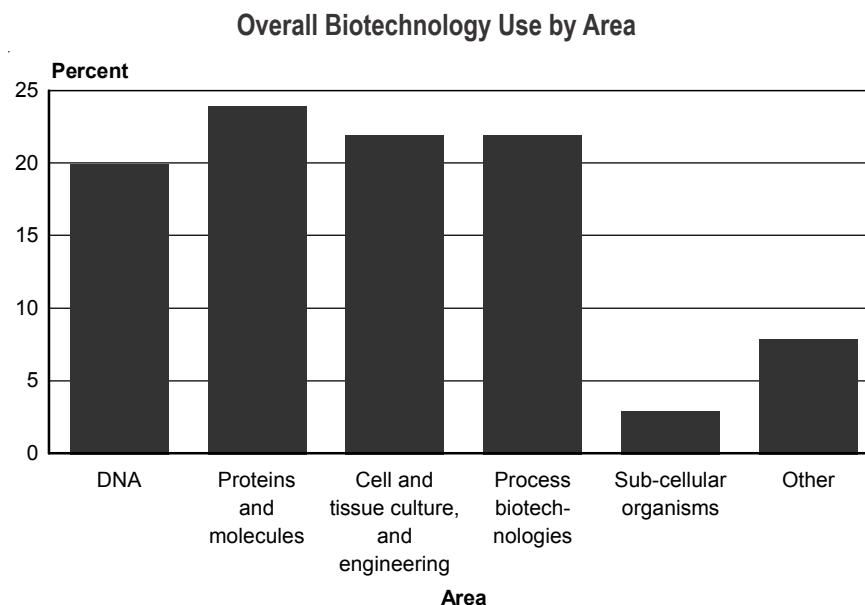
In 2004, 129 organisations that responded to the Biotechnology Survey 2004 indicated that they had used one or more biotechnologies in the last three years. Of these 129 organisations, 110 currently (as at 30 June 2004), use one or more biotechnology techniques or intend to do so in the next three years. This indicates that 19 organisations that have used biotechnology techniques in the last three years, do not currently, or in the next three years, intend to use any biotechnology techniques.

The OECD list-based definition of biotechnology categorises 22 biotechnology techniques (shown in appendix A) within the following areas:

1. DNA – The coding
2. Proteins and molecules – The functional blocks
3. Cell and tissue culture, and engineering
4. Process biotechnologies
5. Sub-cellular organisms
6. Other

Figure 3.01 shows that biotechnologies that fit within the Proteins and molecules category were the most commonly used (24 percent). This was followed by the Cell and tissue culture, and engineering; and Process biotechnologies categories, which both had 22 percent.

Figure 3.01



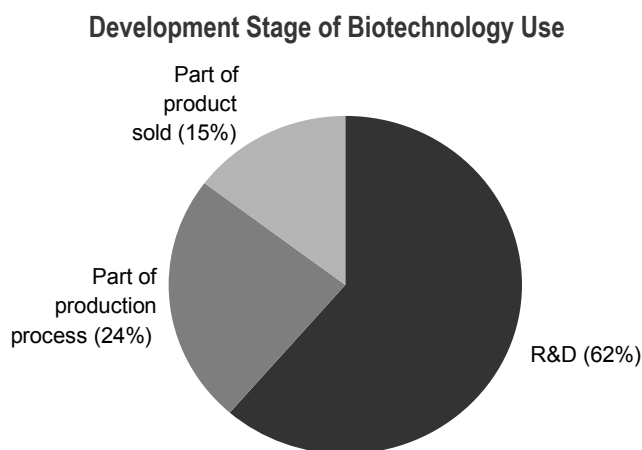
Note that Figure 3.01 shows how common each area of application is, and does not necessarily represent the size of an individual application.

Respondents were asked to categorise their use of biotechnology according to which development stage it was used in. These development stages were:

- research and development (R&D)
- part of a production process
- part of the product sold.

Figure 3.02 shows the development stages in which biotechnologies are being used in New Zealand. The majority (62 percent) are being used at the R&D stage.

Figure 3.02



Note: Figures may not sum to 100 percent due to rounding.

Table 3.01 shows the area of biotechnology by the development stage in which it is being used. Research and development is the most common development stage for all areas of biotechnology use in New Zealand.

Within the Part of the production process development stage, process biotechnologies are used considerably more than all of the other areas of biotechnology.

Table 3.01

**Biotechnology Use**  
By development stage  
2004

Area of biotechnology	Development stage			
	R&D	Part of production process	Part of product sold	Total
	Number			
DNA	93	27	24	147
Proteins and molecules	123	33	27	183
Cell and tissue culture, and engineering	105	36	27	168
Process biotechnologies	75	66	24	165
Sub-cellular organisms	18	3	0	24
Other	48	9	9	63
<b>Total</b>	<b>465</b>	<b>177</b>	<b>111</b>	<b>750</b>

### 3.2 Specific uses of biotechnology

Table 3.02 shows that the most common biotechnology technique used in New Zealand was fermentation/bioprocessing, with 69 different organisations using this biotechnology. Cell/tissue culture and tissue engineering was the second most common with 51 instances. This was followed by DNA sequencing/synthesis/amplification and genetic modification with 48 instances.

Table 3.02

Area of biotechnology	Type of biotechnology	Number of organisations
Process biotechnologies	Fermentation, bioprocessing	69
Cell and tissue culture, and engineering	Cell/tissue culture, tissue engineering	51
DNA	DNA sequencing/synthesis/amplification, genetic modification	48
Proteins and molecules	Hormones and growth factors	42
DNA	Gene probes	36
Other	Bioinformatics	33
Proteins and molecules	Protein/peptide sequencing, synthesis	33
Proteins and molecules	Cell receptors/signalling/pheromones	33
DNA	Genomics, pharmaco-genetics	33

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so some figures may differ from those stated.

Table 3.03 shows the most common types of biotechnology techniques being used in the R&D stage. In this stage, Cell and tissue culture, and engineering, and DNA sequencing/synthesis/amplification and genetic modification were the most common biotechnologies, with 39 organisations using both of these biotechnology types.

Table 3.03

Area of biotechnology	Type of biotechnology	Number of organisations
DNA	DNA sequencing/synthesis/amplification, genetic modification	39
Cell and tissue culture, and engineering	Cell/tissue culture, tissue engineering	39
Process biotechnologies	Fermentation, bioprocessing	33
Other	Bioinformatics	33
Proteins and molecules	Protein/peptide sequencing, synthesis	30
DNA	Genomics, pharmaco-genetics	27
DNA	Gene probes	27
Proteins and molecules	Hormones and growth factors	24
Proteins and molecules	Cell receptors/signalling/pheromones	24

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so some figures may differ from those stated.

For a more detailed table on the uses of biotechnology, please refer to table 2 in the statistical tables.

### 3.3 Biotechnology use by sector

This section breaks down the use of biotechnology techniques by the type of industry in which organisations are classified. Sectors are defined by Australia New Zealand Standard Industrial Classifications 1996 (ANZSIC); for more detail on this please refer to the technical documentation. This section will break down biotechnology use into the following four sectors:

- scientific research
- education (this sector includes universities)
- manufacturing
- other.

The scientific research sector shows consistently high biotechnology activity, and throughout this report this sector will be examined in detail.

Table 3.04 shows how many organisations are using biotechnology techniques, classified by sector. This shows that the scientific research sector is the largest single sector for biotechnology use in New Zealand, accounting for 41 percent of all biotechnology use.

Also worth noting, is that the education sector shows a relatively large use of biotechnology, given the small number of organisations surveyed in this sector (10 organisations).

Table 3.04

**Biotechnology Use by Sector**  
Within previous three years  
2004

Type of biotechnology	Sector				
	Scientific research	Education	Manufacturing	Other	Total
Number of organisations					
<b>DNA - The coding</b>					
Genomics, pharmaco-genetics	18	6	0	9	33
Gene probes	18	6	3	9	36
DNA sequencing/synthesis/amplification, genetic modification	21	9	3	15	48
<b>Proteins and molecules - The functional blocks</b>					
Protein/peptide sequencing, synthesis	15	6	6	6	33
Lipid/protein glycoengineering	12	3	3	0	18
Proteomics	15	6	3	3	27
Hormones and growth factors	15	6	9	12	42
Cell receptors/signalling/pheromones	15	6	0	12	33
<b>Cell and tissue culture, and engineering</b>					
Cell/tissue culture, tissue engineering	24	6	6	15	51
Embryo manipulation	6	6	0	3	15
Hybridization	9	6	0	6	21
Cellular fusion	6	3	3	3	15
Vaccine/immune stimulants	12	6	3	6	27
<b>Process biotechnologies</b>					
Bioreactors	9	6	9	3	27
Fermentation, bioprocessing	12	9	42	6	69
Bioleaching, bio-pulping, bio-bleaching, biodesulphurisation	3	6	6	0	15
Bioremediation, biofiltration	6	6	6	6	24
<b>Sub-cellular organisms</b>					
Gene therapy	6	3	0	0	9
Viral vectors	6	6	0	0	12
<b>Other</b>					
Bioinformatics	18	6	3	6	33
Nanobiotechnologies	3	6	3	0	12
Other	3	3	3	0	9

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

### 3.4 Future use of biotechnology

Sixteen percent of respondents who have used a biotechnology technique in the last three years have indicated that they would use a new biotechnology (other than those they are already using) in the three-year period following the Biotechnology Survey 2004.

