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PRODUCTIVITY COMMISSION

Genetically Modified Products: A Consumer Choice Framework

Staff Working Paper

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Preface

Rapid growth in the development and application of genetically modified (GM) products, particularly in agriculture and medicine, has generated considerable public debate in recent years. Along with these developments, there has been debate over policy issues relating to consumer choice, public health and safety, environmental management, the competitiveness of some Australian industries, international trade and intellectual property.

The aim of this paper is to use an economic framework to consider policy issues relating to GM products and consumer choice, and to review briefly some of the advantages and disadvantages of several policy options in the context of facilitating consumer choice and improving community welfare. As a staff working paper the focus is on examining the analytical issues relevant to policy consideration rather than on specific policy assessments or recommendations.

The paper was written by Andrew Dolling and Deborah Peterson. Paula Holland and Ann Jones made useful contributions, especially to earlier drafts. Helpful comments were made by Dr Neil Byron, Mrs Helen Owens, Dr Lynne Williams, Professor Ian Wills, and Dr Els Wynen (Eco Landuse Systems). Vicki Thompson provided valuable administrative assistance.

The views expressed in this paper are those of the authors and do not necessarily reflect those of the referees or the Commission.

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ANZFA	Australia New Zealand Food Authority
BSE	Bovine spongiform encephalopathy ("mad cow disease")
DES	diethylstilbestrol
EU	European Union
FAO	United Nations Food and Agriculture Organisation
GM	Genetically modified
GMAC	Genetic Manipulation Advisory Committee
GMOs	Genetically modified organisms
GTR	Gene Technology Regulator
IBC	Institutional Biosafety Committee
IOGTR	Interim Office of Gene Technology Regulator
NFF	National Farmers Federation
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
OECD	Organisation for Economic Co-operation and Development
OGTR	Office of Gene Technology Regulator
ORR	Office of Regulation and Review
R&D	research and development
TGA	Therapeutic Goods Administration
WHO	World Health Organisation
WTO	World Trade Organization

Overview

Recent growth in the development and application of genetically modified (GM) products has attracted considerable public attention and debate in Australia and overseas. GM products can offer potentially significant benefits for Australia, but concerns have also been raised. Reflecting these potential benefits and concerns, Australian governments have been reviewing the various implications of GM products for Australia, and developing policy responses. This paper presents an economic framework to examine issues related to GM products and consumer choice, and briefly reviews several policy options.

Background

GM products are produced using modern gene technology. They are used in a wide range of applications in agriculture, medicine and pharmaceuticals, environmental management, and industrial and manufacturing processes.

Examples and uses of GM products

The use of GM crops has grown rapidly in recent years, with worldwide sales of such crops increasing from around US$75 million in 1995 to between US$2100 million and US$2300 million in 1999 (James 1999). The United States is the largest grower, accounting for 72 per cent of the world's total area of GM crops in 1999. The most widely cultivated GM crops are soybeans, corn, cotton and canola.

Australia's production of GM crops has been relatively modest — accounting for around 0.25 per cent of the world's total area of GM crops in 1999 (James 1999) — and has consisted almost entirely of GM cotton modified to be more insect resistant. Nevertheless, other GM crops are under development or on trial in Australia, including canola, wheat, peas, grapevine, barley, potatoes and sugarcane. Moreover, while Australia's production of GM crops is relatively small, many food products sold in Australia include imported GM ingredients.

So far most applications of GM crops have been aimed at providing agronomic benefits to farmers, such as increased resistance to pests or herbicide chemicals. The

next phase of GM crops is expected to offer benefits more directly relevant to consumers, such as low fat oils and low allergy nuts.

Other examples of GM products include:

- medical and pharmaceutical products such as human insulin, growth hormones, hepatitis B vaccines and several types of blood clotting products;
- products to help environmental management tasks such as cleaning oil spills, treating contaminated water and land, converting waste into energy, and controlling feral animals; and
- industrial products made from plants to replace those made from non-renewable chemicals.

The debate

For some, the use of gene technology represents just another step in the ongoing process of improving production techniques. However, others see its use as a fundamental change in the way in which products are made, with social, economic, environmental and ethical implications that require different oversight arrangements from those used for conventional production methods.

Features of GM products that have contributed to the debate include:

- the pace and scope of possible genetic changes — which can include the transfer of desired gene traits across distantly related species not normally achievable under traditional breeding techniques;
- actual and perceived uncertainty about some health and environmental effects;
- the 'invisibility' of many genetic modifications such that consumers cannot easily detect whether a product has been genetically modified;
- the potential irreversibility of effects (particularly environmental effects); and
- ethical, cultural and social issues that concern some people or the community as a whole.

A central issue has been the amount and quality of information available to help consumers make informed decisions about GM products. Consumers' ability to choose between GM and non-GM food products at the point of sale has been a particular concern. The health and environmental implications of GM products have also been frequently questioned, with arguments made about potentially positive

and negative effects. Further issues have related to the competitiveness of some Australian industries, international trade, intellectual property, and the potential concentration of ownership in food production.

An economic framework for analysing consumer choice

Consumers' purchasing choices about GM products are likely to reflect preferences for and perceptions of risk, among other matters. Consumers' risk perceptions can depend on factors such as the size of perceived benefits; whether risks are unknown or known, and imposed involuntarily or voluntarily; and whether the regulatory process relating to GM products is consultative, transparent and independent. Consumer decision making is also likely to reflect ethical, cultural and social preferences.

Consumers may therefore seek information on a broad range of issues in making choices about GM products. Information needs, and final choices regarding GM products, are likely to vary across consumers, reflecting different risk perceptions and preferences, and ethical, cultural and social preferences.

Potential impediments to consumer choice and individual preferences

Market outcomes may not always adequately reflect individual preferences. Information problems in the market, for example, may mean consumers are unable to make decisions that accord with their preferences. Potential information problems include:

- inadequate information on, and understanding of, GM processes and products;
- information biases;
- a lack of credibility or trust in information available; and
- constraints on consumers' capacity to process, understand and use information that is available.

However, even if consumers have difficulty in obtaining and processing information by themselves, this does not necessarily mean government action is required. Collecting and processing information is rarely costless, and market inefficiency does not exist simply because there is less than perfect information.

Further, consumers may be able to use information provided by producers or third parties (including industry associations or community groups). Producers or third parties may provide voluntary labels, private accreditation systems or other forms of

direct information. However, there are limitations to these sources of information. Producers, for example, may not provide negative information about their products, and third parties may not provide adequate information if they cannot sufficiently recoup the costs of providing it from users of the information.

Another reason for market outcomes sometimes not reflecting individual preferences is that individuals may be affected by other people's choices over which they have no control or influence. These problems are often referred to as 'externalities' or 'spillovers'. The result is that the level of consumption chosen by private individuals may not be optimal from the community's point of view.

Three possible sources of spillovers related to GM products include:

- health spillovers — whereby consumers may not face the full costs or benefits of their decisions in relation to their health decisions, perhaps because the public health and tax system absorbs these costs and benefits;
- psychological spillovers — whereby consumers may not account for the negative or positive psychological (and associated welfare) effects of their consumption of GM products on others, and may even breach community ethical standards or norms; and
- environmental spillovers — whereby consumers may not account for the positive or negative environmental impacts of their decisions about GM products.

Roles for government

Where information for consumer choice is significantly impeded, or spillover effects on community welfare exist, government initiatives may be warranted to facilitate consumer choice and improve community welfare. However, government action should only proceed where the anticipated community benefits outweigh the costs.

Government action may also fail to promote community welfare in desired ways if information available to policy makers is inadequate, policies fail to adjust over time, coordination across government agencies responsible for policy action is poor, or interest groups have an undue influence on the policy making process. Any assessment of government action relating to GM products should therefore include a rigorous analysis of policy options, including a comparison of expected community wide costs and benefits, within a transparent and independent policy making framework. Such policy making processes can also maintain consumers' confidence that they can rely on the results of government action.

Policy options

Governments have a range of policy options for addressing potential impediments to consumer choices and community welfare associated with GM products. These include information programs, labelling schemes, licensing schemes, product standards, and moratoriums and bans. Governments in Australia have been considering and implementing many of these approaches.

Information programs and labelling schemes

Government information programs can assist public awareness and understanding of GM products, and thereby help facilitate consumer choice and inform public debate and policy making. Government involvement in the collection and distribution of information about GM products may be useful for overcoming gaps in the amount of information available, and for improving its quality and credibility. Providing information on the quality and extent of safety assessments may also assist consumers to make more informed decisions about whether they consider these assessments adequate and reliable. Providing information on non-GM products may also be useful if it is currently inadequate and/or providing information on GM products alone could otherwise mislead consumers. Further, information programs may be a useful complement to labelling schemes.

Despite these potential benefits, information programs also impose costs on the community — including the costs of program planning, development, administration and implementation. In addition, information programs cannot provide comprehensive information on all GM products because there is such a wide range of current and potential products.

Product labels can help consumers make choices at the point of sale and can provide information on safety, environmental and/or ethical issues. The size of the potential benefits of labelling depends on factors such as the type of information provided and whether it is meaningful to consumers; the range of products that have labels; how information is presented on labels; and the credibility of the labelling scheme. How consumers interpret the information on labels is also important. If labels are misleading they may distort consumer choices and reduce community welfare, rather than contribute to it.

Firms often voluntarily provide product labels, although incentives to do so may not be sufficient to lead to adequate labelling from the community's point of view. In these circumstances mandatory labelling may be appropriate, but only if the community-wide benefits are greater than the costs.

In Australia, there has been considerable discussion of the benefits and costs of extending mandatory labelling laws to include GM foods that are considered to be 'substantially equivalent' to conventional food (as well as those not considered to be 'substantially equivalent' — which already require labelling). Mandatory labelling of all GM food, while offering benefits, is expected to be costly, with a recent report prepared for the Australia New Zealand Food Standards Council estimating one-off set-up costs of $176 million and ongoing costs of $315 million per year in Australia (KPMG 2000). The costs of mandatory labelling, however, are likely to depend on the type of labelling scheme introduced, with higher costs likely for more onerous requirements (as recognised in the KPMG report).

Licensing schemes, product standards and moratoriums and bans

Licensing schemes provide a mechanism for identifying and assessing the likelihood of potentially negative consequences of an activity or product in advance of it occurring. They therefore provide an opportunity to either prohibit a GM product before it is produced or sold in Australia, or to introduce conditions to manage potential risks. By providing signals to consumers that a producer or product meets certain requirements, licensing can offer a means of addressing potential information problems. Licensing also provides a mechanism for addressing spillover issues by requiring, for example, environmental management plans or compliance with generally acceptable ethical standards. Further, licensing schemes can help regulatory agencies monitor the use and effects of GM products.

However, licensing schemes impose resource costs on producers by requiring them to attain licences, and sometimes to change their production methods. They can also delay or prohibit product releases which consumers may value. Further, governments bear monitoring and administration costs in running licensing schemes. Such schemes will usually be more cost effective if problem areas can be effectively identified and targeted by licensing requirements. They are also more likely to be effective if they reflect the different circumstances and risks of the various applications of GM products.

Product standards establish minimum benchmarks for products or require producers to undertake specific activities. As with licensing schemes, product standards can be used to overcome information problems that hinder consumers' assessment of GM products, or where significant spillover effects are possible. Many of the arguments for and against product standards that involve pre-market assessments (as in the case of GM food) are similar to those for licensing. Moreover, product standards are often incorporated into licensing requirements.

Moratoriums or bans can be used to prohibit the production or sale of GM products. They may be applied to all GM products, classes of GM products (such as food or pharmaceuticals) or selected GM products (such as a particular crop). As with licensing schemes and product standards, moratoriums and bans can be used to overcome information related problems facing consumers and possible negative spillover effects. It has been argued that they can be useful in responding to some of the uncertainties associated with GM products, and that they can assist Australian producers selling GM-free agricultural products (particularly in overseas markets), and trying to protect and enhance Australia's 'clean and green' image. Assessment of these arguments must consider whether it is possible to produce both GM and GM-free crops without significantly damaging the market opportunities for producers of GM-free crops. Any assessment should also consider that while banning GM crops may benefit some producers it may penalise others.

Bans and moratoriums are relatively blunt policy instruments, and can prohibit socially beneficial activities as well as harmful ones. By providing a standardised response to a potentially wide range of activities or products, and over a wide range of consumers, they can fail to account for the various circumstances under which GM products may provide net benefits to the community.

Choice of policy options

Each of the above mentioned policy options has its advantages and disadvantages to the community, and these need to be carefully weighed up in policy making. These advantages and disadvantages may vary according to the type of GM product under consideration and the circumstances surrounding its use, and may change over time. Assessments of policy options need to examine a wide range of issues, such as ethical, social, environmental and economic effects (including trade issues). Given the diversity of GM products that are available, or may become available, case by case assessments are likely to be favoured over standardised responses. A mix of options is likely to provide the optimal strategy in many cases, harnessing the strengths of each option and benefiting from complementarities among them. In all cases it is necessary to regularly re-assess the need for policy responses and the appropriateness of any policies adopted, particularly given the rapidly changing nature of gene technology and its application.

1 Setting the scene

Interest in genetically modified (GM) products has intensified as applications of gene technology have accelerated, particularly in agriculture and medicine. While genetic modification offers the potential for significant benefits, including enhanced agricultural production, improved healthcare, and new possibilities for chemical and manufacturing industries, it has also raised concerns and generated considerable public debate.

Much of this debate focuses on agriculture and food, and on consumers' 'right to choose'. Also raised are consumer concerns about potential health effects, several ethical issues and potential environmental impacts.

Further dimensions of the debate include the competitiveness of some Australian industries, international trade, intellectual property rights, the potential for concentration of ownership in food production, and the opportunities for, and corresponding responsibilities of, farmers. These issues are receiving prominence both in Australia and globally, such as at meetings of the Organisation for Economic Cooperation and Development (OECD), the World Trade Organization and the United Nations.

Australian government policies in relation to GM products and their implementation, and how industry and the community respond to these developments, will have significant implications for Australia's economy and environment.

This paper focuses on issues of consumer choice in relation to GM products. It provides an economic framework with which to consider why unregulated markets for GM products may not operate efficiently, the implications of this for consumer choice and community welfare, and the potential role for government. It then reviews several policy options, and discusses the advantages and disadvantages of each in the context of facilitating consumer choice and improving community welfare.

1.1 What are genetically modified products?

A genetically modified (GM) product is one that has been produced using gene technology.[1] The Australian Biotechnology Association (2000, p. 1) defines gene technology as:

> ... the range of techniques used to alter or move the genetic material (genes) of microorganisms, plants or animals, either within the organisms or between different organisms ...

