

A small decorative graphic consisting of a dark grey horizontal bar with a white circular target-like symbol on the left side.

Statistics New Zealand's Framework for Measuring Sustainable Development

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1. Introducing the framework

Statistics New Zealand's Framework for Measuring Sustainable Development defines the concept of sustainable development and provides a basis for selecting indicators to measure progress towards sustainable development.

The framework builds on Statistics New Zealand's previous work on measuring sustainable development – the 2002 publication *Monitoring Progress Towards a Sustainable New Zealand*, and the 2003 *Review of the Monitoring Progress Towards a Sustainable New Zealand Report*.

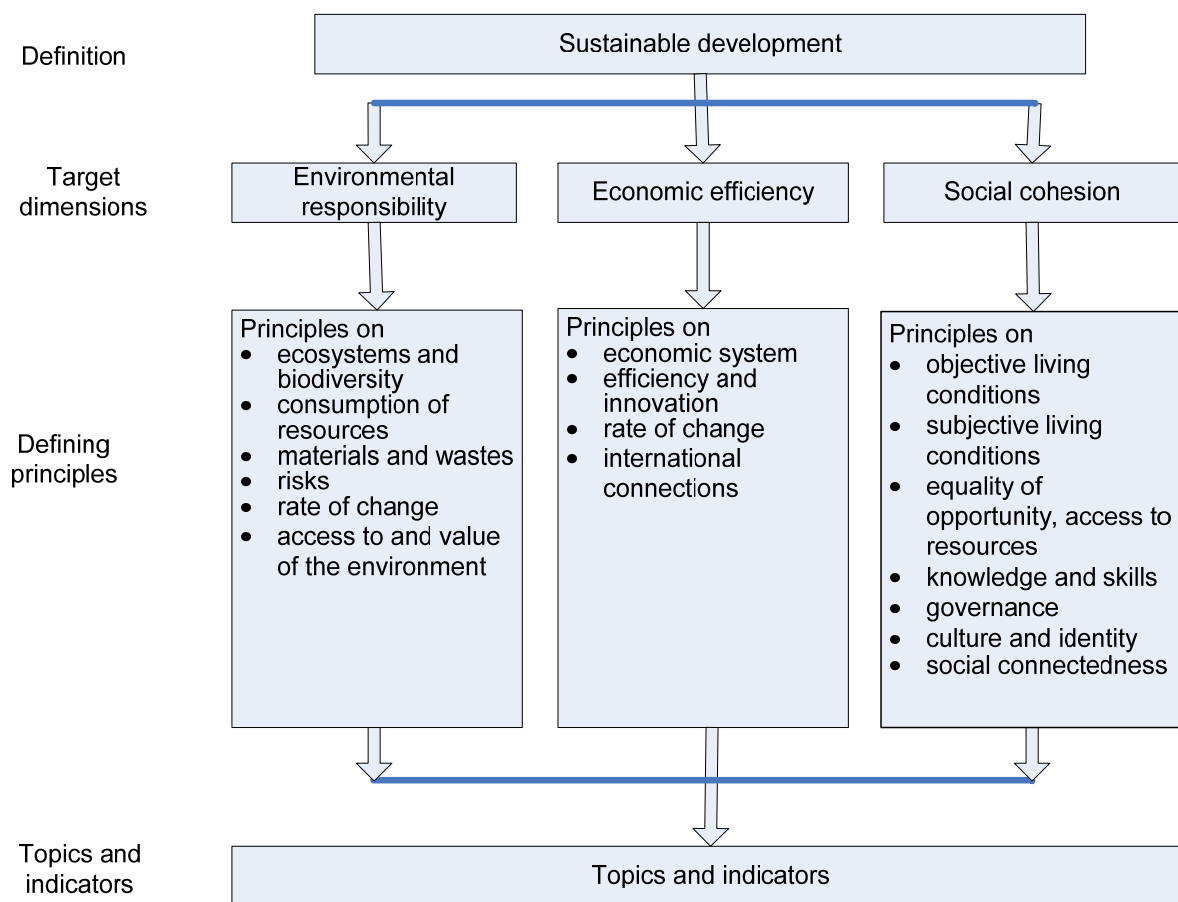
At the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, New Zealand, along with many other nations, adopted the Agenda 21 plan and *Rio Declaration on Environment and Development*. By signing Agenda 21 and the Rio Declaration, New Zealand committed itself to making progress towards sustainable development.

Statistics New Zealand acknowledges the support and assistance of the MONET team at the Swiss Federal Statistical Office in the development of the framework.

1.1 Overview of the framework

Figure 1 shows the framework and how the elements fit together. The target dimensions flow from the definition, and each indicator is linked to at least one of the principles across the target dimensions (see chapter 3 for further explanation of the components of the framework).