### 3.5 New or improved biotechnology processes

Table 3.05 shows that 33 of the 110 organisations which currently use one or more biotechnology techniques introduced a new or significantly improved biotechnology process in the last three years. A total of 132 new or significantly improved biotechnology processes were introduced by these organisations. In the survey, a biotechnology process was defined as “a range of techniques employed in biotechnology”.

Respondents were asked to classify these new or significantly improved biotechnology processes by whether they were new to the world, new to New Zealand, or new to the business.

Of the 132 new or significantly improved processes, 50 percent were new to the world.

Table 3.05

<b>New or Significantly Improved Processes</b>		
<i>Within previous three years</i>		
<i>2004</i>		
	New or significantly improved processes	
	Organisations	Number
<b>Introduced a new or significantly improved process</b>		
New to the world	24	66
New to New Zealand	18	36
New to this business	12	30
<b>Total</b>	<b>33</b>	<b>132</b>

### 3.6 New or improved biotechnology products

Table 3.06 shows that 33 of the 110 organisations have, in the last three years, introduced a new or significantly improved biotechnology product or service. These organisations introduced a total of 105 new or significantly improved biotechnology products or services. In the survey, a biotechnology product was defined as “the goods and services produced for research and commercial use through the utilisation of one or more biotechnology process”.

Fifty-one organisations have indicated they intend to introduce a new or significantly improved biotechnology product or service in the next three years. A total of 258 new or significantly improved biotechnology products are intended to be introduced by these organisations in the next three years.

Table 3.06

<b>New or Significantly Improved Product or Service</b>		
<i>2004</i>		
	New or significantly improved product or service	
	Organisations	Number
Introduced a new or significantly improved product or service in last three years	33	105
Plan to introduce a new or significantly improved product or service in next three years	51	258



## Chapter 4

### Area of Application for Biotechnology

A full set of statistical tables is available with this report. Please view tables 5 and 6 in conjunction with this chapter.

The previous section provided information on the specific types of biotechnology being used by New Zealand organisations. This section describes the areas in which these biotechnology techniques are being applied. The Biotechnology Survey 2004 captured data that can be aggregated into the following broad categories:

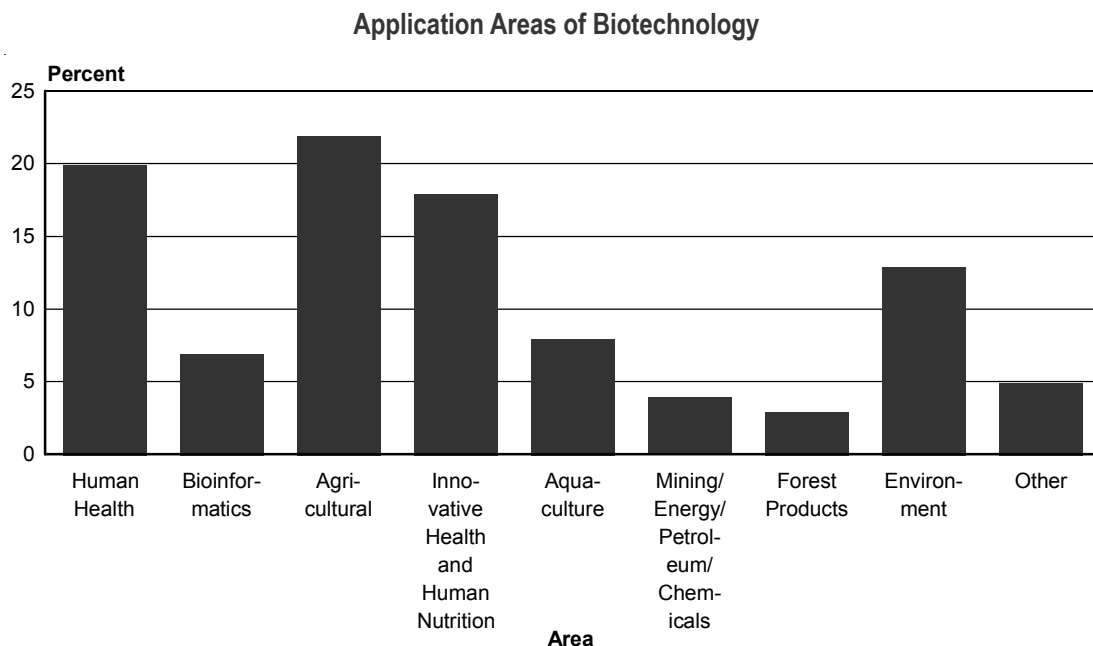
1. Human Health
2. Bioinformatics
3. Agricultural
4. Innovative Health and Human Nutrition
5. Aquaculture
6. Mining/Energy/Petroleum/Chemicals
7. Forest Products
8. Environment
9. Other.

Appendix B shows which specific areas of application make up the above broader categories.

#### 4.1 Areas of application

Figure 4.01 shows that the most common area of biotechnology application is the Agricultural area. Agricultural biotechnology made up 22 percent of all biotechnology applications. The Human Health, and Innovative Health and Human Nutrition areas of application follow, with 20 and 18 percent, respectively.

Figure 4.01



Note that Figure 4.01 shows how common each area of application is, and does not necessarily represent the size or cost of an individual application.

## 4.2 Scientific research areas of application

Compared with the biotechnology sector overall, as discussed in section 4.1, the scientific research sector has a larger focus on the Agricultural area of application. All other categories of biotechnology application remain fairly consistent with the overall biotechnology sector.

Table 4.01

Area of application	Scientific research sector		Overall	
	Number	Percent	Number	Percent
Human Health	27	20	81	20
Bioinformatics	12	9	27	7
Agricultural	36	27	87	22
Innovative Health and Human Nutrition	21	16	72	18
Aquaculture	12	9	33	8
Mining/Energy/Petroleum/Chemicals	0	0	15	4
Forest Products	3	2	12	3
Environment	15	11	54	13
Other	6	4	21	5
<b>Total</b>	<b>135</b>	<b>100</b>	<b>402</b>	<b>100</b>

## 4.3 Specific areas of biotechnology application

Although Agricultural was the most common overall category of application, some interesting differences emerge when further classifying these categories down into more specific biotechnology applications. Refer to Appendix B for details on the area of application classifications.

Table 4.02 shows that the Human Health area of application has the two most commonly used specific biotechnology applications in New Zealand, Diagnostics and Therapeutics. This was followed by Animal biotechnology in the Agricultural area of application.

Table 4.02

Area of application	Specific application	Number of organisations
Human Health	Diagnostics	39
Human Health	Therapeutics	33
Agricultural	Animal biotechnology	30
Bioinformatics	Genomics and molecular modelling	27
Innovative Health and Human Nutrition	Functional foods/nutraceuticals	27
Agricultural	Plant biotechnology	24
Innovative Health and Human Nutrition	Brewing/wine production	21
Environment	Bioremediation and phytoremediation	21

## Chapter 5

# Partnerships, Patents and Publications

A full set of statistical tables is available with this report. Please view tables 7 to 14 in conjunction with this chapter.

This chapter describes the partnerships and alliances associated with biotechnology that have been formed by New Zealand organisations. This includes why alliances were formed, as well as discussing the types of organisations that respondents formed alliances with.

There is a description of intellectual property, including whether alliances and partnerships have been formed to share intellectual property. This section then examines the number of biotechnology patents in the biotechnology sector, as well as whether there have been any disputes or litigation in the last three years.

This chapter also looks at the number of biotechnology organisations whose employees have published biotechnology-related journal articles, or attended or presented at a biotechnology conference.

### 5.1 Strategic partnerships and alliances

Sixty-five percent of New Zealand organisations undertaking biotechnology had at least one partnership or alliance for the purpose of undertaking biotechnology activity (research and/or production) in the last three years.

Figure 5.01 shows that 35 percent of partnerships and alliances were formed for the purpose of product/process development. The next most common purpose was for clinical/field trials, at 24 percent. This is consistent with the results earlier in the report, which show that biotechnology is being used primarily at the R&D stage in New Zealand.

This is consistent with results of the 1998/1999 Biotechnology Survey, where product/process development and clinical/field trials were also the most common type of partnership or alliance, with 38 percent and 19 percent, respectively.