Unlike traditional techniques for making genetic changes, such as selective breeding, gene technology involves the:

> ... isolation and subsequent introduction of discrete DNA segments containing gene(s) of interest into the recipient organism. (ANZFA 1999a, p. 5)

Many of the applications of modern gene technology aim to achieve objectives similar to those of traditional breeding techniques — such as seeds that offer greater pest resistance, higher yields or improved final products — but modern gene technology can also offer:

- much faster transfer of the desired gene trait between related organisms or species; and
- transfers between distantly related organisms or species (transgenic modification) that would not normally be achievable under traditional breeding techniques (ANZFA 1999a).

Products that use ingredients or processing agents that have been produced using gene technology are also often referred to as 'GM products' — even if they are not themselves genetically modified and contain no new or altered genetic material or protein when sold.[2]

Products derived from animals that have been fed GM products are not generally classed as GM products unless the animal has been genetically modified or contains genetically modified organisms. While GM organisms[3] may be part of a final GM food product, such as yoghurt, most are inputs into the production of such products and are no longer 'live or viable' when consumed.

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[1] Gene technology is a specific sub-set of biotechnology. Biotechnology refers to technologies that use biological processes (Biotechnology Australia 1999a).

[2] The refining process used in producing some ingredients (such as sucrose and vegetable oils), for example, destroys and removes any genetic material and protein that may be present in the food ingredient (Donaldson and May 1999).

[3] The Gene Technology Bill 2000 defines an organism as 'any biological entity that is (a) viable (b) capable of reproduction or (c) capable of transferring genetic material'.

GM products may be distinguished according to whether they are considered 'substantially equivalent' to a non-GM variety. A GM food product, for example, is often considered to be 'substantially equivalent' to a non-GM variety if it has substantially equivalent nutritional, allergenic or toxic properties, or if the intended use of the food is not different from that of the existing equivalent non-GM food (ANZFA 1999b).[4] So far, all GM food assessed and approved for sale in Australia is considered 'substantially equivalent' (ANZFA 2000b).[5]

1.2 Current and potential applications of GM products

GM products are being used in a wide range of applications, including in agriculture, medicines and pharmaceuticals, environmental management and industrial processes.

Agricultural applications

One of the major and fastest growing applications of GM products is in agriculture. The most widely cultivated GM crops are soybeans, corn, cotton and canola. GM soybeans accounted for more than half of the world's GM crops (by area) in 1999, followed by GM corn (28 per cent), and cotton and canola (9 per cent each) (James 1999).

The area planted with GM crops grew significantly between 1995 and 1999 (figure 1.1), and the worldwide sales of GM crops expanded from an estimated US$75 million to between US$2100 and US$2300 million over that period (James 1999). Despite this increase, GM crops still only accounted for 40 million hectares in 1999 (around 2.8 per cent of global land devoted to primary crops).[6]

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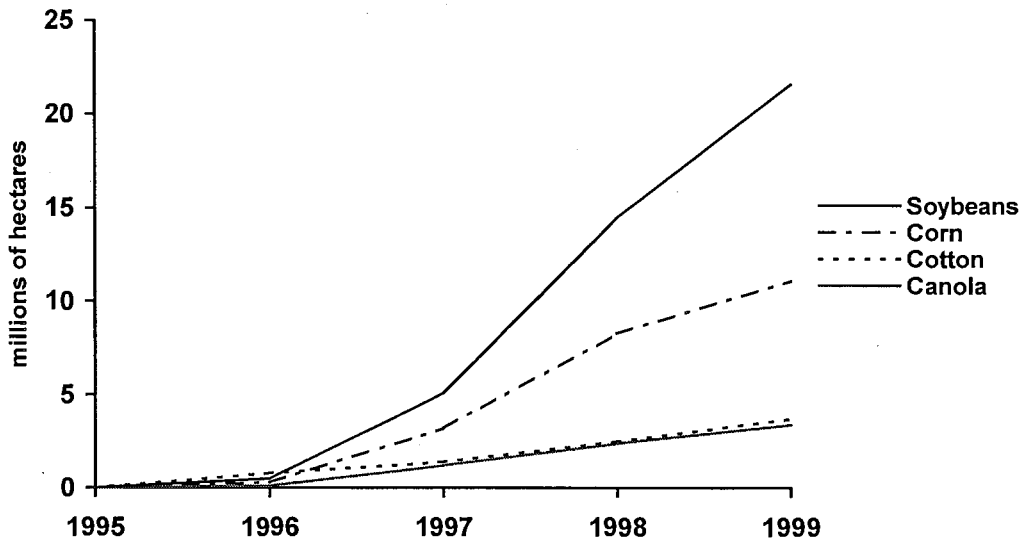
[4] The term 'substantial equivalence' was first used by the United Nations Food and Agricultural Organisation and the World Health Organisation in 1990. It has been used to distinguish a product that is considered to be sufficiently different to warrant special arrangements for being accepted for domestic consumption or import. The term has been criticised for neglecting to deal with the possibility of unexpected novel toxins and allergens (Wynen 1999). The Lay Panel (1999) criticised the terminology because it felt that any genetic modification using modern gene technology is by definition not substantially equivalent.

[5] ANZFA is currently reviewing an application, however, for Oleic Acid Soybeans that are not considered 'substantially equivilent'.

[6] Based on estimates from James (1999) and FAO (2000).

Figure 1.1 **Worldwide growth in farm area by key GM crops: 1995–99**



Data source: James (1999).

James (1999) suggests that total growth in the area planted with GM crops is expected to plateau in 2000, reflecting the unprecedented high adoption rates to date and the high percentage of principal crops already genetically modified in the United States, Argentina and Canada. Further, Foster (2000) has indicated that doubts over profitability and consumer acceptance could lead to some reduction in the area planted with GM crops in the United States in 1999-2000.

The United States is the largest grower of GM crops, accounting for 72 per cent of the world's total area of GM crops in 1999 (James 1999). Other significant growers (by area) include Argentina (17 per cent) and Canada (10 per cent) (figure 1.2). An estimated 38 other countries have conducted field trials of GM products (Pray 1999). Around 60 GM food crops have been commercially released worldwide (Foster 2000).

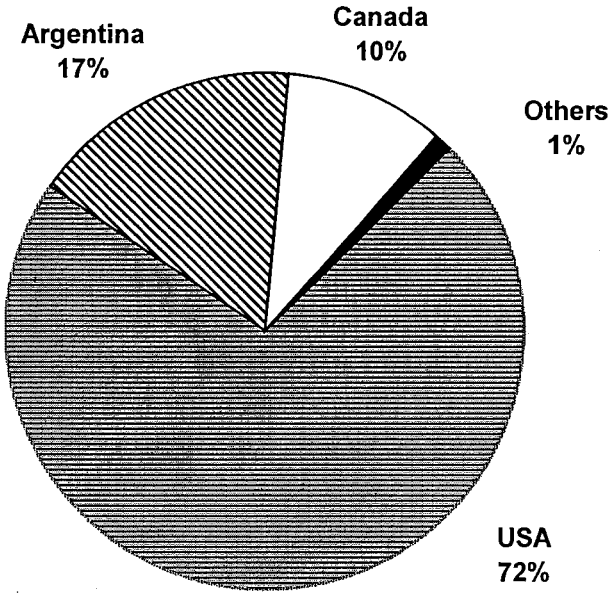
Australia's GM crops accounted for around 0.25 per cent of the worldwide total area of GM crops in 1999 (James 1999). This consisted almost entirely of one crop — Bt cotton. Around one third of Australia's cotton crop was genetically modified in 1999 (Cotton Australia 1999). The Bt cotton used in Australia incorporates a gene from the bacterium *Bacillus thuringienis* which produces a protein that is toxic to certain insects (such as the crop damaging heliothis moth), but not to animals or humans (CSIRO 2000). The only other GM crops in commercial production in Australia are a violet carnation and a carnation with improved vase life. Other GM crops under development or on trial in Australia include canola, wheat, peas,

grapevine, barley, papaya, white clover, potatoes and sugarcane (GMAC 1999). (Appendix A provides further information on field trials in Australia).

A large number of food products available in Australia and overseas already contain at least some ingredients that have been genetically modified. This is because relatively significant proportions of some basic commodity crops heavily used in food production are genetically modified (for example, corn starch in baking and soy lecithin in food processing). Examples of foods that may contain some GM ingredients include chocolate, biscuits, margarine, mayonnaise and bread. Further, many cheeses are produced using GM enzymes (a practice that has been occurring for several years). Some estimates suggest that at least 500 food products currently available in Australia include some GM ingredients (ANZFA 1999c).

So far most agricultural applications of gene technology have been aimed at providing agronomic benefits to farmers in terms of pest, weed and disease management or improved yields. An estimated 71 per cent of worldwide GM crops in 1999 were herbicide tolerant, while 22 per cent were insect resistant and 7 per cent were both herbicide and insect resistant (James 1999). Other agronomical benefits under development include tolerance to various extremes in temperature, water and soil conditions.

Figure 1.2 **World shares of GM crops by area: 1999**



Data source: James (1999).

The next phase in the development of GM crops is expected to offer benefits more directly relevant to consumers. Examples include high protein rice, low fat oils, low allergy nuts, and soybeans with higher levels of anti-cancer proteins than found in conventional varieties. Foods may also offer pharmaceutical benefits, such as hepatitis vaccines in bananas (Foster 2000).

Other GM products under development include products in aquaculture (such as faster growing and larger salmon), and forestry (such as faster growing trees and improved fibre and wood quality).

Medical and pharmaceutical applications

Medical and pharmaceutical applications of GM products in Australia include human insulin, growth hormones, hepatitis B vaccines and several types of interferon and blood clotting products (box 1.1). One of the most widely used GM products is human insulin, which was first produced in Australia in 1982 (Ernst and Young 1999), and which in many cases replaces insulin derived from pigs (Biotechnology Australia 1999a). Gene technology has also provided new tests for diagnosing infectious diseases in humans and animals (Biotechnology Australia 2000a).

Box 1.1 **Examples of medical applications of GM products**

- Human insulin for diabetic patients, which has a lower risk of producing antibodies rejected by humans than that of insulin derived from animals.
- Recombinant interferon-alpha which has improved the treatment of cancers such as melanoma, multiple myeloma, lymphoma and Kaposi's sarcoma (of AIDS), and which has been useful for treating chronic hepatitis B and C.
- Recombinant growth hormone for children who have a deficiency of this hormone, which allows them to grow free of the risks of Creutzfeldt-Jacob disease associated with using the product from human pituitaries (which was the previous source).
- Products for rare enzyme-deficiency diseases (such as Gauchers disease) that would otherwise be treated with a less safe product or not at all.

Source: Biotechnology Australia (1999a).

Environmental and industrial applications

Applications of GM products in environmental management include the clean up of oil spills and the treatment of contaminated land and water (Donaldson and May 1999). Other current and potential applications include bioremediation of heavy

metals, oils and chemicals, conversion of waste into energy, contaminant testing, mine site rehabilitation and control of feral animal pests (Biotechnology Australia 1999a).

Industrial applications of GM products include the manufacturing of chemicals such as enzymes, and the replacement of non-renewable chemicals with those produced by plants (Donaldson and May 1999). Future applications are likely to include the production of industrial fibres such as polyester and plastic (Business Week 1999; Rifkin 1998), and industrial oils used in paints, glues and lubricants (Higgins 2000).

1.3 The debate

The public debate about GM products encompasses issues of consumer choice, public health and safety, the environment, the competitiveness of some Australian industries, international trade, intellectual property rights, and the potential for concentration of ownership in the food and biotechnology industries.

Much of the debate has focused on the use of gene technology in agriculture and food production, with opinions ranging widely:

> Some see genetic modification as part of a continuum in the development of tools for plant breeding. For them, GM is just another step in the process, albeit a powerful one. Others see genetic modification as a fundamental change in the way new crops are produced. For them, this fundamental difference necessitates new ways of assessing safety. (OECD 2000c, p. 3)

The way in which GM products have been introduced and regulated has also sparked controversy:

> The speed at which GMOs have been developed and introduced by multi-national companies and the scientific community has left many people internationally completely unaware and uninvolved in the process. (Lay Panel 1999, p. 2)

Some key features of GM products, which contribute to them being the subject of debate, are presented in box 1.2.

Box 1.2 **Features of GM products**

- *Scope and pace of genetic modification.* The use of modern gene technology has increased both the scope of possible genetic modifications (for example, to include gene transfers not possible under traditional methods), and the speed at which previously achievable modification can occur.
- *Uncertainty about some effects.* The newness and complexity of GM products has contributed to a high level of uncertainty about some of their effects (both positive and negative), particularly in the long term.
- *Pervasiveness and invisibility.* Consumers may frequently but unknowingly purchase and consume GM products (particularly foods containing GM ingredients).
- *Potential irreversibility and continuing liability.* The genetic modification of plants, animals and other life forms may be difficult to reverse in the future, if that were desired. Given their potential to self-propagate or cross breed, new genetic varieties may be difficult or even impossible to retrieve once they are released into the environment.
- *Religious, ethical and social issues.* The belief that gene technology represents interference in the natural evolutionary process, for example, raises concerns for some people.

Consumer choice

Concerns have been expressed about the ability of consumers to make informed choices about GM products. Central to these concerns is the perception that inadequate information about GM products is available to consumers:

> Currently the public does not have enough information about GMO food to make informed purchasing decisions. To allow real choice, information must be more readily available. (Lay Panel 1999, p. 7)
>
> The current information level (which includes a significant level of misinformation) in the public domain does not match the need, and for some time there has been an urgent call for action. (CSIRO 1999a, p. 6)

The Australian Food and Grocery Council (1999, p. 9) notes:

> Consumers' right to choice is only as valuable as the information upon which that right is exercised.

Particular concerns have been the availability and quality of information on the potential health effects of consuming GM products. The possible reduction or change in nutritional content of some GM foods, as well as the possibility of known and unknown allergens and toxins in GM foods, have been raised. Other concerns include the potential consequences of transferring an introduced gene in food to the

microorganisms in the human gastrointestinal tract, and the potential for adverse health effects from the ingestion of genetically modified microorganisms. The possibility that antibiotic resistant genes, which are sometimes used in GM crops, may escape into the food chain has been another concern.[7] (ANZFA 1999a; Donaldson and May 1999; May 1999).

These matters greatly concern some segments of the community, despite the lack of widely accepted evidence that the genetic modification process is inherently harmful to humans (Donaldson and May 1999; OECD 2000b). These fears may, in part, reflect a lack of understanding about the potential benefits and risks of GM products; a lack of confidence in the scientific research and government regulatory frameworks; and/or a high degree of perceived uncertainty about the current state of knowledge.[8] Donaldson and May (1999, p. 22) note:

> ... there is no current evidence to suggest that the process of genetic modification is inherently harmful. Many of the issues raised by foods produced using genetic modification are equally applicable to foods produced by conventional means. ... Nevertheless, nothing can be absolutely certain in a field of rapid scientific and technological development.