Figure 1: The Framework



The framework is based on a capital approach to measuring sustainable development (see appendix 2 for an explanation of this approach). Statistics NZ has been involved in the Working Group on Statistics for Sustainable Development (WGSSD) – a joint OECD, United Nations Economic Commission for Europe (UNECE), and Eurostat international working group. The group, now wound up, produced a report that explores the capital approach as a framework for measuring sustainable development and recommends a small set of indicators for international comparability (WGSSD, 2008). The Statistics NZ framework is also based on the 'MONET' framework developed by the Swiss Federal Statistics Office (Swiss Federal Statistics Office, 2004).

The framework seeks to achieve a balance between being internationally comparable and ensuring it is relevant for the New Zealand context. International comparability will be achieved through incorporating the capital approach as a basis for the framework and selecting indicator types, plus including the core set of indicators recommended by the WGSSD.

Aspects of the framework may change as work on the framework continues.

To find out more about the project, see <http://www.stats.govt.nz/environment/sustainable-development/>.

If you have any questions about the project or want to provide feedback, please email sustainable.development@stats.govt.nz.

2. Definition of sustainable development

The rationale for developing a definition of sustainable development is so the concept of sustainable development can be measured. The definition used in this framework identifies the central ideas we associate with the concept of sustainable development.

These are:

- meeting needs and maintaining options
- principle of fairness between present and future generations
- limits of the environment.

2.1 Our definition

Our definition of sustainable development is:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable development means ensuring that well-being is at least maintained over time. The principle of fairness among and between present and future generations should be taken into account in the use of environmental, economic and social resources.

Meeting these needs in practice requires living within the limits of the natural environment.

2.2 Brundtland definition

The definition used in our framework is based on the Brundtland definition of sustainable development:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987).

See appendix 1 for a discussion on the how we interpreted the Brundtland definition to develop a specific definition as a basis for determining what to measure.

3. The framework

This chapter outlines the components of the framework, as illustrated in figure 1. While chapter 2 described our definition of sustainable development, this chapter puts our definition into practice.

The framework provides the context for selecting indicators to observe and assess progress towards sustainable development. Indicators do not provide information about the whole system, but provide signals about parts of the system. Therefore, effective indicators do not stand alone but should be viewed within the context of our framework.

3.1 Framework approach

If the concept of **sustainability** was being measured, then a purely capital approach could be applied. This would more narrowly focus on whether capital assets are maintained over time. However, a purely capital approach does not adequately consider the concept of **development** and how assets are currently used to meet needs, how assets are distributed, or how efficiently resources are used. Since we are aiming to measure sustainable development, our framework takes into consideration all these issues.

Our framework, based on the MONET framework (Swiss Federal Statistical Office, 2004), combines two methods for setting up indicator systems:

- The **thematic approach** asks which content (with regard to sustainable development) is relevant and should be represented by indicators. This answers the question 'what to measure'. In this framework the thematic approach is applied by including target dimensions, principles, and topics. The United Nations Commission on Sustainable Development approach is also a thematic approach (United Nations, 2001).
- The **procedural approach** focuses on processes and causal connections and represents these in a model. This requires specifying different types of indicators to create a model, which shows the processes that influence sustainable development. This answers the question 'how to measure'. Stock and flow indicators relating to different capital assets (from the capital approach) fall in this category. In this framework the procedural approach is applied through the use of the indicator typology.

Our indicator typology is discussed in chapter 4, and an example of the interaction between the thematic and procedural approach is illustrated in table 5. The rows of the table represent examples of topics and answer the question 'what to measure'. The columns of the table represent the types of indicators and answer the question 'how to measure'. Indicators are selected for each square of the matrix.

3.2 Target dimensions

This framework uses three target dimensions to apply the definition of sustainable development. The role of the target dimensions is to describe what a development path for New Zealand could look like. The dimensions represent what is a complex system, and they reflect the interdependencies between the environment, the economy, and society.

The target dimensions are:

- environmental responsibility
- economic efficiency
- social cohesion.

Each of the target dimensions in this framework has equal importance, reflecting that in the long run none of the dimensions can be achieved at the expense of the others. This is consistent with the notion of meeting needs and maintaining options. For example, economic growth should not compromise the cohesion of society, which could come about if a small group had control of all the productive assets of a country. Similarly, if the environment is preserved to the extent that no economic activity can take place, then this would not be considered development and would threaten social cohesion. The target dimensions therefore reflect the balancing act that needs to take place in order to ensure a development path is sustainable. The target dimensions are not intended to represent a sustainable development strategy, policy goals, or directions.