Figure 5.01

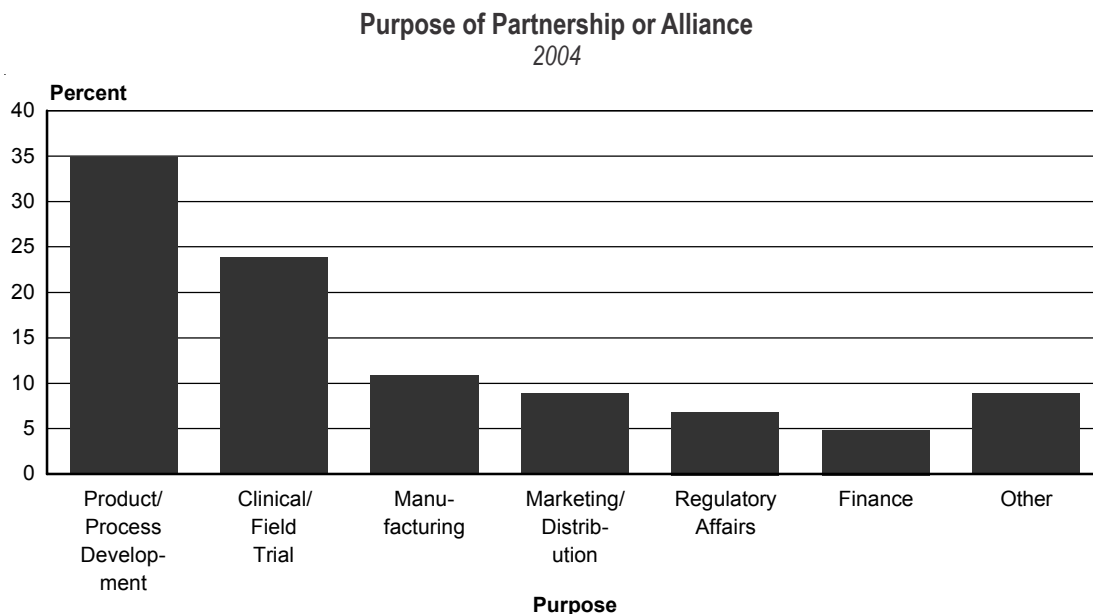


Table 5.01 shows that of the organisations which have had partnerships and alliances with other New Zealand organisations, the most common partners have been with businesses or Crown Research Institutes.

Table 5.01

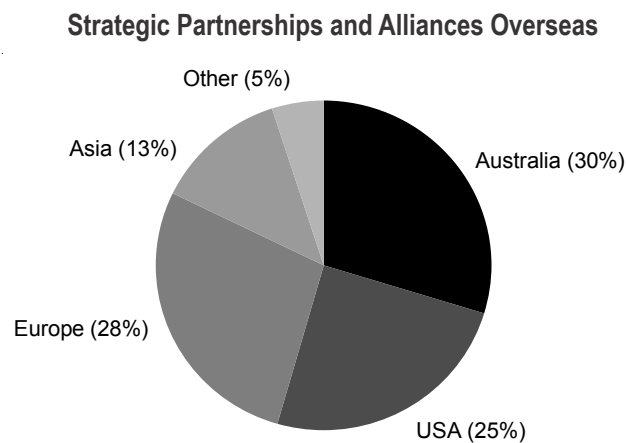
**Strategic Partnerships and Alliances in New Zealand**  
2004

Type of partner	Number	Percent
Another business	45	33
University	39	28
Crown Research Institute	45	33
Other	6	4

However, it was more common for an international alliance or partnership to be with a university than with other organisation types.

Figure 5.02 shows the geographical areas in which these overseas partnerships and alliances are being made. The most prevalent have been with Australian and European organisations, with 30 and 28 percent, respectively.

Figure 5.02



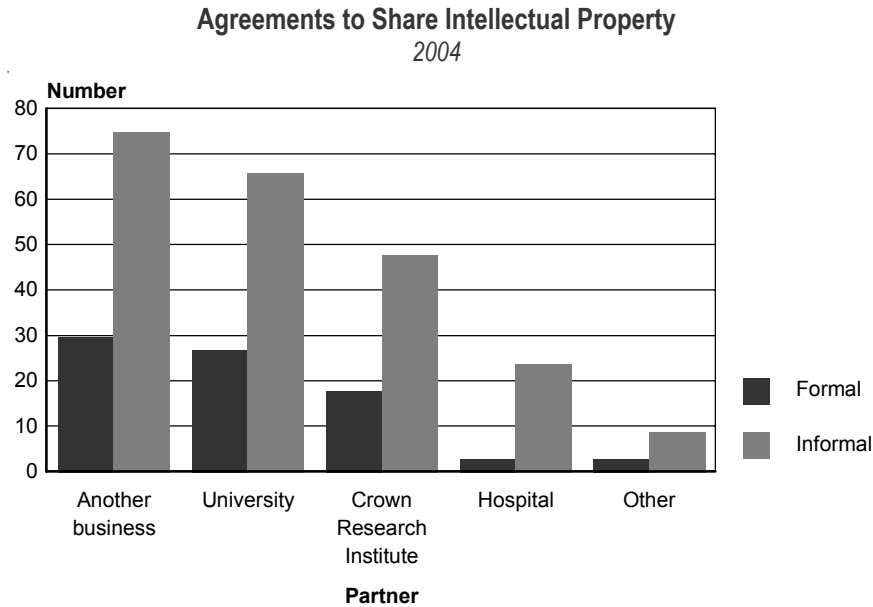
**Note:** Figures may not sum to 100 percent due to rounding.

## 5.2 Intellectual property sharing

Survey results show 90 different formal arrangement types for using intellectual property both in New Zealand and overseas, with arrangements with businesses being the most prevalent.

Figure 5.03 shows that informal sharing arrangements for IP have been more than twice as common as formal sharing arrangements.

Figure 5.03



### Differences between New Zealand and overseas intellectual property alliances

Sixty-three percent of all formal intellectual property arrangements were with New Zealand organisations, and the remainder with overseas partners. Sixty-seven percent of informal arrangements were with New Zealand organisations.

Formal arrangements to share intellectual property in New Zealand were more common with universities. Informal arrangements to share intellectual property in New Zealand were more common with businesses.

Fifty-five percent of overseas formal arrangements to use intellectual property were with businesses. The next largest contributor was universities, with 27 percent.

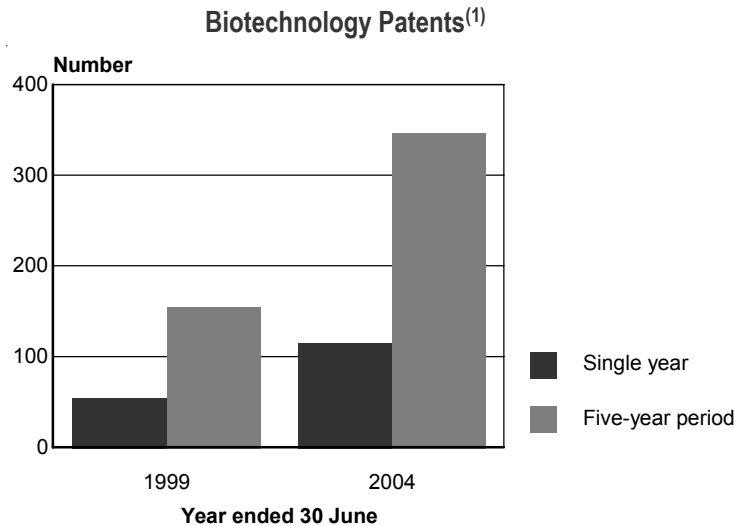
The Biotechnology Survey 2004 showed very similar patterns in the formation of partnerships and alliances to the 1998/1999 Biotechnology Survey. Tables 9 and 10 in the statistical tables show these comparisons.

### 5.3 Patents

In the year ended 30 June 2004, 117 biotechnology-related patents were granted to New Zealand organisations. This compares with 56 patents in the 1998/1999 Biotechnology Survey.

Over the five years to June 2004, 348 biotechnology-related patents were granted to New Zealand organisations. This compares with a five-year total of 156 patents in the 1998/1999 Biotechnology Survey.

Figure 5.04



(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

The scientific research sector was responsible for the majority of patents in the year ended 30 June 2004, with 72 patents. This sector was also responsible for 271 of the total biotechnology patents granted in the five years to June 2004.

### 5.4 Problems associated with intellectual property

Twenty-four of the 110 organisations have at some stage abandoned, or not started, a biotechnology development activity because further work was blocked by intellectual property rights or some knowledge being protected by another organisation.

Twelve organisations reported a total of 18 instances of being involved in litigation relating to patent infringements in the three years to June 2004.

Fifteen organisations reported a total of 24 instances of having disputes relating to access to research data or information in the three years to June 2004.

### 5.5 Research publications and conferences

In the 12 months ending 30 June 2004, 32 percent of organisations had a staff member who published a biotechnology-related journal article.

Sixty-seven percent of organisations had at least one staff member attend a biotechnology conference, and 44 percent of organisations had at least one staff member who presented at such a conference.

## Chapter 6

# Financial and Trade Information

A full set of statistical tables is available with this report. Please view tables 15 and 16 in conjunction with this chapter.

This chapter shows various measures of financial and trade information for the biotechnology sector. This includes the total income and expenditure attributable to biotechnology, as well as comparisons for the private and government sectors. There are also measures of university R&D expenditure, and the value of exports of biotechnology goods, services, processes and knowledge.

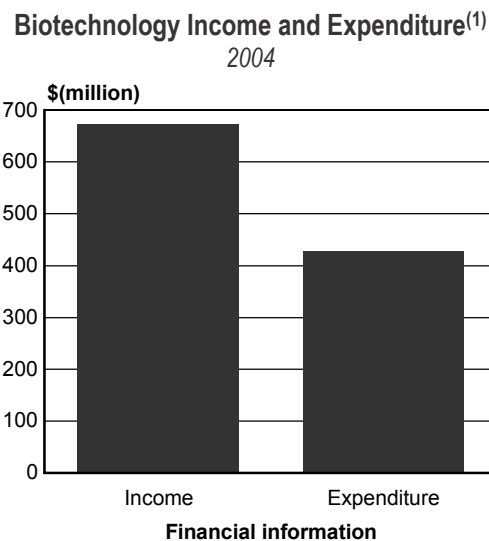
## 6.1 Financial and trade information

The figures given for income and expenditure attributable to biotechnology do not include universities. This is largely due to methodology difficulties related to the collection of income and expenditure data from the university sector. Statistics New Zealand is currently addressing this issue for the Biotechnology Survey 2005.