At the same time, potential health benefits from GM products have also been raised. These include:

- improved treatment of illness through new and improved medical and pharmaceutical products and treatments;
- healthier foods with less fat, improved nutritional value and reduced toxins and allergens; and
- more affordable foods with greater variety which can expand and improve the quality and balance of consumers' diets.

Other indirect health benefits and costs related to GM products include:

- potential health effects brought about by changes in the environment as a result of using GM products — for example, where the use of GM crops reduces the use of pesticides and herbicides possible contamination and chemical residue in final food products may be reduced (Donaldson and May 1999; Polya 1999; Hansen 1998); and

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[7] Antibiotic resistant genes are sometimes used in the development of GM crops as 'markers' to help identify modified traits in the host organism or plant. Recent developments have made it possible to use alternative 'marker gene' systems which do not use genes for antibiotic resistance (May 1999).

[8] See May (1999) for a brief discussion of the relative levels of understanding and 'precision' of gene technology compared with traditional breeding techniques for the production of food.

- potential occupational health and safety issues relating to the handling of GM organisms or products on farms, in laboratories and in commercial environments — for example, changes in the levels and types of herbicides used may result in changes to workers' exposure to such chemicals.

Another important aspect of consumer choice is the ability to adhere to religious, ethical or social beliefs. Some religions, for example, have dietary restrictions which consumers may not wish to contravene. Other consumers may believe that genetic modification is inconsistent with their view of the 'proper' relationship between humans and the rest of nature (HoRSCIST 1992), and may therefore wish to avoid GM products.

These religious, ethical and social dimensions may also be important because they can influence people's risk perceptions which can then influence decision making (chapter 2):

> Ethical standards and fundamental beliefs have a profound effect on people's attitudes towards any new technology, including biotechnology. Perceptions of risk and benefit in biotechnology cannot be dissociated from ethical issues. (Deane 1999, p. 4)

They can also underpin many of the disputes and disagreements about GM products, especially in relation to environmental issues. Harding (1998, p. 61) noted in relation to environmental issues that:

> Even though controversies are typically seen as disputes over 'facts', in most environmental disputes it is the clash between people's value positions which fuels debate, rather than a disagreement over the 'facts'.

Environmental impacts

The potential environmental impacts of GM products are another area of debate — in the context of immediate and long term impacts on the environment; health effects from changes in the environment; and consumer choice and preferences for environmentally beneficial products. Potential environmental impacts have been prominent in public debate over GM products and consumer choice, particularly the implications of GM products in agriculture:

> ... consumers have a right to know about the environmental impact of the food they buy so that if they wish, they can exercise their own preferences and avoid — or choose to buy — food that has been produced a particular way. (Hansen 1998, p. 7)

A common concern relates to the potential for genetic transfer from GM plants to other plants (by cross-pollination for example). This problem can potentially affect farmers if GM crops are grown 'near' non-GM crops. The risk of cross-pollination varies considerably with the type of crop. For example, the risk is relatively low for

cotton, which self-pollinates (Wynen 1999), but higher for canola (whose pollen has been reported to travel by wind and via bees for up to 5 kilometres (Organic Federation of Australia 1999a).

Genetic transfer can also affect the environment more broadly if genetic traits are transferred from GM plants to closely related relatives (such as canola and mustard weed). This can affect the environment directly by changing the genetic make-up of existing plants, or indirectly through flow-on changes in the broader environment. The potential transfer to weeds of genes that provide resistance to chemical herbicides, for example, raises the risk that 'super weeds' may develop in the future (a direct effect). This may lead to the increased use of herbicides (to control these weeds) which may then contaminate nearby crops and/or increase the chemical residues in the soil and waterways (an indirect effect).

Other concerns relate to:

- the use of pesticide or herbicide resistant crops which, while possibly improving farmers' efficiency and returns (through increased yields for example), can also increase the use of pesticides or herbicides;
- a further reduction in the genetic diversity of crops if farmers adopt a narrower range of GM seeds than the range of seeds currently used, and the consequent increase in the risk of significant outbreaks of diseases and pests in the future; and
- the unpredictable and, in some cases, irreversible consequences of releases of new organisms into the environment, including where they may spread, how they mutate and their effect on other forms of life.

However, there are also potential environmental benefits from the use of GM products. Examples include:

- the potential to reduce herbicide or pesticide use for GM crops which either do not require as much chemical pesticide or which allow fewer applications or more benign types of herbicide to be used;
- the potential to reduce the amount of soil tilling which can erode topsoil;
- the development of crops that require less water or fertiliser; and
- more efficient agriculture which can reduce the need for land and forest clearing.

Indeed, it has often been argued that gene technology can reduce the need for the intensive use of chemical fertilisers, pesticides, herbicides and fungicides, and support more 'sustainable' agricultural production systems:

> One significant way in which gene technologies will be used is that they will provide a powerful tool for making our production systems compatible with a sustainable environment. (Peacock 1995, p.59)

Other issues

Community debate on GM products is not only about consumer choice pertaining to human health, ethical values and the environment. It is also about:

- the development and competitiveness of Australia's biotechnology, agricultural and other industries;
- the possible impact of GM products on international trade, and how Australia's regulatory system will conform with its international trade obligations;
- intellectual property rights and patents — for example, whether developments in gene technology should be seen as patentable innovations or scientific discoveries; whether issuing patents in these areas is ethical; and whether patents will grant excessive market power to owners (Biotechnology Australia 1999a); and
- the potential market power of large multi-national biotechnology companies, and the possible concentration of ownership in the supply of food resources.

These issues, however, are beyond the scope of this paper.

1.4 Focus and outline of this paper

This paper uses an economic framework to examine several policy issues relating to GM products and consumer choice. Chapter 2 considers factors influencing consumer choice, why market outcomes may not reflect individual preferences, and why governments may intervene in GM product markets to improve individual and/or community welfare by facilitating or restricting individual choices. Several options available to governments to address these issues are canvassed in chapters 3 and 4. These options include information and awareness programs, labelling schemes, licensing schemes, product standards, and moratoriums and bans.

2 An economic framework for analysis

Australia's economic system for allocating and distributing resources partly depends on consumers' ability to express their preferences for products and services, and to make choices that reflect these preferences. Effective market operation relies on producers receiving signals from consumers through their purchasing decisions about what to produce, how to produce it, and for whom. Consumer choice is also important in its own right — that is, the community places value on consumers being able to express their individual preferences.

This chapter provides an economic framework to examine issues related to GM products and consumer choice. It reviews factors that influence consumer choices, why markets may not reflect individual preferences, and why governments may sometimes choose to facilitate or restrict individual choices in some way.

However, just as the market can be impeded in providing for choices that are in the best interests of either individuals or society, government can be impeded in acting to achieve such aims. These impediments are also considered in this chapter. Further, because government action nearly always involves some costs to the community, anticipated community-wide benefits and costs must be assessed before the appropriateness, or otherwise, of government action is determined.

2.1 Factors influencing consumer choice

Consumers' purchasing decisions are likely to reflect a number of factors, including purchasing power, the range of complementary and substitute products available, knowledge and beliefs about a product, and perceived benefits and costs. As noted in chapter 1, two issues that underpin many of the public concerns regarding GM products are:

- risk and uncertainty; and
- ethical, cultural and social preferences.

Risk and uncertainty

Many product choices involve some degree of risk or uncertainty. Risky situations involve outcomes — positive or negative — that can be defined and for which probabilities are known (to some extent at least). Uncertainty is said to refer to situations when consumers cannot objectively assess the probability that a particular event will occur, or even what outcomes are possible. The two terms are often used interchangeably.

Consumers' perceptions of risk and uncertainty

Consumers' purchasing decisions are influenced by their assessment of the possible outcomes of a decision, and their assessment of the likelihood of possible outcomes. If people cannot objectively assess the probability of a known event occurring, then they may adopt 'rules of thumb' or some other means of forming a rough judgement of the odds. Assessment is much more difficult when consumers believe they cannot even catalogue the range of possible events: in such situations, repeated consumption (akin to repeated sampling in statistics) will not necessarily lead to more accurate estimates of the probability of outcomes and evaluations of the effects. This has implications for the potential for market inefficiencies, discussed in section 2.2.

Deane (1999) identified several factors that are likely to increase consumers' perceptions of risk or uncertainty in the context of GM products (box 2.1). Broad social, cultural and personal influences as well as scientific facts and mathematical probabilities shape consumers' risk perceptions. Deane (1999) argues that the perceived risk of purchasing and consuming GM products, especially foods, may be higher than scientific estimates because the risks are unknown, uncertain, unfamiliar and complex.

In particular, perceptions of risk and uncertainty are likely to vary according to the ability of consumers to exercise choice or control over their decisions. Perceived risk is likely to be higher, for example, for consumers who cannot distinguish between food with characteristics that they do not want from food they consider acceptable (other things being equal). Further, the uncertainty surrounding possible long term consequences of genetic modification may contribute to some consumers' feelings of loss of control.

Given that perceptions of risk and uncertainty are unique to each individual consumer, consumers may seek different information from different sources, and make different purchases when faced with the same information.

Box 2.1 **Factors that increase consumers' perceptions of risk and uncertainty**

Consumers' perceived risk or uncertainty will generally be higher if:

- product benefits are perceived to be low and/or of low relevance to the consumer — for example, perceived risk may increase if benefits accrue primarily to industry;
- the risks are unknown, rather than known;
- the risks are perceived to be imposed involuntarily, rather than accepted voluntarily;
- the person or agency providing the product is believed to have substantial market power or an undue influence on regulatory and public policy decisions;
- the consumer has serious ethical concerns about the process or product;
- the weight of public opinion is negative;
- the person or agency providing information about the process or product is not perceived as being credible, trustworthy or reliable;
- public consultation and participation in the development of policies to regulate the process or product are considered to be inadequate; and
- the regulatory process is not seen as being transparent or independent.

Source: Deane (1999).

Further, the importance of perceptions of risk and uncertainty to consumer decision making, along with the dependence of these perceptions on a wide range of factors, suggests that consumers may seek very broad information when making decisions about GM products. However, information can be costly and time consuming to obtain. This means consumers need to trade off the potential benefits of having additional information against the costs of obtaining and processing that information (section 2.2).

Consumers' risk preferences

Risk preferences also affect purchasing decisions (box 2.2). Many consumers would probably be considered risk averse in their purchases of GM products.

For risk-averse consumers, extreme potential outcomes may exert a major influence on their decision-making (Hinchy and Fisher 1991). Highly risk-averse consumers, for example, may prefer to eliminate the chances of a particular unfavourable outcome. Consumers who are highly concerned about perceived health risks from GM products may choose to avoid all products with GM ingredients even if the probabilities of adverse outcomes are very low and the potential benefits from GM products are significant. Such consumers may be unwilling to trade off some

product attributes for others. They may strongly desire information to identify the products they wish to avoid, and they will want information that is easily accessible at a low cost to them.

Other consumers may be willing to purchase a product with greater perceived risk if the product has some potential health benefits and/or price advantage (for example, see Macpherson, Kearns and Sharland 2000). More information may help these consumers identify the type and size of potential trade-offs.

Box 2.2 **Risk preferences of consumers**

Consumers' attitudes to risk can vary greatly:

- A *risk-averse* consumer prefers to receive an outcome with certainty than to take a gamble, that may achieve the same expected outcome. They are prepared to pay more than the 'actuarially fair amount for coverage against risk' to avoid a gamble.
- A *risk-neutral* consumer is indifferent about taking a gamble or receiving the same expected outcome with certainty.
- A *risk-loving* consumer prefers to take a gamble than to receive the same expected outcome with certainty. They are prepared to pay a premium to take the gamble.

Sources: Eatwell, Milgate and Newman (1987); Pearce and Shaw (1995).

Anxiety, risk and uncertainty

People often feel anxious in a risky or uncertain situation, which can reduce their welfare. Evidence suggests that anxiety or concern (forms of psychological costs — section 2.2) are not necessarily proportionate to the level of risk as measured in scientific risk assessments (see, for example, Starr and Whipple 1980).

Ethical, cultural and social preferences

The consumption of many products can involve ethical, cultural and social questions for some consumers. It has been argued that biotechnology and genetic modification can particularly challenge some firmly held preferences and beliefs (Panter 1999). Issues include:

- religious concerns — for example, some religious groups may wish to extend their beliefs and customs (such as not eating pork or beef) to avoiding foods which have genes added from the animals they wish to avoid eating (such as pigs or cows) (for example, see Lappe and Bailey 1999);

- ethical concerns — for example, some consumers are concerned by what appear to be 'human acts of creation' between unrelated and 'unnatural' partners (HoRSCIST 1992); some are concerned about the relationship between humans and nature; and others are concerned about the consequences of patenting new GM organisms (Lay Panel 1999); and
- other cultural or social perspectives — for example, some consumers are concerned about the potential damage to the environment from cross pollination or other forms of genetic transfer and from the possible reduction in biodiversity (Hansen 1998), while others are concerned about potential consequences for animal health and welfare (HoRSCIST 1992).

Some consumers' concerns vary according to the type of genetic modification and application. Gene transfers involving plants, for example, are generally regarded as being more acceptable than those involving animals (Hansen 1999). Similarly, the use of GM products in medicinal applications is generally associated with lower levels of ethical concern than their use in foods (Deane 1999; Grove-White et al. 1997). The strongest objections may be to the introduction of human genes into other life forms (Hansen 1999).

2.2 Market outcomes and individual preferences

This section considers two reasons for market outcomes not reflecting individual preferences. First, the market may not be able to provide the information relevant to consumers' choices, such as information on risks or ethical issues, or there may be information biases that lead consumers to make decisions that they would not have otherwise made. Further, even if the information available is adequate for consumers' needs, that information may not be seen as credible or trustworthy or consumers may not be able to adequately evaluate it. The extent to which markets can address potential information problems is also discussed.

Second, individuals may care about the decisions of others as well as their own, and these preferences may not be reflected in product choices. This reflects that individuals usually make decisions based on their (private) perceptions of costs and benefits, and do not take into account the views or effects on others. Some individuals may believe, for example, in moral arguments for or against the production and consumption of GM products by others over whom they have no control. These issues are referred to as 'externality' or 'spillover' effects. Generally accepted community standards or social norms are an example of this type of problem where most people in a society hold similar views about the actions of others.

Information problems

Four types of potential information problems are discussed in this section: a lack of adequate information; information biases; a lack of credibility or trust in the information; and constraints on consumers' ability to process and use available information.

Inadequate information

Consumers need appropriate information about the factors they consider to be important in their purchasing and consumption decisions. Inadequate information about GM products may mean that consumers are unable to make decisions that accord with their preferences. If they are unable to distinguish GM products from non-GM products at retail outlets, for example, then they may not buy the product they would have preferred. In other words, the implicit 'vote' expressed by their product selection may be accidental. Thus, firms may receive the wrong signals about which products to produce, and market outcomes could then result in inefficient resource use and reduced community welfare.