Environmental responsibility

Environmental responsibility acknowledges the importance of living within the limits of the Earth's resources. This includes both critical levels of natural capital and preserving biodiversity to ensure the maintenance of options for current and future generations. Living within environmental limits means using the natural resources of the planet in such a way that the systems that regenerate them are not damaged beyond repair.

Economic efficiency

Economic efficiency relates to achieving a greater output per unit of inputs, or put another way, achieving the same output with fewer inputs. Efficiency can be expressed in terms of productivity. This is commonly understood in the concepts of capital and labour productivity, and can also be extended to our environment, for example, measuring the intensity of carbon or water use in terms of volumes per unit of value added.

Protecting our environment will require limits to be placed on the resources used. If we are to continue to increase, or even maintain, our standard of living and provide for the material needs of people within these limits we will need to use the resources we have more efficiently.

Social cohesion

Social cohesion refers to how well people can meet their needs in society and maintain levels of unity and harmony within society. Social cohesion is about why a society holds together, rather than falls apart. Levels of unity and harmony within society will be influenced by perceptions of fairness and people's abilities to fully participate in social and civic life. Social cohesion has implications for the ability of a society to work together to achieve long-term goals and respond to changing conditions.

Culture, which is often described as the fourth pillar of sustainability, is included as an element of social cohesion in this framework. For an individual, sense of belonging to a culture and/or sub-culture may enhance well-being, while for a society it is the strength of the connections across distinct sub-populations or groups that impacts on social cohesion.

The three target dimensions relate to managing a portfolio of assets across society, the environment, and the economy. They take into account levels of critical capital and balance the needs of the current generation with maintaining options for future generations.

From each of the three target dimensions, we identified principles that define what sustainable development means in practice.

3.3 Defining principles

The defining principles for sustainable development used in our framework define in more concrete terms what is meant by the target dimensions. The assumption is that if these principles are followed, New Zealand will be further along its path towards sustainable development.

The principles can be differentiated from desired policy outcomes. They are enduring, and the intention is that they remain valid over the long term. These principles can be thought of as axioms, or statements that are regarded as established, generally accepted, or self-evidently true. For example, the principle 'ensuring that the consumption of renewable resources does not exceed their long-term rates of natural regeneration' can be related to fish stocks. Currently we do not know the regeneration threshold of all fish stocks, but despite this, the principle remains valid.

The principles from the MONET framework were used as a starting point for developing the principles for our framework, and reviewed to ensure relevance in New Zealand. International agreements, scientific principles, national policy statements and strategies, regional policy statements, community outcomes, and legislation were researched as sources of principles. The principles described in this chapter are related back to the key ideas from the conceptual definition, especially the maintenance of capital stocks.

Criteria were developed in order to assess the principles. Each of the principles must:

- have a clear and direct relationship to the definition and target dimensions
- be enduring and relevant over time. The principles are geared towards long-term validity.
- be as balanced as possible. While it is not possible to develop principles completely free of value judgements, the principles strive to be neutral and unbiased.

Tables 1, 2, and 3 list and describe the principles used in this framework, grouped by the target dimensions.

Table 1: Principles of environmental responsibility

Principles	Description
Ecosystems and biodiversity	
1a Preservation and protection of biodiversity	Preserving the dynamic diversity of nature, in terms of the health of ecosystems and species, and genetic diversity. Maintaining or restoring viable populations of indigenous species.
1b Maintenance and restoration of the ecological integrity of ecosystems	Safeguarding the natural processes important for the functioning of ecosystems, and the services that ecosystems provide, from adverse impacts of human activities and pests.
Consumption of resources	
2a Limits for renewable resources	Ensuring that the consumption of renewable resources does not exceed their long-term rates of natural regeneration. Using renewable resources efficiently to avoid unnecessary wastage of resources that may be needed by future generations.
2b Limits for non-renewable resources	Ensuring that the activities and functions that currently rely on non-renewable resources are available to future generations. Dependence on non-renewable resources is reduced through technological development or shifts to renewable resources.
Materials and wastes	
3a Limits for degradable waste and toxins	Ensuring that the release of hazardous or polluting substances into the environment does not exceed the assimilative capacity of the environment. Concentrations are kept below established critical levels necessary for the protection of human health and the environment.
3b Avoidance of non-degradable toxins	Ensuring that the release of non-degradable pollutants into the environment is prevented wherever possible.
Risks	
4a Management of biosecurity risks	Ensuring the protection of New Zealand's population, unique natural resources, and plants and animals from damaging pests and diseases.
4b Apply the precautionary approach	Lack of full scientific certainty is not a reason for postponing measures to prevent environmental degradation or restoration of ecosystems where there are threats of serious or irreversible damage.
4c Avoiding irreversibility	Avoiding irreversible adverse effects of human activities on ecosystems and the services they provide.
Rate of change	
5a Taking into consideration the time needed for natural processes	Balancing the rate of human intervention in nature with the time needed for the natural processes required for the environment to respond and regenerate.
Access and value of the environment	
6a Access to the environment for recreation and tourism	Encouraging access to the natural environment for recreation and tourism as long as use is not inconsistent with the conservation of any natural resource.
6b Protection of Māori values and use of the environment	Recognising and protecting Māori values and use of the environment including the practice of kaitiakitanga, customary use, and matauranga Māori (traditional knowledge).