Biotechnology income in New Zealand for the 2004 financial year was valued at \$675 million. This can be compared in size with the Fishing industry, which has a total income of \$970 million, as reported in the *Annual Enterprise Survey: 2003 financial year (provisional)*.

Biotechnology expenditure in New Zealand for the 2004 financial year was valued at \$430 million.

Figure 6.01



(1) Excludes university data.

Seventy-five percent of income attributable to biotechnology can be attributed to the private sector (\$507 million), with the remaining 25 percent to the government sector (\$168 million).

Sixty-one percent of expenditure attributable to biotechnology can be attributed to the private sector (\$264 million), and the remaining 39 percent to the government sector (\$166 million).

Table 6.01 shows that biotechnology income for the scientific research sector was valued at \$195 million, and biotechnology expenditure was \$225 million. This, in turn, shows that nearly half of all expenditure on biotechnology comes from this sector.

Table 6.01

**Biotechnology Income and Expenditure<sup>(1)</sup> by Sector**  
2004

	(\$)million
<b>Biotechnology income</b>	
Scientific research	195
All other sectors	480
<b>Total</b>	<b>675</b>
<b>Biotechnology expenditure</b>	
Scientific research	225
All other sectors	226
<b>Total</b>	<b>430</b>

(1) Income and expenditure figures exclude university data.

## 6.2 University biotechnology R&D

For income and expenditure figures in section 6.1, there is no data for universities. However, some idea of the importance of universities to the biotechnology sector can be gained from data from the Statistics New Zealand and Ministry of Research, Science and Technology's Research and Development Survey 2004.

Data captured from the Research and Development Survey 2004 shows that universities accounted for \$85 million dollars of biotechnology R&D expenditure in the 2004 calendar year, which represents 19 percent of total university R&D expenditure (\$455 million).

## 6.3 Biotechnology exports

Exports of biotechnology goods, services, processes, and knowledge for the 2004 financial year were valued at \$108 million.

## Chapter 7

# Human Resources and Recruitment

A full set of statistical tables is available with this report. Please view tables 17 and 18 in conjunction with this chapter.

This chapter examines the headcount and full-time equivalent employment in the biotechnology sector, and shows the types of qualifications held by those employed in the biotechnology sector.

Also included is information on the recruitment of overseas staff by New Zealand organisations. This indicates the locations from which successful candidates were recruited, as well as identifying the likely cause of unsuccessful overseas recruitment bids.

### 7.1 Headcount and full-time equivalents

In 2004, the biotechnology sector (110 organisations) employed 2,464 people in New Zealand. The full-time equivalent of these staff is measured at 2,016 employees.

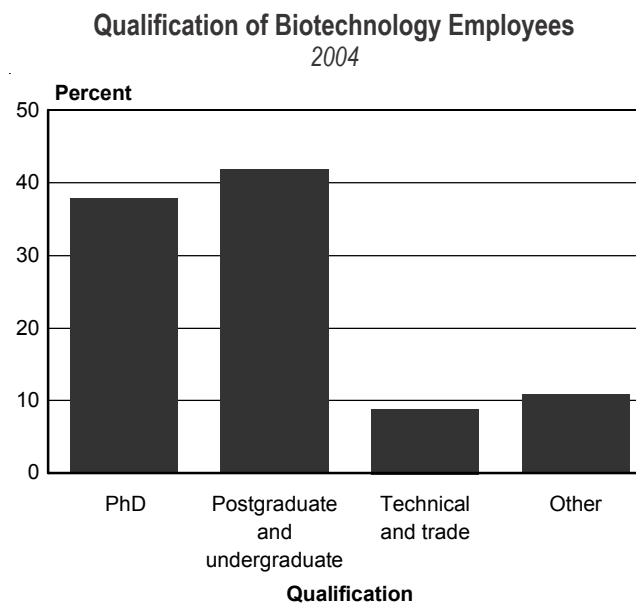
The headcount attributable to the scientific research sector was 1,456, or 59 percent of the total for the biotechnology sector. This is significant as these 1,456 biotechnology employees come from 28 organisations in the scientific research sector.

As at 30 June 2004, there were a total of 68 biotechnology job positions unfilled in the biotechnology sector.

### 7.2 Qualifications of employees

Figure 7.01 shows that a large proportion of employees in the biotechnology sector are highly qualified. Thirty-eight percent of biotechnology employees hold a doctorate, while a further 42 percent hold a postgraduate or undergraduate qualification.

Figure 7.01



### 7.3 Overseas recruitment

Twenty-seven organisations have attempted to recruit biotechnology staff from overseas in the three years to June 2004. Of these, 21 organisations successfully employed staff from overseas.

Of these successful overseas recruitment bids, the majority of applicants came from Europe (44 percent), followed by Australia and the USA, both with 19 percent.

This is very similar to what was seen in the 1998/1999 Biotechnology Survey, when Europe was also the most common source of successful overseas recruitment, followed by the USA and Australia.

Table 7.01

<b>Overseas Recruitment</b>				
<i>2004 and 1999</i>				
Location of successful recruitment	2004		1999 <sup>(1)</sup>	
	Number	Percent	Number	Percent
Australia	9	19	9	19
USA	9	19	12	25
Europe	21	44	15	31
Asia	6	13	6	13
Other	3	6	6	13
<b>Total</b>	<b>48</b>	<b>100</b>	<b>48</b>	<b>100</b>

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

In the three years to June 2004, 18 organisations have had unsuccessful attempts to recruit from overseas. Fifteen of those organisations cited the inability to match overseas salary levels as a contributing factor.

## Chapter 8

# Constraints to Biotechnology R&D

A full set of statistical tables is available with this report. Please view table 19 in conjunction with this chapter.

This chapter examines the constraints that organisations face in New Zealand when conducting biotechnology research and development.

### 8.1 Problems affecting biotechnology R&D

Table 8.01 shows that the most common constraint to biotechnology R&D faced by organisations was access to capital, with 45 organisations seeing this as a problem. The next most common constraints were regulations and lack of information about markets.

This is consistent with the 1998/1999 Biotechnology Survey, where both access to capital and regulations were also the most common barriers to biotechnology R&D.

Table 8.01

**Constraints Affecting Biotechnology R&D**  
2004 and 1999

Constraint	2004		1999 <sup>(1)</sup>	
	Number	Percent	Number	Percent
Access to capital	45	21	96	23
Access to management experts	9	4	27	6
Access to qualified biotechnology research and technical experts	21	10	51	12
Access to suitably experienced biotechnology research and technical experts	24	11	48	11
Access to biotechnology research data and/or information	9	4	21	5
Access to technology	21	10	39	9
Lack of information about markets	27	13	33	8
Regulations	36	17	66	15
Implications of Treaty of Waitangi claims	15	7	21	5
Other	3	1	24	6
<b>Total</b>	<b>210</b>	<b>100</b>	<b>426</b>	<b>100</b>

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.



## Chapter 9

# Technical Documentation

This chapter provides a technical description of the data that has been used to compile this report. It focuses on the data quality and the definitions and processes used for data collection and analysis.

### 9.1 Survey background

The Biotechnology Survey 2004 measures the use of biotechnologies and their uptake. The survey also asked respondents about the characteristics of their organisations, including the use of strategic alliances, information sharing and constraints to biotechnology work.

### 9.2 Data collection

The Biotechnology Survey 2004 was a postal survey of all organisations meeting the population selection criteria. There were two ways in which an organisation could meet the criteria. The first was if certain biotechnology-specific keywords were found to match those in an organisation name on the Statistics New Zealand Business Frame. Statistics New Zealand then supplemented this population with lists from New Zealand Government funding agencies and New Zealand biotechnology associations.

The majority of the questionnaire uses a three-year reference period. Financial information was requested from respondents for the 2004 financial year. The survey was posted out on 1 August 2004.

### 9.3 Target population

The population selection methodology was the same as that used by Statistics New Zealand in the 1998/1999 Biotechnology Survey. The only modifications were the new and updated lists of biotechnology companies received from the Foundation for Research, Science and Technology and New Zealand Biosphere.

The selection unit for inclusion in the population was set at the enterprise level.

#### Criterion 1

The population included enterprises whose predominant activity was likely to be modern biotechnology. This category included:

- a) All enterprises on the Statistics New Zealand Business Frame with any of the following key words in their legal and/or trading names:
  - Bioinformatics
  - Bioprocessing
  - Bioreagent
  - Biotechnology
  - Biotransformation(s)
  - Chromatography
  - Clonal
  - Concentrates
  - Extract
  - Extraction
  - Fluid extraction
  - Functional foods
  - Genetic(s)
  - Genomic(s)
  - Industrial microbiology

- Monoclonal
  - Nutraceutical(s)
  - Proteomic(s)
  - Supercritical
  - Transgenic
- b) Enterprises on the New Zealand Biosphere membership list.
- c) All institutions on the 2003 Foundation for Research, Science and Technology lists of applicants receiving funding to carry out biotechnology-related research and/or development activities.
- d) Local authority sewerage treatment facilities.
- e) All Crown Research Institutes.
- f) University departments that have an interest in biotechnology.
- g) Microbiology units in metropolitan hospitals.
- h) The New Zealand Blood Service.