A lack of adequate information for consumers may arise either from the 'public good' aspect of information or from 'information asymmetries'. The public good problem is that information can easily be passed on to others — that is, it is difficult to exclude others from making use of that information — so it may be difficult for firms to recoup their costs in providing information. Information asymmetries arise when the distribution of information between buyers and sellers is uneven.[1] In either case, consumers may have less than the optimal amount of information and market allocations may be inefficient.

But market inefficiency does not result simply because there is less than perfect information about GM products. Collecting information is not costless, and people can only remember and process a limited amount of information. Thus, consumers will collect and process information only where the expected additional benefit of information exceeds the expected additional cost. However, the market may be

[1] In an extreme case, if buyers cannot readily assess the quality of a product until some time after sale, and the marginal cost of production rises with quality, a 'lemons' problem may arise. That is, if consumers assume an average quality for all products only sellers of lower than average quality products can make a profit (as suppliers of higher quality products will not be able to attain price premiums to cover the extra costs associated with producing higher quality products). In an extreme case, only low quality goods ('lemons') are sold in the market (Akerloff, 1970). The potential for this problem to arise is reduced to the extent that sellers can increase consumers' trust in the credibility of product claims. Common means to achieve this include brand promotion, guarantees, warranties and accreditations.

considered inefficient if what is optimal from an individual consumer's point of view in terms of collecting and processing information is not the same as that of the community as a whole.

Consumers' need for information on GM products may also vary across individuals. Some consumers may not be concerned about the potential benefits or risks of GM products, so may have little desire for information about them. In contrast, others may have a strong preference for obtaining such information. Preference for information may also vary over time. Food 'frights', for example, such as the recent bovine spongiform encephalopathy (BSE) experience in the European Union may increase some consumers' desire for information, at least in the short term.

The effectiveness of consumers' search for information partly depends on the degree to which the characteristics of GM products can be identified and evaluated before purchase and use (box 2.3); the variance in the characteristics of the product; and the frequency of purchase. Other things being equal, if important product characteristics are relatively homogeneous and stable, and the product is frequently purchased, then the consumer can learn about the product more quickly. Since the cost of information gathering and processing is relatively low in such cases, consumers can probably obtain adequate information on their own.

However, frequent or continued consumption of products does not necessarily reveal further information about 'credence' or 'post-experience' characteristics. Leland (1979, p. 1330, quoted in BIE 1996) notes:

> A poor plumbing job might not show up for several years, and there might then be doubt as to whether it was caused by the plumber, by misuse, or by an 'act of God'. The plumbing jobs performed by physicians are presumably even more difficult to assess.

As noted in chapter 1, GM products are being used in a wide range of applications, including foods, pharmaceuticals and industrial products. The degree to which particular GM products exhibit 'post-experience' characteristics will vary, yet it may be argued that all have some strong 'post-experience' qualities due to the current perceived uncertainties associated with genetic modification for many consumers. This limits consumers' ability to learn about GM products by experience. Thus, they must seek other sources of information, including the firms that supply GM products (primary sources) and third parties such as certification services or other agents (secondary sources).

Box 2.3 **Search, experience and post-experience characteristics**

The effectiveness of consumers' ability to search and process information partly depends on the characteristics of the product. Product characteristics can be classified according to whether they are search, experience or post-experience attributes:

- Search characteristics are those product attributes that consumers can determine with relative certainty before purchase. Examples of products with strong search characteristics are bookcases and chairs.
- Experience characteristics are those that consumers can assess only after purchase. Most services, such as hair cuts and landscaping, have strong experience characteristics.
- Post-experience characteristics (sometimes known as credence characteristics) are those qualities that are difficult for consumers to assess even after consumption. This problem may arise because it is difficult to link product use with its effects, given either the complexity of the relationship, or a significant time lag between the cause and effect. Examples of products that may have strong post-experience characteristics are products or services of a technical nature, one-off purchases of used equipment and some pharmaceuticals. An extreme example is DES — a drug prescribed for prevention of miscarriage in troubled pregnancies, which has been shown to increase the risk of cancer in the daughters of women who used the drug during pregnancy (Weimer and Vining 1992, p.76).

Products may have all three elements, for example:

> ... a tomato has search (eg colour), experience (eg taste) and credence (eg levels of micronutrients) attributes. (Caswell and Padberg, 1992, p. 461)

Sources: Caswell and Padberg (1992); Nelson (1970) and (1974); Darby and Karni (1973); Weimer and Vining (1992).

Information biases

Another possible impediment to effective consumer choices about GM products can be information biases — that is, when the consumer has flawed or 'one-sided' information. These biases can arise if suppliers or other interested parties can gain from misleading consumers whose available legal remedies may be prohibitively expensive. Biased information can distort risk perceptions and product preferences.

Persuasive advertising, product promotion and other forms of communication by suppliers and other interested parties may, for example, distort consumers' risk perceptions of GM products so that purchasing decisions are not those that would have been made if consumers were more fully informed. However, it may be difficult to identify such cases because risk perceptions are influenced by so many factors (box 2.1).

Information biases are generally less likely to be a problem where there are a larger number of supplies and competitors that can gain from countering biased information, or undertaking legal action. Further, secondary sources of information (see below) can limit the extent of information bias. Like the problem of inadequate information, information biases are more likely to arise when products are purchased infrequently and have significant post-experience characteristics.

Credibility and trust

Even if adequate information on GM products is available, and if that information is not biased or misleading, consumers may not use the information if they believe it lacks credibility. People's trust in information depends, in part, on its source. Agrifood Awareness Australia (1999, p. 6) notes:

> Consumers are not interested in being "educated about" or "preached to" about the benefits or risks of new innovations and technologies. Rather, the community requires access to quality information and advice from a body which they trust on which to base their choices.

The credibility of a source of information is related to people's perceptions of its incentives to provide biased information. Deane (1999) suggests that university scientists are likely to hold higher levels of public trust than those of scientists associated with biotechnology companies, for example.

The existence of information that consumers believe lacks credibility, however, does not necessarily result in market inefficiency. Consumers tend to discount or ignore information from sources they believe are lacking in credibility. However, inaccurate assessments of credibility may result in choices that are not in consumers' best interests. Whether this warrants corrective action by governments (such as the provision of information) depends on a comparison of benefits and costs (chapter 3).

Information processing problems

Information may be readily available, unbiased and credible but may be difficult to process by consumers. These difficulties may arise because consumers' decision making is constrained by their capacity (available time, resources and so on) to receive, store and evaluate information. This is more likely to occur if information is technically complicated and difficult to interpret, process and understand, and if past experience cannot be drawn upon to help decision making.

Given the complexity and newness of many applications of gene technology, and associated uncertainty, many consumers are likely to find GM products difficult to

assess. This may be particularly the case for groups in the community (children, for example) who may be less able than others to make decisions or to use secondary sources as decision-aids. Consumers may, therefore, find it more efficient to delegate product assessment to others — for example, consumer associations (section 2.2) — or to rely on assessment and regulation of GM products by governments. Alternatively, some consumers may choose to avoid GM products, instead buying at organic[2] food stores or purchasing products labelled 'GM free' (if such labelling is adequate for their needs).

The role of primary and secondary sources of information

Despite the above mentioned information problems, producers (primary sources of information) or third parties (secondary sources of information) may adequately and credibly provide and process information for consumers. Producers of products have an incentive to provide information about product benefits if they believe they can extract a price premium or receive some other net commercial advantage from doing so. GM canola may have potential nutritional benefits from their altered profile of fatty acids (Hansen 1998), while some GM rice, rich in vitamin A and iron, may provide substantial nutritional benefits (AAA 1999; Woznicki 2000). Firms have an incentive to promote these benefits to increase market share over their GM-free counterparts. Similarly, if suppliers of GM-free products believe they can profit from informing consumers about the GM-free status of their products they may provide this information to consumers.

The greater the degree to which producers can positively distinguish their products from others (for example, through branding), generally the greater is the incentive to provide information to help capture the benefits from doing so.

Apart from information that producers provide as directed by regulation, or in anticipation of product liability action (for example, health warnings on cigarette packages), sellers have few incentives to provide negative information about their own products. While there may be incentives for competing firms to provide negative information about their competitor's products, this behaviour may be limited by the perceived effectiveness of such a strategy and by the possible consequences of retaliation or legal action by the competitor.

Many markets have the potential for producers to fail to provide adequate information, and thus the potential for market inefficiency. The potential is lower for markets of frequently purchased products with largely 'search' characteristics,

[2] In Australia, foods derived using genetic modification cannot be certified as 'organic' (Organic Produce Advisory Committee 1998).

and higher for markets of infrequently purchased products with significant 'post-experience' characteristics. The extent to which this potential market failure actually occurs depends on the effectiveness of secondary sources of information.

Producers and consumers often seek information from secondary sources such as subscription services, collective organisations or other agents. Agrifood Awareness Australia, for example, is an industry initiative to help increase public awareness of gene technology, including the application of the technology in agriculture (see, for example, AAA 2000).[3] Similarly, the Organic Federation of Australia provides information and promotes organic (GM-free) farming practices and products, providing a different perspective on some of the issues relating to GM products (see, for example, OFA 2000). Insurers may also provide information to the insurer's policyholders if such information reduces their potential losses. Further, consumers can employ agents directly to assess products on their behalf.

The effectiveness of secondary information sources largely depends on whether the 'public good' aspect of information hinders market rewards to the providers of information. This is determined by the ability of information providers to exclude those who do not pay to produce the information from benefiting from that knowledge (the 'free rider' problem).

Further, secondary information sources are less likely to be effective for products where:

- there is significant quality variation;
- branding is ineffective (such that information providers may find it difficult to gain rewards from the information they provide);
- agents to assist with information collection and assimilation, and decision making, are unavailable or expensive relative to the full price of the product; and
- the distribution of quality is unstable so consumers and agents have difficulty learning effectively (Weimer and Vining 1992).

They are also less likely to be effective (or needed) in providing information for products that have significant search characteristics and a high frequency of purchase because consumers may then learn effectively on their own.

[3] Members of Agrifood Awareness Australia are the Australian Biotechnology Association, Avcare, Grains Research and Development Corporation, National Agricultural Commodities Marketing Association, National Farmers' Federation and Seed Industry Association of Australia.

Secondary information sources are more likely to be useful for products that have significant experience aspects than for those with post-experience attributes. The subscription magazine *Consumer Choice* is an example of successful provision of information about product experience attributes. While potentially playing important roles in providing information to consumers on products with significant post-experience characteristics, secondary sources of information may themselves have difficulty collecting information on such characteristics.

However, even where the use of secondary information sources is limited and market failure may justify government intervention to improve market efficiency, secondary sources can still play an important role.

Externalities or spillover effects

Individuals may care about other people's choices as well as their own which they cannot control or influence to a significant degree. Such problems are referred to as externalities, or spillover effects, and may lead to situations where the level of consumption of GM products by consumers may not be optimal from a community-wide point of view.

Three possible types of spillovers related to GM products are health, psychological and environmental spillovers. Consumers typically have concern for their own health, but they may make decisions that are inconsistent with the community's interests if they do not bear all of the costs or benefits of their decisions, perhaps because some of these costs or benefits are absorbed by the community indirectly through the public health or taxation system.

Similarly, consumers' decisions may not account for the psychological damage or gains experienced by others from such decisions. Some people, for example, may experience reduced welfare from knowing others are consuming GM products, or because their existence or use creates anxiety due to perceived risks and uncertainties about them (section 2.1).

Psychological impacts may also form moral arguments in support of GM products:

> ... there is also the potential to feed more of that very large population who remain hungry in the world. The moral significance of that potential should not be ignored. (Woog 1999, p.1)

They may also arise from concerns about the environmental effects of GM products. Hansen (1998, p.7) argues:

> ... consumers have a right to know about the environmental impact of the food they buy so that if they wish, they can exercise their own preferences and avoid - or choose to buy - food that has been produced in a particular way.

Further, individuals may care about the environmental consequences of other people's product choices, as well as those of their own.

When a large number of individuals have strong preferences about other people's choices, a community standard or social norm could be said to exist. The transfer of genetic material from humans into foods may be an example of an operation that a large number of people may consider to breach generally accepted community standards.

The existence of externalities may justify government intervention to restrict or encourage the choices of some consumers to improve overall community welfare. An assessment of the net benefits and costs of intervention must consider the size and extent of such externalities.

The limited evidence about some of the potential long term health effects of the consumption of GM products means that it may be difficult to determine the significance of potential injury or benefit, and how these compare to the health impacts of non-GM varieties. There are also numerous inherent difficulties in estimating the size of any psychological impact experienced by others. Landsburg (1999) notes that it may be difficult to encourage individuals to report accurately their own emotional distress, and that paying attention to psychological costs and benefits can increase their perceived value or troublesomeness.

One way to value such externalities is to ask individuals how much they would be willing to pay to stop other people consuming GM products. Alternatively individuals may be asked how much they would want as compensation if others were to continue to consume GM products. A key disadvantage of both approaches is that they rely on the ability of individuals to respond to hypothetical situations accurately, not on observable behaviour. Further, they assume that people can be financially compensated, for example, for the compromise of their ethical beliefs. Other limitations of such approaches are found in Hausman (1993).

A better way, albeit limited, of gaining an indication of the significance of such externalities is through broad community consultation and debate. Other avenues include the outcomes of political processes such as elections and referendums. However, the judgement required is likely to be difficult. And as McClure (p. 185, quoted in IC 1994) points out:

> Once one leaves the unrealistic world in which individual actions are fully informed and reflect true preferences, there may be a case for interference with consumer

sovereignty; indeed, what may appear to be violation of consumer sovereignty may further the welfare of those whose preferences are not respected. But the potential for loss of freedom inherent in such arguments must never be discounted.

2.3 Roles for government

The previous section considered several reasons why market outcomes may not always reflect individual preferences — either because of information problems restricting consumer choice or because of spillover effects. These 'market failures' may suggest a role for government to either facilitate or restrict consumer choice. However, governments must assess whether the expected benefits of government action exceed the expected costs. They must also consider the distribution of costs and benefits.

Governments can address market failures using a number of approaches, including providing information, requiring others to provide information, and directly regulating the development and sale of GM products. The most appropriate form of government action depends on the underlying cause of the market failure, and the costs and benefits of the policy options available (chapters 3 and 4).

Questions may be raised in some cases as to whether governments should act on perceived risks and uncertainties which may generate anxiety, and reduce community welfare, even when the government might believe that the anxiety is misplaced (Schelling 1968). If sufficient numbers of consumers demand labelling of all GM products, for example, even supposing there is no scientifically-based objective difference between GM and non-GM products, it could be argued that governments should respond to such demands if it could be established that the net benefit from reduced anxiety outweighs the increased costs. However, as discussed in section 2.2, the size of psychological benefits or costs can be extremely difficult to establish. In addition, other policy options such as information programs may represent a more appropriate policy response.