Table 2: Principles of economic efficiency

Principles	Description
Economic system	
7a Economic system meets the needs of society	Ensuring economic activity meets the needs of individuals and society effectively.
7b Maintenance of infrastructure	Ensuring infrastructure is maintained at an acceptable level.
7c Financial position	Limiting the accumulation of debt to a level that does not limit investment options for future generations.
Efficiency and innovation	
8a Investment in innovation	Promoting and investing in research and development activities. Options are created for current and future generations.
8b Economic efficiency	Ensuring resources are used efficiently.
8c Development of knowledge and skills to meets the needs of economic development	Ensuring organisations and individuals have the knowledge and skills to meet the needs of economic development.
Rate of change	
9a Socially compatible rate of change	Ensuring the economic system achieves the needed change without jeopardising social cohesion.
9b Promoting resilience in the economic system	Encouraging a long-term outlook in the economic system to predict risks and adopt sustainable responses.
International connection	
10a World economic activity from which all parties can benefit	Ensuring that through world activity, one nation's needs are met without compromising the needs of other nations.

Table 3: Principles of social cohesion

Principle	Description
Objective living conditions	
11a Meeting needs	Ensuring the basic needs of the population are met over the long term. Individuals can take reasonable actions to meet material and non-material needs that extend beyond basic needs.
11b Promoting health	Protecting and promoting human health.
Subjective living conditions	
12a Satisfaction and happiness	Maintaining and promoting opportunities for the current generation to find satisfaction and happiness in life without compromising the opportunities for future generations.
Equality of opportunity, access to resources	
13a Equal opportunities and access to resources	Ensuring each member of society has the same rights and opportunities. Society strives to achieve an equitable distribution of access to resources and options.

Table 3 continued

13b	Limits to individual freedom	Individual development is limited where it impinges on the well-being of other individuals in current or future generations.
Knowledge and skills		
14a	Development of individual knowledge and skills	Ensuring each member of society has the opportunity to gain knowledge and skills to enhance their well-being and to participate fully in society.
Governance		
15a	Civil and political rights	Protection of civil and political rights.
15b	Civic and political participation	Civic and political participation is promoted.
15c	Government effectiveness	Ensuring government functions in an open, effective, fair, and accessible manner.
15d	Partnership between Māori and government	Strengthening partnership between Māori and the New Zealand Government as recognised by the Treaty of Waitangi.
International assistance		
16a	Development cooperation	Providing assistance to developing countries to move toward sustainable development, particularly in the Pacific.
Culture and identity		
17a	Historic heritage	Protecting and promoting New Zealand's historic heritage.
17b	Cultural diversity	Ensuring cultural diversity is freely expressed, respected, and valued.
17c	Cultural identity	New Zealanders have a strong sense of identity based on their distinct heritage and cultures.
17d	Māori cultural identity	Recognising and valuing Māori culture as an essential and unique element of New Zealand culture.
Social connectedness		
18a	Social participation	Social participation is promoted.
18b	Integration of disadvantaged groups	Promoting the integration of disadvantaged groups of the population into economic, social, cultural, and political life.

Reference point for indicators

The principles provide a reference point for the indicators. The observed trends for each indicator are compared with the principles, and an assessment is made on the sustainability of the observed trends. An indicator can relate to more than one principle. In the MONET framework, for example, the water use indicator relates to the principle of meeting needs and the principle of limits for renewable resources.

3.4 Topics and indicators

The topics in the framework are areas of interest or themes that are important for sustainable development. Each topic relates to one or more of the target dimensions. For example, the transport topic relates to environmental responsibility, economic efficiency, and social cohesion.

A small number of indicators are then selected for each topic. Each indicator is related to at least one principle, and the observed trends are assessed against these principles. The

links between the target dimensions and principles with the topics and indicators reflect the interdependencies between the economy, society, and the environment.

The 16 indicator topics are:

- population
- atmosphere
- biodiversity
- culture and identity
- economic resilience
- energy
- governance
- health
- innovation
- land use
- living conditions
- social connections
- transport
- waste
- water
- work, knowledge, and skills.

4. Indicator typology

The indicator typology describes the types of indicators that are used in the framework. Our indicator typology follows the procedural approach to measurement, described in chapter 3.1, which focuses on 'how to measure'.