## **Criterion 2**

The second part of population selection attempted to identify enterprises whose predominant activity was not modern biotechnology, but were considered likely to engage in some modern biotechnology activity. This category includes all enterprises on the Statistics New Zealand Business Frame with any of the following key words in their legal and/or trading names:

- Biological
- Bioscience(s)
- Diagnostics
- Health
- Life science(s)
- Pharmaceutical(s)
- Pharmaceutics
- Science(s)
- Scientific
- Serum

The third part of the population selection process involved selecting all enterprises that have geographical units on the Statistics New Zealand Business Frame with one of the following ANZSIC codes:

- A0301 Forestry
- B1101 Black coal mining
- B1200 Oil and gas extraction
- C2121 Milk and cream manufacturing
- C2122 Ice cream manufacturing
- C2129 Dairy product manufacturing
- C2161 Bread manufacturing
- C2182 Beer and malt manufacturing
- C2183 Wine manufacturing
- C2331 Pulp, paper and paperboard manufacturing
- C2543 Medicinal and pharmaceutical product manufacturing
- C2544 Pesticide manufacturing
- L7810 Scientific research

L7829 Technical services nec

O8431 Higher education

O8611 Hospitals

Enterprises were removed from criterion 2 population selection if they had GST sales of less than \$5 million.

## 9.4 Measurement errors

Given the nature of the data collected, there are limitations on the level of accuracy that can be expected from the Biotechnology Survey 2004. For many enterprises in New Zealand, biotechnology represents only a small portion of their operations, and for this reason it is hard to separate out biotechnology work from other work. Detailed definitions of what should and should not be included as biotechnology were provided on the questionnaire, and phone-in help was available to respondents.

## 9.5 Comparison between the 1999 and 2004 surveys

A number of significant changes have taken place between the running of the 1999 and 2004 surveys. The key changes are described below.

The 1998/99 Biotechnology Survey defined modern biotechnology as “the application of scientific and engineering principles to the processing of material by biological agents and the processing of biological materials to improve the quality of life by isolating, modifying and synthesising the genetic instructions responsible for actual biological processes”. The Biotechnology Survey 2004 adopted the OECD definition of biotechnology, for increased international comparability.

The routing question for defining biotechnology use by an organisation in the 1998/1999 Biotechnology Survey used a list of over 50 biotechnology processes. The Biotechnology Survey 2004 used the OECD list-based definition instead.

The entire 2004 questionnaire was redesigned to adhere to new questionnaire standards at Statistics New Zealand.

Caution needs to be taken when making comparisons between data from the Biotechnology Survey 2004 and the 1998/1999 Biotechnology Survey.

## 9.6 Industry sector breakdown

Throughout this report, industries have been classified to the following industry sectors based on their ANZSIC96 (Australia New Zealand Standard Industrial Classification) code.

The scientific research sector includes enterprises classified to Scientific Research (L7810), and Technical Services (L7829). Crown Research Institutes are classified to this sector.

In this report, universities are included in the education sector.

The manufacturing sector consists of all enterprises with an ANZSIC code of C, and includes both food and non-food manufacturing enterprises.

Table 9.01

Industry Sector Breakdown	
2004	
Sector	ANZSIC96 Description
Education	N8431
Manufacturing	C
Scientific research	L7810
Other	All other ANZSIC codes

## 9.7 Response rate

The target overall response rate for the Biotechnology Survey 2004 was 90 percent. The survey achieved an actual response rate of 94 percent. A sector breakdown of response rates is given below in Table 9.02.

The population for the Biotechnology Survey 2004 consisted of 563 enterprises.

Table 9.02

Sector	Response Rate		
	By sector		
	2004		
	Response rate		
	Sent	Received	Percent
Education	11	10	91
Manufacturing	177	167	94
Scientific research	72	62	86
Other	303	290	96
<b>Total</b>	<b>563</b>	<b>529</b>	<b>94</b>

## 9.8 Imputation

No imputation was conducted for the Biotechnology Survey 2004.

## 9.9 Definitions

**ANZSIC:** Australia and New Zealand Standard Industrial Classification system – NZ version 1996.

**Biotechnology:** The application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

The following list of techniques was published by the OECD in 2004 as an interpretative guide as to what biotechnology includes:

- **DNA - The coding:** genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/ amplification, genetic engineering
- **Proteins and molecules - The functional blocks:** protein/peptide sequencing/synthesis, lipid/ protein glyco-engineering, proteomics, hormones, and growth factors, cell receptors/signalling/ pheromones
- **Cell and tissue culture, and engineering:** cell/tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine/immune stimulants, embryo manipulation
- **Process biotechnologies:** bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurisation, bioremediation, and biofiltration
- **Sub-cellular organisms:** gene therapy, viral vectors.
- **Other:** bioinformatics, nanobiotechnologies, other.

**Enterprise:** A business or service entity operating in New Zealand. It can be a company, partnership, trust, estate, incorporated society, producer board, local or central government organisation, voluntary organisation or self-employed individual.

**Goods and services tax (GST):** Respondents are asked to exclude GST if possible in the financial figures provided in the questionnaire. If they have not, Statistics New Zealand takes out GST to make all enterprises comparable.

**Research and development (R&D):** Research and experimental development comprising creative work undertaken on a systematic basis in order to increase the stock of knowledge. Any activity classified as R&D is characterised by originality. Investigation is a primary objective.

**Statistics New Zealand Business Frame:** A register of all businesses operating in New Zealand.

## Appendix A

**OECD biotechnology classifications**

Area of biotechnology use	Biotechnologies included in the OECD list-based definition
DNA - The coding	Genomics, pharmaco-genetics Gene probes DNA sequencing/synthesis/amplification, genetic modification
Proteins and molecules - The functional blocks	Protein/peptide sequencing/synthesis Lipid/protein glyco-engineering Proteomics Hormones and growth factors Cell receptors/signalling/pheromones
Cell and tissue culture, and engineering	Cell/tissue culture, tissue engineering Embryo manipulation Hybridization Cellular fusion Vaccine/immune stimulants
Process biotechnologies	Bioreactors Fermentation, bioprocessing Bioleaching, bio-pulping, bio-bleaching, biodesulpherisation Bioremediation, biofiltration
Sub-cellular organisms  Other	Gene therapy Viral vectors Bioinformatics Nanobiotechnologies Other

*Appendix B***Area of biotechnology application classifications**

<b>Area of biotechnology application</b>	<b>Specific area of application</b>
Human Health	Diagnostics Therapeutics Gene therapy
Bioinformatics	Genomics and molecular modelling
Agricultural	Plant biotechnology Animal biotechnology Biofertilizers/biopesticides/bioherbicides/ biological feed additives/microbial pest control Non-food applications of agricultural products
Innovative Health and Human Nutrition	Functional foods/nutraceuticals Dairy Baking Brewing/wine production
Aquaculture	Fish health Broodstock genetics Bioextraction
Mining/Energy/Petroleum/Chemicals	Microbiologically enhanced petroleum/mineral recovery (Cleaner) Industrial processing
Forest Products	Silviculture (Cleaner) Industrial processing
Environment	Biofiltration Bioremediation and phytoremediation Diagnostics
Other	Custom synthesis Other

## Statistical Tables

Table 1

**Biotechnology Use by Development Stage**  
2004

Area of biotechnology	Number in development stage			
	R&D	Part of production process	Part of product sold	Total
DNA - The coding	93	27	24	147
Proteins and molecules	123	33	27	183
Cell and tissue culture, and engineering	105	36	27	168
Process biotechnologies	75	66	24	165
Sub-cellular organisms	18	3	0	24
Other	48	9	9	63
<b>Total</b>	<b>465</b>	<b>177</b>	<b>111</b>	<b>750</b>
Percentage				
DNA - The coding	20	15	22	20
Proteins and molecules	26	19	24	24
Cell and tissue culture, and engineering	23	20	24	22
Process biotechnologies	16	37	22	22
Sub-cellular organisms	4	2	0	3
Other	10	5	8	8
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
Total in development stage	62	24	15	100
Number of organisations using biotechnology in last 3 years				129
Number of organisations currently or intending to use in next 3 years				110

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.  
Figures may not sum to totals due to rounding.