Limitations of government action

Government action, however, can fail to promote community welfare in desired ways, and governments must be conscious of the potential for such failure:

> ... just as individual choice sometimes fails to promote social values in desired and predictable ways, so too does collective choice [Government action]. Public policy, therefore, should be informed not only by an understanding of market failure but of *government failure* as well [italics original]. (Weimer and Vining 1992, p. 112)

Government failure can arise from factors such as inadequate information, policy inertia, poor coordination and 'regulatory capture'. Inadequate information on GM products and their effects, for example, can restrict policy makers' ability to adequately evaluate policy choices. Collecting information about GM products may be difficult due to the range of GM products, uncertainty over some of their impacts, and difficulty in valuing some of the potential benefits and costs of policy action.

Policy inertia can stem from community attitudes, available information or technologies changing without corresponding adjustments in government responses. An appropriate government response in one period may appear a government failure in a later period (OECD 1992). A ban on a particular GM crop, for example, may be appropriate initially but may become out of date as technology develops and new information becomes available (chapter 4).

Poor government coordination can occur between the various levels of government, as well as among the various agencies within each level that are responsible for developing and enforcing laws on GM products. While inter-government agreements have been developed, and well established protocols on responsibility exist, the large number of players in the regulatory system for GM products (other things being equal) could potentially mean that some government responses are not as effectively implemented, updated or enforced as desired.

Regulatory capture refers to situations in which interest groups 'capture' or strongly influence the policy making process. The economically significant and politically sensitive nature of many government responses to GM products means that these types of 'government failures' are quite possible, hence the importance of independent and transparent regulatory authorities and processes.

Frameworks for government decision making

Any assessment of potential policy action must involve the rigorous analysis of policy options, and the comparison of expected costs and benefits for all groups affected, including the broader community. Assessment should examine a wide range of both benefits and costs, including scientific, economic, social and ethical considerations. The distribution of the potential costs and benefits must also be considered. Such measures can assist the adoption of policy options that offer the greatest net benefits to the community.

Frameworks to assist policy makers in assessing policy options are well established. Policy making principles are incorporated in Regulation Impact Statement requirements, for example. These requirements include:

- the identification of the problem that needs to be addressed;
- the identification of the objective to be achieved;
- the identification of options that may constitute a viable means of achieving the desired objective;
- an assessment of the costs and benefits of the options on all groups affected;
- a consultation statement; and
- a strategy to implement and review the preferred option (ORR 1998).

Other complementary frameworks and tools for policy making are also important, such as appropriate frameworks for risk analysis.[4] Consultation processes in particular are likely to make useful contributions to the policy making process given the wide range of issues raised by GM products, the range of values and opinions people have on them, and the uncertainty and lack of information in some areas.

Good policy making processes, in addition to helping policy makers adopt policy options that offer the greatest net community benefit, can be important for maintaining confidence in regulatory systems. Rigorous and independent decision making processes in relation to GM products, including broad impact assessment and consultation, have received widespread support (Lay Panel 1999; NFF 1999a). A recent conference on GM food (OECD 2000c, p. 8) concluded:

> ... risk analysis systems are only likely to generate public trust if based on transparency, provision of information (on monitoring, research results, etc.), and on greater inclusiveness of the various stakeholders.

[4] International concepts and principles for the risk assessment of GM foods, for example, have been developed through organisations such as the World Health Organisation, the Food and Agricultural Organisation and the OECD (ANZFA 2000).

3 Policy options: Information programs and labelling schemes

The presence of several information related impediments to consumer choice about GM products raises the possibility of information based policy responses. This chapter reviews two such policy options: information and public awareness programs, and labelling schemes. Chapter 4 reviews more restrictive measures to address potential information impediments or spillover issues, including licensing schemes, product standards, and moratoriums and bans. The focus in both chapters is to identify the issues to consider when assessing policy options to facilitate consumer choice and improve community welfare.

3.1 Information and public awareness programs

Information programs can be designed to improve both consumer and community awareness and understanding of gene technology and the products made using it. They can thus help facilitate consumer choice, and inform public debate and policy making. The information provided can cover a range of issues, including the potential benefits and risks of GM products, scientific and technological developments, economic, environmental and social implications, and regulatory arrangements.

There has been widespread demand over the past year or so for information to improve the public's awareness and understanding of GM products, and for governments to be involved in its provision (AAA 1999; Lay Panel 1999; NFF 1999a; HoRSCPIRS 2000). The Australian Food Grocery Council (AFGC 2000, p. 1) argues that:

> The Government's leadership is critical to inform consumers about GM foods, its application and the regulatory systems which exist for pre-clearance and labelling particularly in the face of misinformation and unbalanced comments that abound the use of the technology in the food supply.

The Lay Panel to the First Australian Consensus Conference on Gene Technology in the Food Chain (1999, p. 4) also notes:

> There is currently a lack of understanding in the general community of the risks and benefits involved in introducing GMOs into the food chain, both short-and long-term.

Greater government provision of information on GM products has also been advocated by international agencies:

> Both governments and scientists should do more to provide the public with clear, understandable and relevant information. (OECD 2000c, p. 9)

Further, several surveys in Australia have indicated that consumers feel they have inadequate information on GM products (CSIRO 1998; AC Nielsen 1999). An AC Nielsen (2000) survey reported that less than 20 per cent of the 950 Australians surveyed were convinced that consumers had been well informed on the advantages and disadvantages of GM food. Commenting on qualitative work it had undertaken in August 1999, AC Nielsen (1999, p. 1) stated that:

> There is a varying degree of confusion amongst consumers about genetic modification and why crops are genetically modified. Misconceptions are rife. Some people mistrust information from companies who appear to have a vested interest — even government departments can be suspect.

Concerns over the quality of information available to consumers have often been raised in public debate (AFGC 1999; CSIRO 1999a). Biotechnology Australia (2000c) has also pointed to survey work that indicates consumers are seeking more balanced and factual information on GM foods.

The Commonwealth Government has supported the need for, and some public funding of, improved information on GM products, allocating funding for public information on biotechnology in both its May 1999 and 2000 Budgets. The Government's recently established agency, Biotechnology Australia, is responsible for developing and implementing its public awareness strategy (box 3.1), and a national strategy for biotechnology more generally.

Potential benefits of public information programs

Information and public awareness programs can offer several benefits to consumers and the community. One benefit is that they can help consumers choose products that best suit their needs. Given concerns over some consumers' lack of information on and understanding of GM products, public information programs may be able to play useful roles. They can be particularly useful where firms, industry groups and other sources of information may not provide adequate responses to the information asymmetries between producers and consumers. They can also help overcome the inability of the market to provide sufficient information for consumers where such information exhibits 'public good' characteristics. Public awareness programs may also be useful in overcoming deficiencies in the quality and credibility of information on GM products, and in addressing misinformation and misconceptions that may exist (chapter 2).

Box 3.1 **The Commonwealth Government's public awareness program**

Biotechnology Australia is responsible for the Commonwealth Government's public awareness program. Key elements of the program include:

- providing information about the risks and benefits to the community of biotechnology applications in health and agriculture;
- informing the community about how the risks are identified and assessed, and how GM organisms and products are regulated to protect human health and the environment;
- providing information to the community on biotechnology through cooperation with consumer groups, industry and other relevant stakeholders; and
- research and public consultations to help identify consumers' information needs, and to track changes in consumer attitudes and information needs.

Examples of the Commonwealth Government's public awareness activities include:

- the publication and distribution in supermarkets of a brochure on gene technology, its regulation, and food ingredients that might have been genetically modified;
- the establishment of the Gene Technology Information Service (involving a free call telephone service), and Internet site; and
- the use of community forums to provide information about gene technology and its potential impact on regional Australia.

Source: Biotechnology Australia (1999a) and (2000c).

Information programs can also support other government policies, such as the regulation of GM products and labelling arrangements. Providing information on pre-market assessments and regulatory arrangements, for example, has often been advocated (CSIRO 1999; GRDC 1999; Lay Panel 1999). For example, a CSIRO (1999, p. 1) submission to a Parliamentary inquiry into primary producer access to gene technology emphasised the need for:

> ... informing the community about how safety, both in terms of public and environmental health, is assured ...

Providing information on regulatory arrangements could help consumers better understand the quality and extent of safety assessments undertaken on their behalf, and enable them to make more informed decisions about whether these assessments are adequate for their own purposes.[1] Information on how non-GM products are regulated, and the risks and benefits of such products, may also provide useful contextual information to further assist consumers.

[1] In June 2000, ANZFA (2000b) released a public information paper on its safety assessment process for GM food.

By helping to lift community awareness and understanding of GM products, information programs can also encourage more informed public debate on the broad suite of policies that relate to GM products. These include the licensing of researchers and producers, product standards, environmental regulation, intellectual property and other industry policies — of which many will have direct or indirect impacts on consumers' present and future choices about GM products.

Informed community debate on significant new technologies can be particularly important as a means of developing and framing community responses, and managing change. As Wartburg (1999, p.1) notes:

> The arrival of a new technology signals the beginning of a period of change, conflict, and uncertainty. It is also the beginning of a process in which individuals and society as a whole struggle to understand the new technology and cope with the implications of the accompanying changes.

Similarly, the Lay Panel (1999, p. 5) argues:

> In a democracy, the public should be involved in decision making and therefore need to be informed about all issues involving their future.

Finally, information programs can be simple to administer, and monitoring costs can be relatively low. Measuring the costs of this policy option is also relatively easy — something that can be much harder for many other policy options.

The size of the expected benefits of public information programs will partly depend on the extent of the information related problems to be addressed. This will influence the extent to which publicly funded information is warranted, given that consumers often make purchasing decisions in an environment of incomplete information (chapter 2). The size of the benefits will also depend on the design and effectiveness of the programs.

Costs and limitations of information programs

The costs of public information programs can vary significantly, depending on the nature and scale of the program, and can include program planning, development, administration and implementation costs. As with any other government program, these costs need to be weighed against the expected benefits.

There may be scope for government, industry and community groups to jointly develop and fund information programs. However, the effect of funding arrangements on the perceived independence and credibility of the information would need to be considered.

In addition to the costs of running an information program, governments may also incur costs related to collecting information, and research and monitoring activities related to GM products (see below).

In addition to costs, information programs also have their limitations. In particular, given the wide range of current and potential applications of GM products, the provision of risk-benefit information on each is impractical. Therefore, while information on the expected risks and benefits of broad classes of GM products is likely to be useful, it is unlikely to be an effective substitute for pre-market assessments, or other types of information delivery such as product labelling.

Factors influencing the effectiveness of information programs

Several factors are relevant to the effectiveness of information programs, including:

- the relevance of the information to consumers' decision making;
- the perceived credibility of the information; and
- the ability of consumers to assimilate and use the information.

The provision of information that is relevant to consumers requires the consideration of factors that can affect consumers' purchasing decisions and their ability to participate in informed public debate. These factors can include the potential risks and benefits of purchasing and consuming GM products (including human and environmental safety issues and the potential irreversibility of damage); broad ethical and social issues (including the pushing of natural boundaries and the misuse of knowledge); economic implications (including the potential for market power); how gene technology works; and the regulatory arrangements that apply to gene technology (Wartburg 1999).

A lack of information and discussion on these factors may contribute to poorly informed attitudes and perceptions about GM products (positive or negative), which could constrain both effective consumer choices and development of government policies. It has also been suggested that information or education programs can 'backfire' when such broader information needs are not met, or where relationships are confrontational (Wartburg 1999).

Thus, research and consultation to identify information that is relevant to consumers can be important. These processes may need to account for the potential diversity of information needs across consumers, and the potential differences between the views of the general public as a whole and those of particular interest groups (May

1999). Further, given that resources are limited, such activities could identify priority concerns to assist with the most effective use of resources.

The provision of relevant information also requires the periodic review of information needs which may change over time. Review can be particularly important in areas of rapid technological change such as gene technology.

The effectiveness of public information and awareness programs also depends on consumers' perception of the credibility of the information provided. Consumers are likely to discount or ignore information that they perceive as being biased or not credible. Public debate has involved considerable emphasis on the credibility of information and the perceived trustworthiness of information providers. Wartburg (1999, p. 30) argues that trust needs to be earned:

> ... earning trust requires three conditions: openness, truthfulness, and the willingness on the part of those working with the technology and especially its advocates to share knowledge and first-hand experience. There must also be a balance in the presentation of new information.

Providing balanced information can often mean providing information on the alternatives to GM products, and the advantages and disadvantages of these options — a point also made frequently in public debate (Mayer et al. 1995; Organic Federation of Australia 1999b).

Along with being relevant and credible, information also needs to be useable. Usability partly depends on how information is presented, how clear it is, and which medium is used to present it. Given the wide audience that information on GM products needs to reach, a range of formats and mediums for delivery should be considered (see, for example, Biotechnology Australia 1999b). The Lay Panel (1999), for example, recommended:

- the establishment of a gene technology information office;
- government sponsored advertising campaigns;
- toll free phone lines and web sites for consumer information;
- public notices on GM issues;
- information fact sheets; and
- focused education and CD-ROMs (see box 3.1).

The provision of information to consumers sufficiently in advance of either broad policy or specific regulatory decisions on GM products, along with the timely

provision of information *after* decisions have been made, can also influence the effectiveness of information programs. This can influence both a program's direct usefulness and its perceived credibility and acceptability.

As the volume of information on GM products increases, a key challenge will be to summarise, present and distribute cost effectively information that is relevant to consumer and community decision making. The goal for government policy is to raise consumer awareness and understanding of GM products to facilitate consumer choice — rather than simply to provide information *per se*.

How well consumers are able to use the information provided may also depend on how well they can discriminate between products at the point of sale. This suggests that public awareness programs may benefit from being accompanied by product labelling (section 3.2).

Role of public information collection, research and monitoring

In addition to providing consumers and the community with information that is already known by governments, scientists and/or industry, governments may also need to help overcome gaps in the information available on GM products. Government involvement in information collection, and research and monitoring may be particularly required where the public good characteristics of information restricts the information available in the market. This involvement can include research into the social, economic, environmental and health effects of GM products.

The results of publicly funded research and monitoring can be used as part of public information programs. This information can also be used to inform regulators on the risk-benefit characteristics of GM products, which may assist them in making regulatory decisions on behalf of consumers and the community as a whole. Publicly available information can also increase the accountability of regulators and decision makers.

Monitoring the environmental and health effects of GM products over time may be particularly important. Regular feedback to decision makers can be an effective response to the lack of familiarity and uncertainty (both positive and negative) which can be associated with GM products. The Lay Panel (1999) recommended establishing a specific adverse reaction register to monitor possible health links to GM organisms, for example.

Examples of current government activities in this area include research and monitoring undertaken by the CSIRO and ANZFA. The Commonwealth

Government's *Gene Technology Bill 2000* also provides for the Gene Technology Regulator to undertake research necessary to determine the approval or otherwise of applications it may receive for the research and production of GM products.