4.1 Types of indicators

Four types of indicator are used in this framework:

- stock
- flow
- level
- structural criteria.

The purpose of having these types is to create as complete a model as possible of the processes that influence sustainable development. Different types of indicators provide different messages, and together they provide a fuller picture of the situation.

Two of the four indicator types are based on a stock-flow model. Capital stock and flow indicators derive from the capital approach to measuring sustainable development (see appendix 2 for further explanation of the capital approach).

Level indicators have been included, as they capture the benchmark and the degree to which the needs of individuals and society are met. Structural criteria capture the two aspects of sustainable development that are not captured by capital stock and flow indicators: efficiency and disparity in access to capital. These criteria are derived from our definition of sustainable development – efficiency relates to the efficient use of resources and disparity in access relates to the notion of fairness.

Table 4 shows what the four types of indicator measure.

Table 4: Indicator types

Type of indicator	The question the indicator answers in relation to meeting a particular need	Description of the indicator	Value measured
Stock (S)	How much resource (capital) is available to satisfy a particular need?	To be able to meet the needs described by the level indicators, appropriate provision of natural, economic, and social resources (capital) is required. In this context, capital is defined broadly, and includes produced, natural, human, and social capital. Capital stocks refer to the measurable quantity of a resource that is both accessible and available for use at a particular moment in time.	Capital stocks are measured using physical quantities or monetary measures. These may be represented as absolute values (drinking water supply, newspaper circulation figures) or relative values (proportion of threatened species, hospital beds per capita).
Flow (F)	To what extent does the capital appreciate/ increase or depreciate/ diminish?	Meeting the needs (described by level indicators) generally requires consumption of capital and often produces emissions (negative flows). Conversely, measures are taken to maintain or improve total capital (eg in the form of net investments in the economy or environmental protection measures). Flows have positive or negative effects on capital.	Flow indicators measure the activities (flows) that cause changes in stocks (additions or reductions) from one period to the next. They are described in terms of input and output flows. They may be represented as absolute values (eg greenhouse gas emissions in tonnes) or relative values (eg proportion of GDP spent on education, phosphorus input per hectare).
Level (L)	To what extent is a human need met?	Level indicators provide a starting point or benchmark to assess the extent to which human needs are met.	Level variables are measured on a per capita basis.
Structural criteria (T)	To what extent is capital being used in a socially responsible and efficient manner?	Structural criteria are: <ul style="list-style-type: none"> • Economic, environmental, and social efficiency. For example, fuel consumption per 100km is an indicator of environmental efficiency. • Disparities: These relate to the distribution of met needs and capital between various population groups (age, ethnicity, sex etc) or between different regions. 	Efficiency is always expressed as a relative variable (eg nitrogen oxide emissions per km) or defined as a proportion (eg proportion of journeys made using public transport). The description of disparities can be broken down by population group (eg proportion of women completing tertiary education) or region (eg regional economic output).

The indicator typology is a guide for selecting specific indicators, rather than a strict framework. This means that:

- it is not necessary to select all four types of indicators for each topic if it doesn't make sense to do so
- it is not possible to allocate each specific indicator unambiguously to one type of indicator
- a causal relationship (as in the transport example above) between the individual indicators of a topic area is desirable, but not essential.

4.2 Examples of indicators

Using different types of indicators for one topic provides a fuller picture and allows more complex statements to be made relating to sustainable development, see table 5 for examples. An example from the transport topic is useful to illustrate how the indicator typology works. A decrease in nitrogen dioxide emissions per kilometre (S) would show an increase in efficiency. However, if the total emissions from road traffic (F) increased, because the total kilometres per capita (L) had increased, then the increase in growth would be greater than the increase in efficiency, and this would result in a negative change overall.

Table 5: Examples of indicators by type

Type of indicator	Level (L)	Stock (S)	Flow (F)	Structural criteria (T)
Topic				
Soil	Living space per person	Proportion of undeveloped land	Annual soil sealing	Population density factor
Education	Measurement of skills Average schooling	Total library provision Number of places in tertiary education	Annual lessons Ratio of education spending to GDP	Proportion of women completing tertiary education
Mobility	Annual per capita distance traveled in km	Number of private motor vehicles Public transport infrastructure (eg number of kms of track)	Per capita fuel consumption in road transport	Modal split (proportion of annual per capita distance traveled on public transport in km) Average fuel consumption per 100kms

Note: These are hypothetical indicators, rather than the actual indicators that exist or will be used.

Appendix 1: Interpretation of the Brundtland definition

This appendix discusses our conceptual definition of sustainable development and interpretation of the Brundtland definition in more detail. The rationale for providing a definition of sustainable development in the framework is so the concept can be measured.