Table 2

**Types of Biotechnology Used**  
*Use in previous three years*  
 2004

Type of biotechnology	Overall		R&D development stage	
	Number	Percentage	Number	Percentage
<b>DNA - The coding</b>				
Genomics, pharmaco-genetics	39	5	27	6
Gene probes	48	6	27	6
DNA sequencing/synthesis/amplification, genetic modification	60	8	39	8
<b>Proteins and molecules - The functional blocks</b>				
Protein/peptide sequencing, synthesis	45	6	30	6
Lipid/protein glycoengineering	27	4	18	4
Proteomics	30	4	21	5
Hormones and growth factors	51	7	24	5
Cell receptors/signalling/pheromones	36	5	24	5
<b>Cell and tissue culture, and engineering</b>				
Cell/tissue culture, tissue engineering	69	9	39	8
Embryo manipulation	18	2	15	3
Hybridization	30	4	21	5
Cellular fusion	15	2	9	2
Vaccine/immune stimulants	36	5	21	5
<b>Process biotechnologies</b>				
Bioreactors	33	4	18	4
Fermentation, bioprocessing	93	12	33	7
Bioleaching, bio-pulping, bio-bleaching, biodesulphurisation	15	2	9	2
Bioremediation, biofiltration	27	4	15	3
<b>Sub-cellular organisms</b>				
Gene therapy	9	1	9	2
Viral vectors	12	2	12	3
<b>Other</b>				
Bioinformatics	42	6	33	7
Nanobiotechnologies	15	2	12	3
Other	9	1	9	2
<b>Total</b>	<b>753</b>	<b>100</b>	<b>462</b>	<b>100</b>

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated. Figures may not sum to totals due to rounding.

Table 3

**Biotechnology Use by Sector**  
*Use within previous three years*  
 2004

Type of biotechnology	Sector				
	Scientific research	Education	Manufacturing	Other	Total
	Number of organisations				
<b>DNA - The coding</b>					
Genomics, pharmaco-genetics	18	6	0	9	33
Gene probes	18	6	3	9	36
DNA sequencing/synthesis/amplification, genetic modification	21	9	3	15	48
<b>Proteins and molecules - The functional blocks</b>					
Protein/peptide sequencing, synthesis	15	6	6	6	33
Lipid/protein glycoengineering	12	3	3	0	18
Proteomics	15	6	3	3	27
Hormones and growth factors	15	6	9	12	42
Cell receptors/signalling/pheromones	15	6	0	12	33
<b>Cell and tissue culture, and engineering</b>					
Cell/tissue culture, tissue engineering	24	6	6	15	51
Embryo manipulation	6	6	0	3	15
Hybridization	9	6	0	6	21
Cellular fusion	6	3	3	3	15
Vaccine/immune stimulants	12	6	3	6	27
<b>Process biotechnologies</b>					
Bioreactors	9	6	9	3	27
Fermentation, bioprocessing	12	9	42	6	69
Bioleaching, bio-pulping, bio-bleaching, biodesulphurisation	3	6	6	0	15
Bioremediation, biofiltration	6	6	6	6	24
<b>Sub-cellular organisms</b>					
Gene therapy	6	3	0	0	9
Viral vectors	6	6	0	0	12
<b>Other</b>					
Bioinformatics	18	6	3	6	33
Nanobiotechnologies	3	6	3	0	12
Other	3	3	3	0	9

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Table 4

**New or Significantly Improved Processes and Products**  
*2004*

	New or significantly improved process or product	
	Organisations	Number
<b>Introduced a new or significantly improved process in last 3 years</b>		
New to the world	24	66
New to New Zealand	18	36
New to this business	12	30
<b>Total</b>	<b>33</b>	<b>132</b>
Introduced a new or significantly improved product or service	33	105
<b>Plan to introduce a new or significantly improved product or service in next 3 years</b>	<b>51</b>	<b>258</b>

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Table 5

**Biotechnology Area of Application**  
*2004*

Area of application	Scientific research sector		Overall	
	Number	Percent	Number	Percent
Human Health	27	20	81	20
Bioinformatics	12	9	27	7
Agricultural	36	27	87	22
Innovative Health and Human Nutrition	21	16	72	18
Aquaculture	12	9	33	8
Mining/Energy/Petroleum/Chemicals	0	0	15	4
Forest Products	3	2	12	3
Environment	15	11	54	13
Other	6	4	21	5
<b>Total</b>	<b>135</b>	<b>100</b>	<b>402</b>	<b>100</b>

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated. Figures may not sum to totals due to rounding.

Table 6

**Biotechnology Application**  
2004

Area of application	Overall	
	Number of organisations	Percent
<b>Human Health</b>		
Diagnostics	39	10
Therapeutics	33	8
Gene therapy	9	2
<b>Bioinformatics</b>		
Genomics and molecular modelling	27	7
<b>Agricultural</b>		
Plant biotechnology	24	6
Animal biotechnology	30	7
Biofertilizers/biopesticides/bioherbicides/biological feed additives/microbial pest control additives/microbial pest control	18	4
Non-food applications of agricultural products	15	4
<b>Innovative Health and Human Nutrition</b>		
Functional foods/nutraceuticals	27	7
Dairy	18	4
Baking	6	1
Brewing/wine production	21	5
<b>Aquaculture</b>		
Fish health	9	2
Broodstock genetics	9	2
Bioextraction	15	4
<b>Mining/Energy/Petroleum/Chemicals</b>		
Microbiologically enhanced petroleum/mineral recovery	6	1
(Cleaner) Industrial processing	9	2
<b>Forest Products</b>		
Silviculture	9	2
(Cleaner) Industrial processing	6	1
<b>Environment</b>		
Biofiltration	15	4
Bioremediation	21	5
Diagnostics	18	4
<b>Other</b>		
Custom synthesis	12	3
Other	12	3

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated. Figures may not sum to 100 percent due to rounding.

Table 7

**Purposes of Partnerships and Alliances**  
*2004 and 1999*

Purpose	2004		1999 <sup>(1)</sup>	
	Number of organisations	Percent	Number of organisations	Percent
Product/Process Development	57	35	96	38
Clinical/Field Trial	39	24	48	19
Manufacturing	18	11	27	11
Marketing/Distribution	15	9	30	12
Regulatory Affairs	12	7	24	10
Finance	9	5	9	4
Other	15	9	18	7

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated. Figures may not sum to 100 percent due to rounding.

Table 8

**Partnerships and Alliances in New Zealand**  
*2004*

Type of partner	2004	
	Number of organisations	Percent
Another business	45	33
University	39	28
Crown Research Institute	45	33
Other	6	4

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Figures may not sum to 100 percent due to rounding.

Table 9

**Partnerships and Alliances Overseas**  
*2004*

Location of partner	Type of partner		Total	Percent
	University	Other		
Australia	24	12	36	30
USA	18	15	30	25
Europe	24	12	33	28
Asia	6	9	15	13
Other	3	0	6	5

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Figures may not sum to 100 percent due to rounding.

Table 10

**Formal Arrangements to Share Intellectual Property**  
2004 and 1999<sup>(1)</sup>

Type of partner	In New Zealand		Outside New Zealand		Total	
	Number	Percent	Number	Percent	Number	Percent
<b>2004</b>						
Another business	15	26	18	55	30	33
University	18	32	9	27	27	30
Crown Research Institute	15	26	3	9	18	20
Hospital	3	5	0	0	3	3
Other	3	5	3	9	3	3
<b>1999</b>						
Another business	18	27	18	60	36	38
University	21	32	9	30	30	31
Crown Research Institute	21	32	0	0	21	22
Hospital	3	5	0	0	3	3
Other	3	5	3	10	6	6

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Figures may not sum to 100 percent due to rounding.

Table 11

**Informal Arrangements to Share Intellectual Property**  
2004 and 1999<sup>(1)</sup>

Type of partner	In New Zealand		Outside New Zealand		Total	
	Number	Percent	Number	Percent	Number	Percent
<b>2004</b>						
Another business	42	29	30	40	75	34
University	39	27	24	32	66	30
Crown Research Institute	42	29	9	12	48	22
Hospital	18	12	6	8	24	11
Other	3	2	3	4	9	4
<b>1999</b>						
Another business	63	25	51	52	114	33
University	72	29	39	39	111	32
Crown Research Institute	75	30	0	0	75	22
Hospital	27	11	3	3	30	9
Other	12	5	6	6	18	5

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Figures may not sum to 100 percent due to rounding.

Table 12

**Biotechnology Patents**  
*2004 and 1999*

	Number of patents	
	2004	1999 <sup>(1)</sup>
<b>Year ended 30 June</b>		
Scientific research sector	72	--
All other sectors	45	--
<b>Total</b>	<b>117</b>	<b>56</b>
<b>Five years ended 30 June</b>		
Scientific research sector	271	--
All other sectors	77	--
<b>Total</b>	<b>348</b>	<b>156</b>

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

Table 13

**Problems Associated with Intellectual Property**  
*2004*

	Number of organisations	Number of cases
<b>Work abandoned due to:</b>		
IP rights blocked	24	...
Lack of access to research	15	...
<b>In the three years to June 2004:</b>		
Involved in litigation relating to patent infringements	12	18
Involved in disputes relating to access to research or data	15	24

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Table 14

**Research Publications and Conferences***Year ended 30 June 2004*

	Number of organisations
Published an article on biotechnology in a refereed journal	36
Attended a conference on a biotechnology subject	75
Presented a research paper at a conference on biotechnology	48

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Table 15

**Biotechnology Income and Expenditure<sup>(1)</sup>**  
*By private and public sector*  
 2004

	(\$)million <sup>(2)</sup>
<b>Biotechnology income</b>	
Private sector	507
Public sector	168
<b>Total</b>	<b>675</b>
<b>Biotechnology expenditure</b>	
Private sector	264
Public sector	166
<b>Total</b>	<b>430</b>

(1) Income and expenditure figures exclude university data.