3.2 Labelling schemes

Product labels are often used to communicate information at the point of sale about how a product is made, its ingredients, its country of origin and other issues important to consumers. By allowing GM products to be more easily identified by consumers who want to buy them, and more easily avoided by those who do not, labelling can potentially help markets work more efficiently.

Product labelling can be voluntary or mandatory. Firms often undertake voluntary labelling if they believe there is a commercial advantage in doing so. These commercial advantages may result from direct marketing benefits or from a motivation to avoid government imposed labelling. Some propose mandatory labelling as a way in which to address problems of information asymmetry (chapter 2) because it requires producers and suppliers to share information with consumers (Phillips and Isaac 1998). Another potential reason for mandatory labelling is to overcome any credibility problems that may be associated with voluntary labelling. Mandatory labelling can exist alongside voluntary labelling.

While labelling may be used for a range of GM products, the focus of community debate in recent years has been on the labelling of GM food — that is, labelling to identify whether a food product has been made using gene technology or includes GM ingredients. This section, in focusing on GM food labelling, discusses the potential benefits of labelling (both mandatory and voluntary), and the factors that influence its effectiveness. The choice between mandatory and voluntary labelling is also discussed, including the specific benefits and costs of mandatory labelling.

Potential benefits of labelling

Several surveys have been conducted over the last few years to gain insights into consumer preferences for the labelling of GM food in Australia. Many have indicated strong support for labelling (Biotechnology Australia 1999b; CSIRO 1998). A national survey by Biotechnology Australia (1999b), for example, revealed that 89 per cent of its sample of the general public disagreed with the statement that it was not worth labelling GM food.

Some surveys have also identified that consumers are willing to pay more for food products that are labelled 'GM free' than for those that are not labelled (see, for

example, Macpherson, Kearns and Sharland 2000) — although the extent of this willingness to pay is not always clear.

Surveys have also sought to gauge consumers' ranking of the importance of GM information on food labels compared with other information. A CSIRO (1999b, p. 15) survey found:

> ... most respondents supported the inclusion of information about biotechnology on food labels, [but it] was ranked in importance behind issues such as country of origin, use of pesticides/additives and nutritional information.

Despite the apparent support for the labelling of GM food products in general, the size of the benefits that consumers may derive from such labelling is hard to determine, and few assessments have been undertaken. This may reflect the inherent difficulties in measuring consumer valuations in the absence of observed behaviours, and the potential differences between people's expressed preferences in surveys and their actual behaviours. Unfortunately, comparisons with the costs of such labelling are thus considerably more difficult and subjective. This may explain (at least in part) why so much debate has emerged over the appropriateness of GM labels.

The type of labelling that is provided is important in considering the size of the benefits from product labelling, including:

- *the type of information provided* — for example, labels could identify whether a product contains genetically modified ingredients; whether the genetically modified ingredients involved the transfer of genetic material across or within species; possible changes in nutritional, allergenic and toxic properties; and/or whether gene technology was used at any stage in the production of a product (regardless of whether the product contains traceable amounts of GM content);

- *the range of products that are labelled* — for example, the greater the threshold of content of GM ingredients before mandatory labelling is required, the more difficult it may be for some consumers who wish to avoid GM foods altogether; and

- *how information is presented on the label*, such as the label's size, format and location on the product (for a general discussion of presentation issues in labelling, see IC 1996).

Other factors that can influence the benefits of labelling GM food include:

- consumer perceptions of the credibility of the labelling schemes; and

- whether consumers actually read the label or use the information in their decision making.

Consumers' interpretation of the label information is a further consideration. Concerns have been expressed over the potential for some types of mandatory labelling to be interpreted as a warning statement:

> There is a genuine fear that labelling biotech goods based on their method of production would be the equivalent of a "skull and crossbones' — that the very presence of a label would indicate to the average consumer that safety risks exist, when evidence shows that they do not. (Smith 2000, p. 2000)

To counter this problem it may be possible to provide additional information (including qualifications) on product labels to prevent consumers from developing false impressions about a product. Caswell (1998, p. 2) provides an example of a possible qualifying statement for claims that a product is GM-free:[2]

> An example would be requiring a disclaimer that there is no safety difference between products that use or do not use a GMO technology on a label that says the technology has not been used.

However, also to be considered is the limited space available on product labels and the alternative uses of labels for informing consumers, particularly given various views on what information is relevant:

> There is a limit determined by both physical space and by what the community regards is relevant or useful. Should the label describe any or all of the farming practices used? ... Each of these issues is important to some people but not others. (Gene Technology Information Unit, 1996, p. 1)

Consumers may value labels more on transgenic products than on those made using genes from the same species. The European Union has mandatory labelling for food that contains GM material that may give rise to ethical concerns such as animal genes in vegetable products (EC Regulation 258/97 [Novel Food Regulation]).[3] Some means of assessing and prioritising different preferences for information, and of weighing these against costs, is needed to make such decisions. Research and consultations on the information needs of consumers may provide insights into this matter (section 3.1).

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[2] Qualifications such as these have been used in the United States regarding rbST (recombinant bovine somatatrophin) milk (Caswell 1998).

[3] Further, the Food Advisory Committee of the United Kingdom Ministry of Agriculture, Fisheries and Food recommended in 1991 that foods containing GMOs transferred from organisms within the same species would not require special labelling, but that foods derived using GM organisms which had not been modified from sources within its own species would (cited in HoRSCIST 1992).

The information provided on labels may not be sufficient to facilitate consumer choice. Labels stating that a product is genetically modified or GM free may be of little benefit if consumers have inadequate information about what genetic modification means, or about its impact on human health, the environment and other issues relevant to consumer choice — impacts which can often depend on the type of GM product and how it was produced. Indeed, if misinterpreted, labels may mislead consumers and distort their choices.

Thus, it is often argued that labelling schemes need to be supported by information schemes (Dawkins 1996; OECD 1997). This may involve the provision of information in stores, and can include information on GM products and comparative information on similar non-GM products. Labels may also include supplementary information to provide more specific information to consumers on health or environmental impacts, such as 'made from GM corn using less pesticide than conventional corn' (for example).

Mandatory versus voluntary labelling

Australian and New Zealand health ministers are considering extending mandatory labelling for GM food products to include 'substantially equivalent' GM food (ANZFA 1999c).[4] GM food that is not considered 'substantially equivalent' — such as a GM food containing new allergens compared with those in non-GM varieties — already requires labelling (chapter 1).

Support for mandatory labelling across all GM food to facilitate consumer choice has come from a number of sources (see, for example, Hansen 1999 and 1998; Morgan 2000). Hansen (1999, p. 4), from Consumers International and the Consumers Union of the United States, for example, argues:

> An absolute baseline step that must be taken is to require mandatory labelling of [genetically] engineered food at all stages, from production to consumption, ... We as consumers have a right to know what we are eating.

Arguments for the mandatory labelling of all GM foods have often been made on the grounds of consumer choice and not health and safety issues:

> ... labelling serves the consumer's right to know, and is above and beyond underlying national programs to assure the safety of food from such things as hazardous pesticides residues and additives, and disease-causing bacteria. (Hansen 1998, p. 1)

[4] An inter-governmental taskforce on GM food labelling was established to assist in this task, consisting of senior officials from the cabinets and health departments of State and Territory, Commonwealth and New Zealand governments.

Australian health ministers have stated on several occasions that their consideration of an extension of mandatory labelling to all GM foods is based on consumer choice rather than concern over health and safety (see, for example, Tambling 1999).

Despite this support, concerns have been raised that mandatory labelling of all GM food would be impractical and prohibitively expensive. The National Farmers Federation (1999b, p.7) argues:

> ... that the compliance costs of unlimited labelling of all GM products in our foods would be horrendous — and the costs of labelling comprehensively would be outrageous.

International labelling arrangements for GM foods

Internationally, many governments have mandated the labelling of GM foods that are deemed to be 'not substantially equivalent' (box 3.2). Some countries, including Japan and countries in the European Union, also require GM products that are 'substantially equivalent' to be labelled, subject to differing threshold levels and exemptions. The European Union has also introduced legislation to require identification of GM soy and maize foods sold by catering establishments (restaurants, bakeries and so on).

Potential benefits of mandatory labelling

The main argument cited in favour of mandatory labelling is that it provides greater certainty that information on the GM content or process of a food product is provided, even where the market size or other constraints may limit the extent to which information is provided voluntarily. The Lay Panel (1999, p.8) argues:

> Comprehensive labelling is the only way to ensure that health, religious, moral and ethical food choices are placed solely in the hands of each individual consumer.

Other potential benefits of mandatory labelling for GM food include:

- improved health and safety to the extent that health information is provided on the labels (such as in the case of GM food that is not 'substantially equivalent');
- improved transparency of the use of GM ingredients or processes, which may reduce consumer fear of being uninformed about the use of gene technology and thus may reduce the potential for losses in consumer confidence in the food supply;
- increased incentive for firms to provide information to consumers about GM products where information may otherwise be inadequate (chapter 2);

- public perception that the information provided is more credible than voluntary labelling schemes run by firms with vested interests, and with the potential benefits of legislative penalties and enforcement (although voluntary labelling schemes certified by consumer or environment organisations may be perceived as equally, or even more, credible than government schemes); and

- the use of standardised terminology on GM labels which may be useful given that consumers may have limited time and ability to interpret label information (although consistent terminology could be achieved under voluntary labelling if either industry agreed on such terminology or governments set regulatory requirements for the use of certain terms).

The potential of mandatory labelling to contribute to consumer choice will partly depend on the extent and usefulness of voluntary labels. If voluntary labels covering either GM or GM-free products are widely used, then the benefits of additional mandatory labels will be lower. The extent to which voluntary labelling is likely to be used will depend on whether it is in the interests of producers to use them. If a GM product offers substantial health benefits (such as additional vitamins in rice to reduce the incidence of blindness (Woznicki 2000)), then GM suppliers may have an incentive to highlight the qualities of their product through voluntary labels to obtain a larger market share or a price premium. Alternatively, if enough consumers prefer products to be GM-free, then producers will have an incentive to provide and label products accordingly. Sanitarium, for instance, label their soy 'milk' as being produced from non-modified soy beans (Polya 1999).

The nature and extent of consumer risk perceptions and preferences for information on social, ethical, economic and environmental issues will also be relevant in determining the size of the potential benefits of labelling, to the extent that labels provide information to help consumers with these issues. Labelling schemes may also be more beneficial if supported by information and awareness programs.

The availability of alternative ways in which to assess product characteristics, such as purchasing at organic shops, also affects the additional benefit of mandatory labelling. The more common are organic and other GM-free food shops, the lower are the potential benefits from mandatory labelling because consumers who object to GM products can target their purchases effectively through these stores without the need for labels.

Box 3.2 Labelling arrangements for GM food

Australia and New Zealand

GM food which is 'not substantially equivalent' (chapter 1) to unmodified foods must be labelled 'genetically modified'. The label must indicate the biological origin and nature of the characteristic or property modified (ANZFA 2000a). GM foods considered 'substantially equivalent' do not require labelling at present. Australian and New Zealand health ministers are considering the extension of mandatory labelling to all GM food products (ANZFA 1999c).

United States

GM foods that are substantially nutritionally different from unmodified foods, or that contain allergens or toxins, must be labelled. There is no requirement for producers to label products that are substantially equivalent (Smith 2000).

Canada

GM foods must be labelled where safety concerns such as allergenicity and compositional or nutritional changes are identified. In this situation, labelling is required to alert consumers or susceptible groups in the population. Other labelling of GM foods is voluntary (Health Canada 1999).

Japan

Labelling is mandatory for many GM foods. All products that are 'not substantially equivalent' must be labelled. Products that are 'substantially equivalent' must be labelled if they include one of 24 ingredients requiring GM labels, and if they are a top 3 ingredient or make up more than 5 per cent of the product by weight (Reuters 1999).

European Union

Labelling is mandatory for all food products containing GM ingredients except highly refined derivatives, processing aids and additives. An exception also exists for firms that have tried to avoid GMOs but still find a low percentage of GM material in their products as a result of accidental contamination. In these cases, firms need not label products as containing GM products provided:

- the origin of the GM food is accidental; and
- the proportion of GM material is not higher than 1 per cent of each ingredient individually considered (European Union 1999; FSA 2000).

The European Commission emphasises that the absence of a GM label due to accidental contamination is not to be interpreted as the equivalent of a GM-free product. The commission is reviewing the contents of possible EU legislation in this area. In recently introduced legislation, foods containing GM soy and maize sold to and by catering establishments must also be labelled.

Source: Belgian Biosafety Server (2000); EC Regulations 258/97 (Novel Food Regulation), 1139/98 (labelling of GM soy and maize products) and 49/2000 (amendment to 1139/98); European Union (1999); FSA (2000); Reuters (1999b); Smith (2000).

Voluntary labelling does not appear to have been widely used in Australia, possibly because few GM products currently offer direct benefits to consumers. Another reason may be the uncertainties that face firms in making GM-free claims, given the limitations of segregation and testing systems, and the fact that Australia's fair trading laws regarding possible 'false and misleading' claims have yet to be tested in this area.

To the extent that any uncertainty over the application of Australia's fair trading laws remains, there may be a role for government to issue guidelines on voluntary labelling. ANZFA is currently considering arrangements to facilitate the use of negative claims, such as GM-free or 'sourced from non-GM ingredients', including considering definitions and requirements for such labels. The US Government recently decided to develop voluntary guidelines as part of its new policy on the labelling of GM foods — a policy that emphasises the role of voluntary labels to inform consumer choice, and does not introduce mandatory labelling for 'substantially equivalent' food (box 3.2).

Costs and limitations of mandatory labelling

Mandatory labelling of GM products may assist consumers in their decision making, yet this assistance comes at a cost to governments and producers — a cost that may ultimately be passed on to consumers. The likely size of such costs has been debated in Australia and overseas.

Most costs to producers from mandatory labelling arise from the requirement that producers alter existing labelling practices and adopt new systems for ensuring accurate labelling (including the cost of segregating GM products from those that are unmodified). Product segregation (otherwise known as the 'chain of custody' or 'identify preservation') involves ensuring that crops with special characteristics can be traced from the field to their final destination. The segregation of products according to genetic content can be a complex procedure, and can involve the knowledge or expertise of a specialist or the use of specialist testing equipment (Buckwell et al. 1999). Separate transport and storage facilities may also be needed, along with the administration, certification and auditing of segregation systems. Producers may also incur costs through any switching to non-GM inputs.

Phillips and Isaac (1998) suggest mandatory labelling would result in excessive cost increases and that these could threaten the research and commercialisation of GM products. Foster, Rees and Toyne (1999) suggest the costs of mandatory labelling could be so substantial that they could represent a barrier to market access. Firms that find the costs of labelling excessive could decide not to invest in biotechnology (Phillips and Isaac 1998).