Defining sustainable development

The definition of sustainable development used in this framework is:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable development means ensuring that well-being is at least maintained over time. The principle of fairness within and between present and future generations should be taken into account in the use of environmental, economic and social resources.

Meeting these needs in practice requires living within the limits of the natural environment.

This definition expands on the Brundtland definition which was adopted at the World Commission on Environment and Development in 1987 (it is commonly referred to as the Brundtland definition after the chair of the commission):

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The Brundtland definition is anthropocentric – it places humans as the focus of attention.¹ The definition also requires the needs of the present generation to be balanced with the needs of future generations. Therefore, the maintenance of options for current and future generations to meet their needs is an important element of sustainable development.

Sustainable means 'durable', 'can be continued', or 'lasting'. This implies that sustainable development is development that can be continued into the future. The challenge of the concept is less with the word 'sustainable' but with the word 'development' (Pearce & Warford, 1993 in WGSSD, 2008, paragraph 87). Development is usually seen as a positive change. However, whether a change is thought to be positive or negative involves value judgements, and can change over time and according to differences in perspectives (WGSSD, 2008, paragraph 89). Development is different from growth. Growth entails an increase in physical variables, whereas development includes both qualitative and quantitative features.

¹ There are essentially two starting points for viewing sustainable development. The anthropocentric view places human needs as the starting point and environment protection as necessary in that it contributes to human well-being. This aligns with the first principle of the Rio Declaration, which states that "human beings are at the centre of concerns for sustainable development," (UNCED, 1992). On the other hand, the physiocentric view focuses on the protection and conservation of the environment for its own sake, irrespective of its utility to humans.

Meeting needs and maintaining options

Individuals and society derive well-being from the total wealth of a country, where the total wealth encompasses a range of capital assets and is broader than just financial wealth. These assets generate a stream of benefits over time, which contribute to the well-being of individuals and society.² These capital assets can be categorised as natural, human, produced, and social capital (for a more detailed discussion of the capital approach, see appendix 2).

Capital assets are therefore integral to meeting needs. Maintaining and managing them in a way that preserves options over time to ensure a non-declining level of well-being is a necessary condition of sustainable development.

The capital approach allows us to examine the maintenance of options for meeting needs in two ways.

- **Weak sustainability** is where one type of capital stock can be replaced or substituted by another. An often cited example is produced and human capital being substituted for natural capital, such as when technological advancement has allowed substitution of scarce resources with those that are more abundant. Weak sustainability implies that the sum of all capital assets must be maintained, rather than individual stocks of capital (WGSSD, 2008, paragraph 261). However, this also assumes a level of certainty about each capital stock that does not really exist.
- **Strong sustainability** is where produced, natural, social, and human capital are not regarded as freely interchangeable and each type of capital stocks should be maintained. It is assumed that substitution possibilities among capital stocks are limited, because some of the forms are considered critical and cannot be substituted for (WGSSD, 2008, paragraph 262).

The debate over weak and strong sustainability relates to the degree to which capital stocks can be substituted for each other. A key point in this debate is that some forms of capital are considered 'critical' – they are not substitutable as they provide a stream of benefits that are essential and for which no known substitute exists. This relates to the fact that Earth has a finite carrying capacity, and we must live within these limits. An example of a critical natural asset is a reasonably stable climate. If the climate is destabilised, the basis for our civilisation in the long run may be threatened in a fundamental sense, almost irrespective of our material wealth (WGSSD, 2008, paragraphs 256–259).

Critical capital is generally associated with forms of natural capital, however it can be argued that there is a critical level of social capital that is essential in order to maintain development in the long term.

Meeting needs and maintaining options can be characterised as managing a portfolio of assets. In managing these assets, we must take into account that there may be limits to the amount of substitutability, which has implications for the options available to future generations.

² There are many definitions of well-being and debate around its determinants. The *Social Report* defines social well-being as those aspects of life that society collectively agrees are important for a person's happiness, quality of life and welfare (Ministry of Social Development, 2007, p4). Welfare has a more specific definition in economics, which relates to the benefits of consuming goods and services over time.

The requirement to maintain or increase well-being over time is included in the conceptual definition of sustainable development. Well-being is a term that is familiar in the New Zealand context, and the link between well-being and sustainable development is explicit in the Local Government Act 2002, which in part 1, chapter 3 refers to the role of local authorities in “promoting the social, economic, environmental, and cultural well-being of communities, taking a sustainable development approach”.