(2) Figures are rounded to the nearest million dollars.

Table 16

**Biotechnology Income and Expenditure<sup>(1)</sup>**  
*By sector*  
 2004

	(\$)million <sup>(2)</sup>
<b>Biotechnology income</b>	
Scientific research	195
All other sectors	480
<b>Total</b>	<b>675</b>
<b>Biotechnology expenditure</b>	
Scientific research	225
All other sectors	206
<b>Total</b>	<b>430</b>

(1) Income and expenditure figures exclude university data.

(2) Figures are rounded to the nearest million dollars.

**Note:** Figures may not sum to totals due to rounding.

Table 17

**Biotechnology Employees by Qualification**  
*2004*

Qualification	Number of employees	Percentage
PhD	940	38
Postgraduate and undergraduate	1,029	42
Technical and trade	214	9
Other	281	11
<b>Total employees</b>	<b>2,464</b>	<b>100</b>
Total FTE	2,106	...

**Note:** Figures may not sum to totals due to rounding.

Table 18

**Overseas Recruitment**  
*2004 and 1999*

Recruitment group	2004		1999 <sup>(1)</sup>	
	Number	Percent	Number	Percent
Organisations with successful recruitment	21	...	27	...
Organisations with unsuccessful recruitment	18	...	7	...
<b>Location of successful recruitment</b>				
Australia	9	19	9	19
USA	9	19	12	25
Europe	21	44	15	31
Asia	6	13	6	13
Other	3	6	6	13
<b>Reason for unsuccessful recruitment</b>				
Inability to match overseas salary levels	15	36	...	...
Personal income taxes too high	0	0	...	...
Immigration rules and procedures	6	14	...	...
Lack of advancement opportunities	6	14	...	...
Loss of professional networks	6	14	...	...
Other	9	21	...	...

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.

Figures may not sum to 100 percent due to rounding.

Table 19

**Constraints Affecting Biotechnology R&D**  
*2004 and 1999*

Constraint	2004		1999 <sup>(1)</sup>	
	Number of organisations	Percent	Number of organisations	Percent
Access to capital	45	21	96	23
Access to management experts	9	4	27	6
Access to qualified biotechnology research and technical experts	21	10	51	12
Access to suitably experienced biotechnology research and technical experts	24	11	48	11
Access to biotechnology research data and/or information	9	4	21	5
Access to technology	21	10	39	9
Lack of information about markets	27	13	33	8
Regulations	36	17	66	15
Implications of Treaty of Waitangi claims	15	7	21	5
Other	3	1	24	6

(1) Data for 1999 was captured in the 1998/99 Biotechnology Survey.

**Note:** All counts in this survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated.  
Figures may not sum to 100 percent due to rounding.



# Biotechnology Survey 2003/2004

☎ Phone: 0800 333 108  
 📠 Fax: 09 920 9195  
 📧 Email: bus@stats.govt.nz  
 ✉ Mail: Statistics New Zealand  
 Freepost 10007  
 Private Bag 92003  
 Auckland

**Are the address details above correct? If not, use the boxes below to correct any errors.**

Contact name	<input type="text"/>	0001
Business name	<input type="text"/>	0002
PO Box number or street number and name	<input type="text"/>	0003
Suburb	<input type="text"/>	0004
City	<input type="text"/>	0005

**Return date:**

Please return this completed questionnaire in the freepost envelope provided by:

**Purpose of this survey:**

The purpose of this survey is to collect statistics to develop an understanding of the use of biotechnology in New Zealand. The statistics collected by this survey will be used to measure the contribution of biotechnology to the New Zealand economy and in the formulation of policies and procedures in support of biotechnology business activity.

**Compulsory requirement:**

The taking of this survey has been approved by the Minister of Statistics and the return of this questionnaire duly filled in and signed is a compulsory requirement under the Statistics Act 1975.

**Confidentiality of information supplied:**

Only people authorised by the Statistics Act 1975 are allowed to see your individual information, and they must use it only for statistical purposes. Your information will be combined with similar information to prepare summary statistics.




Brian Pink  
 Government Statistician

Biotechnology Survey

# Instructions

## 1 How to answer:

- Please write your answers with either a blue or black pen.
- Mark your answers like this: 
- Keep each number or letter within the boxes provided. For example: 

		3	2	1
--	--	---	---	---
- Leave question and answer boxes blank where there is no response.
- Enter zero when the answer to the question is zero.

## 2 Please keep a record of the time it takes to complete this questionnaire. You are asked to record this at the end of the questionnaire.

To help work out your time, you can record your start time here. 

--	--	--	--

### Include:

- The time spent reading the instructions, working on the questions and obtaining information.
- The time spent by all employees in collecting and providing this information.

## 3 Include information only for the organisation named on the front page - do NOT provide consolidated data.

### Exclude:

- Subsidiary or associated businesses.
- Accounting divisions that operate entirely outside New Zealand.

## 4 Survey reference period

Unless otherwise specified, please provide data for the year ended **30 June 2004** OR your last accounting year that ended within the 12 months up to 30 June 2004.

## Definitions

### 5 What is biotechnology?

The OECD defines biotechnology as the application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

The OECD provides the following list of biotechnologies, which can be used as an indicative guide to biotechnology activity.

**DNA - the coding:** Genomics, pharmaco-genetics, gene probes, DNA sequencing / synthesis / amplification, genetic modification.

**Proteins and molecules - the functional blocks:** Protein / peptide sequencing / synthesis, lipid / protein glycoengineering, proteomics, hormones and growth factors, cell receptors / signalling / pheromones.

**Cell and tissue culture and engineering:** Cell / tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine / immune stimulants, embryo manipulation.

**Process biotechnologies:** Bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurisation, bioremediation and biofiltration.

**Sub-cellular organisms:** Gene therapy, viral vectors.

**Other:** Bioinformatics, nanobiotechnologies, etc.

### 6 Development stages

The process of using biotechnology for commercial purposes can be divided into three main stages. These stages are outlined below:

#### Research / product development stage

Refers to the development of biotechnology products, processes and knowledge through research and development (R&D).

This stage includes the testing of processes and products in clinical or field trials.

#### Part of the production stage


The biotechnology product, process, or knowledge is used as an input into another distinct product or process.

#### Part of the product sold stage

The biotechnology product, process or knowledge becomes part of, or the entire final product sold.

### 7 What is research and development (R&D)?

Research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge. Any activity classified as R&D is characterised by originality. Investigation is a primary objective.

 This section asks about the use of biotechnologies by this organisation. Please refer to **6** for the definitions of the development stages.

## DNA - The Coding

**8** Mark all that apply. In the last 3 years, in which development stage(s) has this organisation used the following?

		Research & development	Part of the production process	Part of the product sold	Did not use this biotechnology
i	Genomics, pharmaco-genetics	<input type="radio"/> 0811	<input type="radio"/> 0812	<input type="radio"/> 0813	<input type="radio"/> 0814
ii	Gene probes	<input type="radio"/> 0821	<input type="radio"/> 0822	<input type="radio"/> 0823	<input type="radio"/> 0824
iii	DNA sequencing / synthesis / amplification, genetic modification	<input type="radio"/> 0831	<input type="radio"/> 0832	<input type="radio"/> 0833	<input type="radio"/> 0834

## Proteins and Molecules - The Functional Blocks

**9** Mark all that apply. In the last 3 years, in which development stage(s) has this organisation used the following?

		Research & development	Part of the production process	Part of the product sold	Did not use this biotechnology
i	Protein / peptide sequencing, synthesis	<input type="radio"/> 0911	<input type="radio"/> 0912	<input type="radio"/> 0913	<input type="radio"/> 0914
ii	Lipid / protein glycoengineering	<input type="radio"/> 0921	<input type="radio"/> 0922	<input type="radio"/> 0923	<input type="radio"/> 0924
iii	Proteomics	<input type="radio"/> 0931	<input type="radio"/> 0932	<input type="radio"/> 0933	<input type="radio"/> 0934
iv	Hormones and growth factors	<input type="radio"/> 0941	<input type="radio"/> 0942	<input type="radio"/> 0943	<input type="radio"/> 0944
v	Cell receptors / signalling / pheromones	<input type="radio"/> 0951	<input type="radio"/> 0952	<input type="radio"/> 0953	<input type="radio"/> 0954


## Cell and Tissue Culture, and Engineering

**10** Mark all that apply. In the last 3 years, in which development stage(s) has this organisation used the following?

		Research & development	Part of the production process	Part of the product sold	Did not use this biotechnology
i	Cell / tissue culture, tissue engineering	<input type="radio"/> 1011	<input type="radio"/> 1012	<input type="radio"/> 1013	<input type="radio"/> 1014
ii	Embryo manipulation	<input type="radio"/> 1021	<input type="radio"/> 1022	<input type="radio"/> 1023	<input type="radio"/> 1024
iii	Hybridization	<input type="radio"/> 1031	<input type="radio"/> 1032	<input type="radio"/> 1033	<input type="radio"/> 1034
iv	Cellular fusion	<input type="radio"/> 1041	<input type="radio"/> 1042	<input type="radio"/> 1043	<input type="radio"/> 1044
v	Vaccine / immune stimulants	<input type="radio"/> 1051	<input type="radio"/> 1052	<input type="radio"/> 1053	<input type="radio"/> 1054



## Area of Application

 This section asks about the industry sector and the area of application for which this organisation uses biotechnology.