Several recent studies on the costs of introducing mandatory labelling have highlighted a number of points. First, the overall costs of mandatory labelling are likely to be significant (although they may be small for some product groups). Estimates for introducing mandatory labelling for all GM foods in Australia range from $491 million in the first year (and $315 million for every subsequent year) to as high as $3 billion in the first year (and $1.5 billion annually thereafter) (KPMG 1999, 2000), depending on the stringency of the requirements imposed (box 3.3).

Second, the studies indicate that the costs are likely to vary across labelling systems and to be greater as the required changes to existing product labelling practices are more onerous. This appears to be supported by the higher costs estimated in the 1999 KPMG report relative to those in the 2000 KPMG report (box 3.3). Further support appears to be given by the significant reductions in compliance costs achievable if certain groups of ingredients are excluded from the definition of GM foods (KPMG 2000). For Australia, cost reductions from exempting products such as processing aids, additives and highly refined ingredients are estimated at up to 27 per cent for initial set-up costs; up to almost 70 per cent for the operation of on-going compliance systems; and up to 50 per cent for the on-going costs of substitute ingredients (as companies seek to change their production formulations to achieve 'non'-GM status for their products) (KPMG 2000). Adopting equivalent requirements to those recently introduced in the European Union (box 3.2) would mean reductions of 27 per cent, 72 per cent and 56 per cent respectively of the original estimates (KPMG 2000).

Buckwell et al. (1999) estimated that segregation systems requiring zero thresholds of GM content are likely to have significantly higher costs of segregation relative to those systems with non-zero thresholds. For example, Buckwell et al. (1999) estimated that segregating soybeans with a zero tolerance would result in cost increases of up to 149 per cent, while segregating soybeans with tolerance levels of 0.1 and 1 per cent would result in cost increases of around 10 per cent. (Box 3.4 provides a context for considering the use of 'thresholds' for GM content.)

A third finding of the studies is that the costs of segregating systems (and therefore labelling arrangements) are likely to vary according to the nature of the crop being grown and the type of products obtained from that crop (Buckwell et al. 1999; KPMG 2000).

Fourth, segregation costs are also likely to differ significantly depending on the nature of the segregation system. Buckwell et al. (1999) has argued that costs can be significantly higher where segregation systems are initiated in parallel with existing commodity systems and operated by organisations that handle both GM and non-GM products, than when closed and dedicated systems of sourcing are used.

Box 3.3 **Estimated costs of labelling GM food**

KPMG conducted two major studies into the costs of introducing mandatory labelling for GM food in Australia. These studies included estimates for labelling regimes that require the labelling of foods that are 'substantially equivalent' as well as foods that are not 'substantially equivalent'.

KPMG 1999

In 1999, KPMG estimated that the cost to Australian industry for mandatory labelling with a zero GM tolerance could be around $3 billion in the first year, falling to $1.5 billion per year thereafter. This would equal approximately 6 per cent of the turnover of food manufacture in the first year, and 3 per cent of turnover in subsequent years. These estimated costs include the costs of segregating food and altering food packaging. KPMG estimated that some major ingredients could rise in price by around 10-15 per cent. These estimates assumed that manufacturers would assess all ingredients (including compound ingredients, processing aids, additives and flavourings) for their GM status. These figures are considered to represent the highest cost option or 'worst case' scenario for industry (ANZFA 2000a).

KPMG 2000

Subsequent research lead by KPMG estimated that the costs could be much lower for a less onerous scheme. The ongoing costs of compliance were estimated at $107 million per year, and additional ingredient costs would be around $207 million per year. Set-up costs were estimated to be $176 million, with ongoing monitoring and enforcement costs of $0.85 - $14.5 million. The report indicated that food production costs could increase by 0 to 6 per cent.

Explaining the differences

The estimates in the 1999 and 2000 studies were both based on zero tolerance of GM content and no exclusions. However, the more recent study assumed that firms investigated the GM status of their products up to the point considered 'reasonable' using a common law 'due diligence' standard of care, while the 1999 report assumed that firms undertook full assessments of all ingredients. However, KPMG (2000) noted that some of these cost differences might also be due to the different and more limited scale of the research in the 1999 report.

Sources: ANZFA (2000a); KPMG (1999) and (2000).

Fifth, the costs of segregation systems may fall over time. It may be possible to achieve improvements in efficiency over time, for example, as operators become more experienced in isolation practices, and as they achieve economies of scale in processing and handling (Buckwell et al. 1999).

Another influence on the cost effectiveness of mandatory labelling is the enforcability of labelling requirements — considering both the limitations of detection and analysis methods, and the costs of applying them. Enforcement may

be particularly difficult, for example, for some processed foods in which novel DNA is no longer identifiable (KPMG 2000). Absence of effective enforcement may diminish consumer confidence in the regulatory system covering GM products or other non-GM products.

An important consideration in assessing the costs of mandatory labelling is the distribution of the costs across different groups in the community, particularly the extent to which cost increases may be passed on to consumers. ANZFA (1999e) noted that product manufacturers would be expected to carry the cost of mandatory labelling initially, but that these costs would be passed onto consumers through higher retail prices.

Ultimately, the extent to which cost increases are passed on to consumers will be determined by the nature of the demand and supply of affected products. Producers will be able to pass on at least some of the cost increases to consumers where there are few or poor substitutes for the product. However, where many substitutes are available, producers will be less able to pass on these costs and thus will bear more of the labelling costs. Nevertheless, if all producers in a particular market are required to undertake segregation and verification activities, then cost pressures across the market would be expected to emerge. This increases the likelihood that costs will be passed on to consumers because fewer substitutes would be available which would not face cost increases.

Box 3.4 **'Thresholds' and 'tolerances' in food production**

Thresholds or tolerances are commonly used in food production. In the case of grains, 'thresholds' are often used because it is difficult to eliminate all possible co-mingling in terms of grade, quality and type throughout harvesting, storage, transport and processing chains, and therefore to ensure the absolute purity of products.

European Union regulations (box 3.2) tolerate up to 1 per cent accidental GM material in a food product before labelling is required:

> The threshold aims at solving the problem faced by operators who have tried to avoid GMOs but who due to accidental contamination still find themselves with a low percentage of GM material in their products. It will thus offer legal certainty to those operators. (European Union 1999, p.1)

In Europe, there is also a 5 per cent 'tolerance' of non-organic material allowed in some processed foods derived from, and labelled as being made from, organic ingredients. The Australian National Standard for Organic and Bio-dynamic Produce 1998 also allows up to 5 per cent non-organically derived ingredients in processed products labelled as using organic production methods (Organic Produce Advisory Committee 1998).

Source: Buckwell et al. (1999); European Union (1999); Organic Produce Advisory Committee (1998).

The costs of mandatory labelling of GM food may also represent a larger proportion of total production costs for smaller sized producers to the extent these costs are 'fixed' or decrease as output increases (administration and set-up costs may represent examples of the fixed costs of labelling).

Mandatory labelling also has its limitations, and it cannot be expected to deal with all the consumer issues relating to GM products. While it may assist in reducing the information asymmetries between consumers and producers, and in some cases the gaps in the credibility of information provided voluntarily by firms, it cannot address all the information impediments that may restrict consumer choice (chapter 2). Labelling will not, for example, necessarily reduce possible deficiencies in the overall amount of information held by either consumers or producers (although it may stimulate the search for more information). In addition, consumers are likely to remain poorly placed to acquire and process unaided the potentially complex information that may be necessary to judge effectively the risks and benefits of GM products. This suggests that other forms of government action may also be appropriate, including information collection, research and monitoring, and risk assessment. The OECD (2000c, p. 6) notes:

> Though labelling might allow choice, it would not in itself help answer the question whether there were long-term impacts of GM food — beneficial or detrimental — on human health. Appropriate testing and monitoring measures would be necessary for this purpose.

Finally, labelling does not provide an effective response when governments need to override consumer choices so as to maximise overall social welfare, such as in instances of significant environmental spillover costs or breaches of community ethical standards and norms (chapter 2).

Other issues

Other issues include the degree of consistency of Australia's food labelling laws and those of other countries, particularly our major trading partners. Greater consistency or compatibility with our major trading partners could reduce the costs faced by Australian producers in complying with both Australian and overseas requirements.

Further, the more stringent Australian requirements are, and/or the more they differ from those of other countries, the greater is the possibility of disputes over the legitimacy of Australian labelling laws and whether they act as non-tariff trade barriers in violation of World Trade Organization agreements. Such disputes could harm Australia's trade opportunities.

3.3 Summing up

Both information programs and product labels can help address information related problems consumers may have in making choices about GM products. Information programs can help facilitate consumer choice, and inform public debate and policy making, by assisting public awareness and understanding of GM products. They can also complement other government actions by raising public awareness and understanding of them. Information provided should be credible, relevant and timely.

Providing information is not costless, however, and it cannot be expected to meet all consumers' information needs — especially given the diversity of GM products available, or that may become available. The provision of relevant information also requires the periodic review of information needs, which may change over time. The effectiveness of different approaches to providing information should also be periodically reviewed.

Both mandatory and voluntary labelling can help facilitate consumer choice by providing information at the point of sale. Factors such as the type of information provided, the type and range of products that are labelled, how information is presented, and how the information is interpreted, are important in determining the extent of the benefits from labelling.

There may be benefits from a mandatory labelling scheme if the incentives for voluntary labelling are insufficient to provide adequate labelling from the community's point of view. However, the costs and benefits of mandatory labelling need to be carefully assessed, with costs and benefits likely to depend on the type of labelling scheme introduced. The most onerous labelling requirements may not necessarily be the most beneficial from the community's perspective. The technical ability of firms to comply with, and for government agencies to enforce, mandatory labelling arrangements are also important considerations, as are Australia's international obligations.

There is also a need for the periodic review of labelling arrangements. This reflects the potential for the number and nature of GM foods to change; improvements in methods of detection and segmentation; changes in responses by firms and third parties (such as increased voluntary labelling and certification); changes in consumer attitudes and information needs; improved scientific knowledge of genetic modification; and developments in GM food labelling by Australia's major trading partners.

4 Policy options: Licences, standards, moratoriums and bans

In addition to information based strategies to help facilitate consumer choice, governments have several policy options to directly regulate GM products, producers of them and the processes used in their development and production. Governments can also use many of these options to address spillover problems from the production or consumption of GM products, thus improving community welfare. This chapter briefly reviews some advantages and disadvantages of several of these policy options, including licensing schemes, product standards, and moratoriums and bans.

4.1 Licensing schemes

Licensing schemes provide a means of pre-market identification and/or assessment of producers, production processes, and final products. They can also be used to limit the number of operators conducting certain activities where this may help overcome excessive use or consumption of a resource. Licensing schemes generally include the following characteristics:

- the notification of an activity or business to the licensing agency, which can include a requirement that the organisation supply information on what work they anticipate undertaking and how and where they plan to conduct it;
- the approval of an activity, organisation and/or its facilities by the licensing agency before the organisation commences the activity or business; and
- the use of conditions and requirements that can apply to the staff or process employed, or to the final product or output generated (BIE 1996).

Licensing schemes therefore provide a mechanism for assessing the likelihood of potentially negative consequences, which provides an opportunity for either prohibiting an activity before it occurs, or introducing conditions to manage

potential risks.[1] Such schemes are generally used in addition to product liability laws, negligence laws and environmental laws, and can incorporate the use of product standards.

Various participants in the public debate on GM products support these types of pre-release or market assessments. Hansen (1999, p. 5) argues that:

> Consumers feel safety must be assured through stringent pre-market review by government regulatory authorities of potential health and environmental risks.

The National Farmers Federation (1999a, p. 16) states:

> ... there is a need for the control and rigorous testing in a transparent manner of agricultural biotechnology products, based on sound scientific principles prior to their release onto the market or the environment.

The Commonwealth Government has proposed a system of notifications and licences to regulate all 'dealings' involving GM organisms (GMOs) (that is, research, manufacture, production, commercial release and import) (IOGTR 1999a). These arrangements require the Gene Technology Regulator (GTR) to be notified of all non-exempt dealings with GMOs. Further, it is proposed that the GTR must undertake case by case pre-release assessments of all dealings involving GMO field trials and commercial releases of GMOs into the environment. It will also require the certification of organisations involved in developing or using GMOs (box 4.1). Appendix B provides further information on these proposed arrangements and identifies existing oversight arrangements (which are primarily provided under voluntary arrangements by the Genetic Manipulation Advisory Committee and the Interim-Office of Gene Technology Regulator).

Existing product regulators such as the Australia New Zealand Food Authority, Therapeutic Goods Administration and the National Registration Authority handle the oversight of most GM products (as opposed to GMOs). These organisations administer various regulatory arrangements including product standards, pre-market assessments and licensing (Appendix B).

Potential benefits of licensing schemes

Licensing can be a useful means of addressing several of the potential impediments to achieving socially optimal outcomes in relation to GM products (chapter 2). First, licences can offer a means of addressing information problems by providing signals

[1] An alternative approach, known as negative licensing, allows activities until unacceptable outcomes occur, in which case the organisation responsible is prohibited from undertaking further activity, or only allowed to continue subject to specific conditions.

to consumers that a producer and/or its products meets certain standards, and by providing incentives for producers to meet certain product quality levels. Thus, licensing can help overcome information asymmetries between producers and consumers, and restrictions consumers may otherwise face in processing information. Second, licences can be useful in addressing 'spillovers' and achieving other social goals by attaching requirements or conditions — such as the development of environmental management plans and strategies, compliance with community standards, or the meeting of community service obligations.

Box 4.1 **Proposed licensing and accreditation scheme**

Licensing 'dealings' with GMOs

Under the Commonwealth Gene Technology Bill 2000, licensing is required for all 'dealings' with GMOs, except those considered to be 'notifiable low risk dealings' or 'exempt dealings'. Dealings include research, manufacture, production, commercial release and import. Low risk dealings would not require licensing on a case by case basis, but would require some regulatory oversight by the Gene Technology Regulator. Some laboratory-contained work could be prescribed as a 'notifiable low risk dealing' provided the GTR is satisfied it poses minimal risk. No field trial or other deliberate release of a GMO into the environment, however, could be considered as a 'notifiable low risk dealing'. Exempt dealings involve very low risk dealings and occur within specified parameters.

Accrediting organisations

The Bill also proposes the development of an accreditation scheme for organisations involved in genetic modification. Under the scheme, the GTR would assess the type of activity proposed to determine whether the organisation is capable of undertaking them in a safe manner. Organisations would be accredited where they could demonstrate that they have established, and will maintain, an Institutional Biosafety Committee (IBC) in accordance with the GTR's guidelines. An IBC is an in-house unit which is qualified to take up some policing responsibilities. It may, for example, oversee much of the routine research work involving genetic modification, certify low level containment facilities and advise the GTR of any breaches of the legislation that come to its attention.