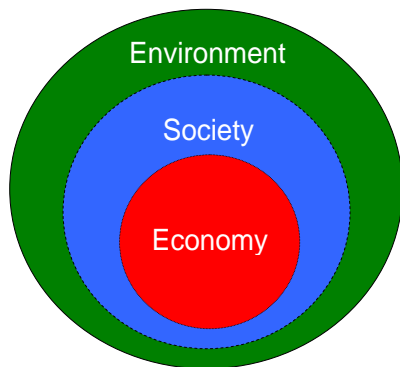
Fairness within and between generations

The Brundtland definition refers to balancing the entitlement of the present generation to meet their needs, with the ability of future generations to meet their needs. ‘Present generation’ refers to those who are alive today; ‘future generations’ are those who are not yet born. The goal of sustainable development is to ensure the availability of options for both those currently living and for future generations to meet their needs. One is not to be achieved to the detriment of the other. Therefore, the principle of fairness, both between and within current and future generations, is included in the definition. Future generations should have the same options as the present generation, and should not be limited by the consequences of actions of the present generation.

Limits of the environment

There is a strong relationship between meeting human needs now and into the future, and living within the limits of the environment. Figure 2: Relationship between the environment, society, and the economy, represents that people are at the centre of concern for sustainable development, and that both society and the economic activity within it are constrained by the natural systems of the Earth.

Figure 2: Relationship between the environment, society, and the economy



The functions provided by the natural environment can be divided into three groups: resource functions, sink functions, and ecosystem services. Resource functions are the natural resources used by humans. Sink functions are the ability of the natural environment to absorb waste and pollution caused by human activities (United Nations, European Commission, International Monetary Fund, OECD, & World Bank, 2003).

Ecosystem services refer to resources and processes that are provided by ecosystems. Ecosystem services encompass **supporting** services such as soil formation and nutrient cycling, **provisioning** services such as production of food and clean water, **regulating** services such as regulation of climate and disease, and **cultural** services such as spiritual

and recreational benefits obtained from ecosystems (Millennium Ecosystem Assessment, 2003).

Biological diversity (biodiversity) is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species, and of ecosystems (Convention on Biological Diversity, 1992). Biodiversity and ecosystems are closely related concepts. Products of biodiversity include many of the services produced by ecosystems and changes in biodiversity can influence all the other services they provide (Millennium Ecosystem Assessment, 2003). Ecosystems and the biological diversity contained within them provide a stream of goods and services, the continued delivery of which remains essential to our well-being (Defra, 2008).

Appendix 2: The capital approach

Overview of the capital approach

The capital approach to measuring sustainable development borrows the concept of capital from economics, and broadens it to include other elements that are relevant to human well-being.

The term 'capital' was first used in economics to describe assets that enable future economic production, such as buildings and machinery. Capital assets are capable of generating income and have themselves been produced. All goods and services can be viewed as being produced through the use of capital, normally in conjunction with human labour. The capital approach, therefore, analyses assets or capital goods as means of production that will produce a flow of services into the future.

In sustainable development literature, this notion of capital has been broadened to include four types of capital – financial and produced capital, natural capital, human capital, and social capital. These capital assets make up the national wealth of a country, which is the total resource base of a nation. Capital assets in this broader sense can be defined as resources that generate a flow of goods and services that enhance well-being over time.

As streams of benefits flow from capital assets, maintaining or enhancing stocks of capital is a necessary condition for sustainable development. The stock of capital that is currently used to meet the needs of the present generation should be passed on to the next generation intact or enhanced.

The concept of leaving capital intact relates to the Hicksian definition of income: income is the maximum amount an individual can consume during a period and remain as well off at the end of the period as at the beginning (Hicks, 1946). This definition can be applied to the total resource base of a nation. The income of a nation is the amount that it can collectively spend during a period without depleting the capital base upon which it relies to generate this income (United Nations, European Commission, International Monetary Fund, OECD & World Bank, 2003, paragraphs 1.18–1.20).

Description of types of capital

Produced and financial capital

Produced capital includes fixed assets that are used repeatedly or continuously in production processes for more than one year. Fixed assets can be tangible, such as machinery, buildings, roads, harbours and airports, and intangible, such as computer software, original works of artistic value, intellectual property, and other specialised knowledge used in production (WGSSD, 2008, paragraphs 222–226).

Financial capital includes assets and liabilities that have a degree of 'liquidity' and tradability as a discrete store of value. They come in many forms and include currency, deposits, debt, company shares, government bonds, and other financial instruments. Financial capital may further be defined as an asset for which a counterpart liability exists (WGSSD, 2008, paragraph 222).

Natural capital

Natural capital refers to Earth's natural resources, land, and the ecological systems that provide life-support and other services to society and all living things. This broad category covers both non-renewable natural resources (such as land, coal, oil and gas, minerals, and gravel) and conditionally-renewable resources (such as forests, fish, and water flows used for hydro power production). In addition, natural capital covers ecosystems and other natural systems that provide various essential services to humans. Examples are: nature's absorptive capacity for waste products that otherwise would cause pollution damages, and recreational services provided by the environment (WGSSD, 2008, paragraphs 227–234). Ecosystems have the ability to renew and maintain themselves, depending on conditions, both in terms of their components (eg species), and functions (the interaction between species and with the physical environment, eg the conversion of sunlight into energy stored in food).