### Human Health-Bio

**16** Mark all that apply. What area(s) of application best describe the products and / or services produced by this organisation?

- |     |  |                       |      |
|-----|--|-----------------------|------|
| i   | Diagnostics<br>(eg immunodiagnostics, gene probes, biosensors, medical laboratory)   | <input type="radio"/> | 1601 |
| ii  | Therapeutics<br>(eg vaccines, immune stimulants, biopharmaceuticals, rational drug design, drug delivery, combinatorial chemistry) | <input type="radio"/> | 1602 |
| iii | Gene therapy<br>(eg gene identification, gene constructs, gene delivery, gene replacement)   | <input type="radio"/> | 1603 |

### Bioinformatics

**17** Mark the space if this organisation produced products and / or services in the following area of application.

- |   |  |                       |      |
|---|--|-----------------------|------|
| i | Genomics and molecular modelling<br>(eg DNA / RNA / protein sequencing and databases for genetic information from humans, plants, animals and micro-organisms) | <input type="radio"/> | 1701 |
|---|--|-----------------------|------|

### Ag-Bio

**18** Mark all that apply. What area(s) of application best describe the products and / or services produced by this organisation?

- |     |   |                       |      |
|-----|---|-----------------------|------|
| i   | Plant biotechnology<br>(eg tissue culture, embryogenesis, genetic markers, genetic modification)                                    | <input type="radio"/> | 1801 |
| ii  | Animal biotechnology<br>(eg diagnostics, therapeutics, embryo transplantation, genetic markers, genetic modification)               | <input type="radio"/> | 1802 |
| iii | Biofertilizers / biopesticides / bioherbicides / biological feed additives / microbial pest control<br>(eg bacteria, fungi, yeasts) | <input type="radio"/> | 1803 |
| iv  | Non-food applications of agricultural products  | <input type="radio"/> | 1804 |

### Innovative Health and Human Nutrition

**19** Mark all that apply. What area(s) of application best describe the products and / or services produced by this organisation?


- |     |   |                       |      |
|-----|---|-----------------------|------|
| i   | Functional foods / nutraceuticals<br>(eg probiotics, unsaturated fatty acids, unspecified food additives) | <input type="radio"/> | 1901 |
| ii  | Dairy   | <input type="radio"/> | 1902 |
| iii | Baking  | <input type="radio"/> | 1903 |
| iv  | Brewing / wine production   | <input type="radio"/> | 1904 |



## New / Improved Biotechnology work

### 25 In the last 3 years, did this organisation introduce any new or significantly improved biotechnology processes?

Note: Biotechnology processes are a range of techniques employed in biotechnology. Please refer to **5** for an indicative list of biotechnologies.

Yes <sup>2500</sup>  1  How many processes?

2501

No  2  Go to **27**

### 26 How many of these new or significantly improved processes were:

i New to the world?

2601

ii New to New Zealand?


2602

iii New to this business?

2603

### 27 In the last 3 years, has this organisation introduced any new or significantly improved biotechnology products / services?

Note: Biotechnology products are the goods and services produced for research and commercial use through the utilisation of one or more biotechnology processes.


Yes <sup>2700</sup>  1  How many products / services?

2701

No  2

### 28 In the next 3 years, does this organisation plan to introduce any new or significantly improved biotechnology products / services?

Note: Biotechnology products are the goods and services produced for research and commercial use through the utilisation of one or more biotechnology processes.

Yes <sup>2800</sup>  1  How many products / services?

2801

No  2



**32** Mark all that apply. Which of the following overseas organisations did this organisation make partnership(s) / alliance(s) with in the last 3 years?

	Australia	USA	Europe	Asia	Other
i University	<input type="radio"/> 3211	<input type="radio"/> 3212	<input type="radio"/> 3213	<input type="radio"/> 3214	<input type="radio"/> 3215
ii Other organisations, please specify:	<input type="radio"/> 3221	<input type="radio"/> 3222	<input type="radio"/> 3223	<input type="radio"/> 3224	<input type="radio"/> 3225
3226	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Financial and Trade Information

**i** Please provide financial information for total business activity and careful estimates for the percentage of biotechnology activities.

Please report data for the accounting year ended 30 June 2004 or your last accounting year that ended within the 12 months up to 30 June 2004. Do NOT include sales and operations of your subsidiaries located outside New Zealand.

- Supply GST EXCLUSIVE values if possible.
- Supply whole dollar values only.

**33** What is the end-date of the accounting year you will report for?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Day		Month		Year		

3301

**34** The figures given in this questionnaire:

Exclude GST  1

Include GST  2

3401

**35** What is the total income of this organisation?

\$     ,

3501

**36** What is the percentage of total income attributable to biotechnology for this organisation?

%

3601

**37** What is the total expenditure of this organisation?

\$     ,

3701

**38** What is the percentage of total expenditure attributable to biotechnology for this organisation?

%

3801

**39** What is the total value of goods, services, processes and knowledge exported by this organisation?

\$     ,

3901

**40** What is the percentage of goods, services, processes and knowledge exported that are attributable to biotechnology for this organisation?

%

4001



**44** Has this organisation ever had to abandon or not start a biotechnology development activity, because further work was blocked by IP rights or some knowledge protected by another organisation?

Yes  1

No  2 → Go to **46**

4401

**45** Mark as many spaces as you need to show which of the following reasons caused the above:

i Was unable to purchase this IP  4501

ii Was unable to licence this IP  4502

iii Any other reason  4503

**46** Has this organisation ever had to abandon or not start a biotechnology development activity, because further work had been blocked by lack of access to basic research data or information?

Yes  1

No  2

4601

**47** In the last 3 years has this organisation been involved in litigation relating to patent infringements?

Yes  1 → How many different cases?

No  2

4701

**48** In the last 3 years has this organisation been involved in disputes relating to access to research data or information?

Yes  1 → How many different cases?

No  2

4801

## Research Publications and Conferences

**49** In the 12 months ending 30 June 2004, did any staff member of this organisation:

		Yes	No	
i	Publish an article on biotechnology in a refereed journal?	<input type="radio"/> 1	<input type="radio"/> 2	4901
ii	Attend a conference (national or international) on a biotechnology subject?	<input type="radio"/> 1	<input type="radio"/> 2	4902
iii	Present a research paper at such a conference (national or international) on biotechnology?	<input type="radio"/> 1	<input type="radio"/> 2	4903

## Human Resources Supporting Biotechnology

### 50 Please give the number of biotechnology employees (headcount) and their full-time equivalents as at 30 June 2004.

Note: Full-time equivalents may be given to a decimal point.

Full-time equivalent (FTE): Biotechnology may be carried out by persons who work solely on biotechnology projects or by persons who devote only part of their time to biotechnology, and the balance to other activities such as testing, quality control and production engineering. To arrive at the total effort devoted to biotechnology in terms of hours worked, it is necessary to estimate the FTEs of these people working part time in biotechnology.

FTE = Number of persons who work solely on biotechnology projects + the estimate of time of persons working part-time on biotechnology.

Example calculation: If out of five scientists engaged in biotechnology work, one works solely on biotechnology projects and the remaining four devote one quarter each of their working time, the calculation would be:  
 $FTE = 1 + 1/4 + 1/4 + 1/4 + 1/4 = 2 \text{ FTE}$ .

#### Exclude:

- Staff performing indirect support to biotechnology activities
- Central finance or personnel services
- Centralised support services, eg computer departments, security, cleaning, cafeteria etc.

#### Biotechnology employees

i	Headcount as at 30 June 2004	<input type="text"/>	5001
ii	FTEs during the year ended 30 June 2004	<input type="text"/>	5002
iii	Biotechnology positions unfilled as at 30 June 2004	<input type="text"/>	5003

### 51 Please show the highest qualification levels of personnel working on biotechnology as at 30 June 2004.

	Qualification	Headcount as at 30 June 2004	
i	PhD	<input type="text"/>	5101
ii	Bachelor degree or equivalent and postgraduate qualifications other than PhD  For example: Masters degrees and post graduate diploma.	<input type="text"/>	5102
iii	Technical and trade qualifications  For example: NZ Certificate of Engineering and NZ Trade Certificate.	<input type="text"/>	5103
iv	Other qualifications	<input type="text"/>	5104





## Comments and Additional Information

### 58 How long did it take you to complete this questionnaire?

**Include:**

- The time spent reading the instructions, working on the questions, and obtaining information
- The time spent by all employees in collecting and providing this information

hrs   mins

### 59 Comments

Please make any comments that would help Statistics New Zealand interpret the information that you have given.

5901

### 60 Who should we contact if we need to clarify any of the responses you have given?

Name	<input type="text"/>	6001
Position	<input type="text"/>	6002
Email	<input type="text"/>	6003
Phone	<input type="text"/>	6004
Fax	<input type="text"/>	6005

I declare that this questionnaire has been completed to the best of my knowledge.

Signature	<input type="text"/>	Date	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	6006
		Day	Month	Year				

Thank you for your time and effort

[www.stats.govt.nz](http://www.stats.govt.nz) has the main results of all our surveys

08/2004