Human capital

Human capital is “the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic wellbeing” (OECD, 2001, p18). The economic importance of knowledge and skills is widely recognised within labour economics (for individuals' income), growth theory, and business. At the same time, the personal well-being effects and social effects of learning are considered by many to be as important as the economic effects (WGSSD, 2008, paragraphs 235–241).

Social capital

The most commonly adopted definition of social capital is the OECD definition: “networks, together with shared norms, values and understandings which facilitate co-operation within or among groups” (OECD, 2001b). Like other forms of capital, social capital generates benefits that improve well-being. The benefits can be grouped into those associated with institutions and those associated with culture. The former includes the rule of law and administration of justice, universal suffrage, transparency of political processes, and international conventions and agreements. The latter includes language, religion, and sports.

The assets of social capital are the networks and associated norms, such as shared understandings and informal rules that influence behaviour. Networks link individuals, groups and institutions, and occur in a variety of different modes and forums, including face-to face meetings, legislation and technology-assisted transmission of information. Improved social capital produces positive outcomes, such as identity and a sense of belonging, increased knowledge and understanding, community resilience, and lowering of transaction costs. A lack of social capital results in negative outcomes, such as social exclusion or intolerance of difference, reduced family functioning and corruption (WGSSD, 2008, paragraphs 242–249).

Networks can be classified into three types (bonding, bridging, and linking) and function across two social planes (horizontal and vertical). Bonding networks connect similar and equal individuals, groups, or institutions (horizontal plane). Bridging networks connect dissimilar people at the same level (horizontal plane). Linking networks connect individuals, groups, and institutions to authority (vertical plane) (WGSSD, 2008, paragraph 387).

Two other forms of capital that are sometimes discussed are institutional capital and cultural capital. In this framework, they are treated as a subset of social capital for the reasons given below.

- **Institutional capital**

Institutional capital is “the range of formal and informal civic, political and legal arrangements that underpin market activity and civic life” (adapted from OECD, 2001b). Institutional capital relates to both formal networks and processes, such as the legal system and democratic participation, as well as informal elements. Institutional capital is related to the concept of ‘linking networks,’ described above, which connects individuals and groups to authority.

- **Cultural capital**

Culture is considered to be an integral part of sustainable development in New Zealand. Cultural capital is defined as “the set of values, history, traditions and behaviours which link a specific group of people together” (Spellerberg, 2001). The concept of cultural capital and how it relates to sustainable development will be explored further in a collaborative Official Statistics research project between Statistics New Zealand and researchers from the Agribusiness and Economics Research Unit at Lincoln University.

Glossary of terms

Capital assets	Resources that generate a flow of goods and services that enhance well-being over time.
Critical capital	Capital assets that are not substitutable as they provide a stream of essential benefits for which no known substitute exists.
Eurostat	Eurostat is the Statistical Office of the European Commission.
Flows	Activities that cause changes in stocks (additions or reductions) from one period to the next. Flows are a record of resource production and consumption.
Indicator typology	Describes the four different types of indicators used in the framework: stock, flow, level, and structural criteria indicators.
Inter-generational justice	The entitlement of future generations to meet their needs.
Intra-generational justice	The entitlement of the present generation to meet their needs.
MONET framework	The framework developed to measure sustainable development as a collaboration between the by the Swiss Federal Statistical Office, the Swiss Agency for the Environment, Forests and Landscape, and the Swiss Federal Office for Spatial Development.
OECD	Organisation for Economic Co-ordination and Development.
Stocks	The measurable quantity of a resource that is both accessible and available for use at a particular moment in time.
Strong sustainability	Strong sustainability assumes that substitution possibilities among capital stocks are limited, even in the face of technological progress, because of the critical nature of some services. It therefore demands that there be minimum levels below which stocks of critical capital not be allowed to fall (WGSSD, paragraph 262).
Sustainable development	Defined in this framework as: Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development means ensuring that well-being is at least maintained over time. The principle of fairness among and between present and future generations should be taken into account in the use of environmental,

economic, and social resources.

Meeting these needs in practice requires living within the limits of the natural environment.

Weak sustainability

The total per capita value of all capital stocks, or total national wealth per capita, should not decline over time in real terms. Weak sustainability incorporates an assumption of perfect substitutability between the various stocks of capital (WGSSD, paragraph 261).

Working Group for Statistics on Sustainable Development (WGSSD)

Joint OECD, UNECE, and Eurostat international working group that Statistics New Zealand has been involved in.

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