Source: IOGTR (1999a) and (1999b).

Some of the specific benefits claimed for the licensing of GM products include:

- the protection of human health and the environment, and the maintenance of ethical standards — this may be achieved through the requirement of pre-release or pre-market assessments and the potential attachment of conditions to licences. In determining whether to grant a licence under the proposed arrangements in the *Gene Technology Bill 2000*, the GTR would have to assess it against policy principles and guidelines, such as ethical guidelines, issued by a ministerial

council comprising of ministers from the Commonwealth and State and Territory governments. If acceptable under these guidelines, the GTR would then assess an application for health and environmental risks. If necessary, it would attach conditions to, or prohibit, any activities that it considered to involve unjustifiably high risks, or breaches of community ethical standards;[2]

- the improved ability to monitor GM products — this may allow regulatory agencies to target inspection activities and audits more efficiently (BIE 1996), monitor environmental impacts, and assist in identifying potential problems that other organisations may repeat; and

- increased consumer confidence in GM products — this may be achieved via the exclusion of poor quality suppliers or products from the market. This may be beneficial to the extent that confidence is below what it would be if consumers had access to appropriate information and could evaluate it efficiently (chapter 2).

Further, as the Office of Regulation Review (1995) noted in its review of the enforcement of Australia's food laws, licences can increase business awareness of product safety issues and regulations (which can help overcome a common source of non-compliance).

Producers have an incentive to observe licence requirements in the knowledge that they risk penalties or the forfeiture of their licence if found breaching licensing requirements. In the Commonwealth *Gene Technology Bill 2000*, for example, organisations may be fined for breaches of the law. The need to gain approval for licence renewals may also provide a bargaining tool for government agencies to encourage improved compliance with laws (ORR 1995).

The size of the potential benefits from licensing schemes depends on several factors. They are generally likely to be greater when:

- there is a large variation in the quality of the products or the organisations involved in producing or using GMOs or GM products — a variation which would otherwise raise the costs for consumers of attaining and assessing information necessary for decision making;

- evaluating a GM product requires significant technical expertise which consumers may not have (chapter 2);

[2] An example of a condition that may be attached to a licence could be the requirement to establish buffer zones between GM crops and non-GM crops, or between GM crops and natural vegetation or habitat that may be at risk from cross-pollination.

- the potential adverse consequences from poor product quality for consumers or the spillover effects on others or the environment are significant, irreversible or expensive to reverse;

- it is hard to detect a problem once it has occurred and to attribute liability to the party at fault (an issue that can restrict product liability laws, tort laws and negotiated agreements and contracts). This situation is most likely when products have significant 'post-experience' qualities (chapter 2), or environmental impacts are difficult to trace; and

- there is limited knowledge and understanding of, and thus considerable uncertainty about, GM products such that 'precautionary' action though pre-release and pre-market assessment, including risk assessment and management, may be useful (BIE 1996). Such action may be appropriate, for example, for GM crops if their environmental impacts are not well known or are likely to vary depending on where they are planted and the conditions under which they are grown.

GM products currently exhibit many of these characteristics, so licensing and associated pre-release and pre-market assessments would appear to offer significant benefits to the community. However, these benefits need to be weighed against the associated costs, and both the benefits and costs will depend on the design of the licensing scheme and its implementation.

Potential costs of licensing schemes

Despite the potential for licensing schemes to improve consumer and community welfare in relation to the development and application of GM products, they also impose costs on organisations, governments and the community. These costs can include:

- the resource costs imposed on organisations in attaining licences;
- the resource costs of any adjustments that organisations have to make to their operating behaviour to meet licensing requirements;
- welfare losses due to any delays in product releases or prohibitions of products (which can include benefits to consumers or the environment (chapter 1) that are forgone as result of licensing schemes);
- the monitoring and administration costs to government of running licensing schemes (such as the costs of assessing applications, monitoring performance and imposing penalties. If these costs are passed on to organisations involved in using GM products, then while the burden of them shifts from taxpayers to such organisations, they remain real resource costs to the community); and

- the efficiency costs of any potential decrease in competition through possible restrictions on the number of licence holders, or unwarranted barriers (caused by the stringency or burdensome process of licensing requirements) to organisations wishing to be involved in the use of gene technology.[3]

To the extent these cost pressures occur across all producers, or licence requirements act as a barrier to entry which leads to reduced competition, the price of GM products may rise and the range of products available to consumers may diminish. However, whether competition is reduced will depend not only on the number of actual and potential producers of GM products, but also on the existence of producers of similar and substitutable non-GM products. These costs will most adversely affect consumers who would not ordinarily choose to pay for the higher level of 'quality assurance' that licensing schemes may provide.

Factors influencing the cost effectiveness of licensing schemes

Factors that may influence the cost effectiveness of licensing schemes, and thus need to be considered in scheme designs, include:

- the efficiency of granting licences — as an example, 'one-stop-shops' may be used so applicants can go to one central agency for their licensing requirements, and effective coordination between government agencies can minimise duplication and unnecessary delays;

- the ability to identify and target problem areas through regulatory assessments and requirements — if the processes or facilities targeted by regulatory agencies (such as the level of GMO containment in an organisation's facilities) are good indicators or proxies for likely outcomes then licences are more likely to be effective;

- flexibility in licensing schemes — including the ability to issue different classes of licences and conditions to reflect different circumstances and risks associated with various applications of genetic modification. Risks associated with GM crops, for example, may vary according to the specific modification undertaken and the location of any field trials or commercial releases. Net benefits to the community are more likely if policy responses are closely aligned and proportionate to the nature and magnitude of the problems being addressed and to the potential benefits from the use of gene technology;

[3] This may be an advantage, however, if a goal of government policy is to reduce access to a common resource (where uninhibited access will lead to the inefficient overuse of a resource). Access to genetic resources may benefit from such approaches, for example.

- the adoption of rigorous, transparent and consultative processes — which can contribute to more informed and accountable government decisions, and greater confidence in regulatory systems;

- the ability of regulators to review and enforce compliance with required conditions; and

- the efficiency and equity of cost recovery schemes. While cost recovery measures such as licensing fees can also be used as a form of spillover tax/subsidy, risk premium tax or insurance scheme measure, the use of licensing fees for these purposes should be assessed on their own merits and not assumed to be appropriate simply because 'spillovers' or risks exist.

Finally, because licences are only one of a number of means of dealing with information related problems and spillovers, they need to be compared against other options to determine their overall usefulness in relation to GM products. Licences may also be considered as complements to other policy measures. If licences can offer additional net benefits to the community, they may form part of an appropriate mix of policy measures covering GM products.

4.2 Product standards

Product standards are intended to reduce the negative impacts of an activity or product by requiring producers to meet certain minimum benchmarks, or to undertake specific activities. They may relate to all products of a certain type (for example, all food products or all pharmaceutical products), or only GM products (for example, GM food). Product standards in this context differ from product liability laws, which refer to generic laws or rules that apply to all products such as common law and the *Trade Practices Act (1974)*. Product standards can form part of a licensing scheme or may be used separately.

Product standards may be mandatory, as set out in statutes, regulations or ministerial orders, or voluntary, as recommended by technical committees, industry associations or private certification organisations. They can involve enforcement before a product is sold, such as via pre-market assessments and audits of production processes, or after production and sale, such as after market product reviews, monitoring and responding to complaints.

Product standards can be classified as being either:

- prescriptive (or process based) — whereby standards specify the technical means for attaining specified outcomes, such as specifying that facilities must

have certain equipment or characteristics, or that specific distances must be maintained between GM crops and neighbouring properties; or

- performance based — whereby standards specify the desired outcomes in precise terms but allow individuals to determine their own techniques for achieving the outcome (such as specifying maximum tolerance levels for certain toxins in a final food product); or

- principles based — whereby standards describe the objective in general terms and require interpretation according to the circumstances (such as specifying that all food must be safe) (ORR 1998).

Currently, several standards are enforced in relation to GM products to help protect the health and safety of consumers. All food (whether genetically modified or not) is required to be safe under the Australia New Zealand Food Standards Code. Further, under Food Standard A18, all foods produced using gene technology are subject to compulsory pre-market safety assessments conducted by ANZFA (1999c). This arrangement is similar to that adopted in the European Union.

In the case of pharmaceutical and therapeutic goods, all products sold in Australia (whether genetically modified or not) must undergo a safety assessment process undertaken by the Therapeutic Goods Administration. The Therapeutic Goods Administration also inspects manufacturing premises, conducts routine and targeted testing of products, and monitors adverse reactions. These requirements aim to ensure the quality, safety, efficacy and timely availability of therapeutic goods (IOGTR 1999c).

Potential benefits of product standards

Product standards are often introduced to respond to information problems that consumers may experience in making purchasing and consumption choices. They generally can offer net benefits where the expected costs to consumers of making poor decisions, as a result of inadequate information, are considered high enough to justify the extra costs that such standards may impose to reduce or avoid these problems. Standards can be particularly valuable for ensuring consumer safety where consumers find it difficult to determine whether products are safe. As discussed in chapter 2, this difficulty may arise because the information is hard to collect, or because processing the information is beyond the capacities or resources of some consumers.

Unlike public awareness or labelling schemes, which can inform and facilitate consumer choice, mandatory standards for GM products can seek to influence

purchasing and consumption decisions by restricting choices to only those products deemed 'safe' or 'socially acceptable'.

Product standards can also be used to reduce potential adverse spillovers.[4] If standards require a product to undergo a pre-market assessment before being sold, for example, regulatory authorities have an opportunity to assess a product for any potential spillover effects, such as environmental impacts or ethical concerns. A product standard of this type may be particularly useful when the potential cost of the spillover is great. If a product involves considerable 'post-experience' characteristics (chapter 2) with the potential for catastrophic and irreversible consequences, for example, then direct restrictions may be the preferred approach (Weimer and Vining 1992).

Standards can also be easy to understand, and can provide both consumers and producers with a degree of certainty about product requirements (especially if they are complemented by codes of practice to explain further how to achieve compliance). Standards can also provide a transparent means for consumers, industry and governments to monitor the production and quality of GM products.

The size of the potential benefits from using standards to regulate GM products will depend on:

- the extent to which they provide additional information or protection to consumers or address potential spillovers; and
- how much consumers and the community value the additional information, protection and management of spillovers.

Assessment of the first issue must consider the role of existing product lability laws — including tort law, contract law and consumer protection laws such as the *Trade Practices Act (1974)*. The more capable are these rules (often referred to as 'framework' rules) in efficiently addressing information and spillover problems, the less beneficial product standards for GM products are likely to be.

Tort law, for example, can both lower the expected losses to consumers and increase the incentives for producers to produce safe products by allowing those who have suffered damages to seek compensation through the courts. However, tort laws may be less effective as either a compensation mechanism or a deterrent if potential damages are small (where the legal costs may outweigh the compensation benefits), or very large (where the legal liability of companies, being limited to their

[4] Product standards may also be used to increase potential 'positive' spillovers.

assets, may be below the damage incurred). Further, Weimer and Vining (1992, p. 170) notes about post-experience products:

> ... we expect tort to be least effective in limiting inefficiency of information asymmetry in cases of post-experience goods because of the difficulty of establishing links between consumption and harmful effects.

In addition, reliance on such 'framework laws' can leave producers and consumers less clear about their rights and responsibilities. Legal action under Trade Practices and tort law may also be too costly or operate too slowly to be an efficient method of changing behaviour (ORR 1998).

It is also important to assess the extent to which consumers and the community value the potential improvements in information, health protection or spillover management that product standards may offer. Measuring these improvements, especially regarding health and environmental issues can often be a challenging task. However, identifying potential impacts and making explicit the assumptions used in decision making can assist in the development of appropriate policy responses.

Potential costs of product standards

The use of standards to regulate GM products also imposes costs on the community including:

- the resource costs of any adjustments organisations have to make to their operating behaviour;
- monitoring and administration costs to government;
- welfare losses due to any delays in product releases; and
- the efficiency costs of any potential decrease in competition which may result if standards act as entry barriers to organisations that wish to be involved in the use of gene technology.

Product standards can also limit the range of products available, either by deliberately prohibiting particular products, or by establishing 'quality' benchmarks below which products cannot fall. Establishing minimum product quality levels may be a valuable goal, but lifting the 'quality' threshold is not always in all (or even most) consumers' best interests. Nor is it always clear that a 'quality' or 'safety' attribute for one consumer will also be a quality or safety attribute for another consumer. Given that consumers are likely to have different preferences for different levels of quality, and different valuations of the product benefits which

they weigh up against the potential costs, setting a uniform quality benchmark may have negative effects on consumer welfare.

Given the potential costs of mandatory product standards, voluntary standards and codes of practice could be considered. Voluntary standards developed by industry, for example, can benefit from the expertise of those most familiar with the processes of production, be quickly updated, and perhaps be more readily observed by producers (ORR 1998). Yet they may fail to focus on community objectives sufficiently, may lack the benefits of government enforcement and compliance, and may not have the degree of independence and transparency necessary for community confidence. For these reasons, some groups have rejected reliance on voluntary regulatory arrangements, and favour mandatory government approaches:

> If Australia embraces GT technology [gene technology] it must be subject to stringent control by independent regulatory and advisory bodies. Self-regulation by commercial interests is seen as totally unacceptable. (Lay Panel 1999, p. 3)

That said, there may still be roles for voluntary standards or codes of practice to complement mandatory product standards. These may be developed by industry or regulatory agencies, and include community input. An example is the development of a code of practice covering the use of GM products in agriculture by the Agriculture and Resource Management Council of Australia and New Zealand (1999).

Factors influencing the cost effectiveness of product standards

Several design and enforcement issues influence the effectiveness of product standards. One important factor is the standard's degree of flexibility. Allowing flexibility in how organisations produce GM products, and having standards adjust to particular risk levels where practical, can keep regulatory costs down. Such flexibility may also minimise restrictions on innovation and changes in best practice production processes:

> ... if you set up a system which is there only to monitor process it is quite likely that this system will become obsolete quite quickly, either because people's perception change and they are no longer concerned about the process or because the technology changes which it certainly is doing very rapidly and some new approach comes in which falls totally outside the definition which you have set up. (CSIRO quoted in HoRSCIST 1992, p. 245)

However, more prescriptive or process based standards may be more appropriate if outputs are hard to detect or measure; the consequences of negative effects are large; input measures can act as good proxies for final outcomes; and the certainty of regulatory requirements is highly valued.

It may be more efficient, however, to use a mix of prescriptive and flexible approaches (such as performance based or principle based standards). Such a policy response benefits from the use of the relative efficiencies of various options depending on the circumstances.

Another important factor in determining the effectiveness of product standards is how well they target the problems identified — particularly underlying problems (ORR 1998). An important issue in this context is whether GM products are subject to standards purely because they have been produced using gene technology (regardless of whether they introduce new or increased risks or problems); or because consumers may have particular difficulty in efficiently identifying and managing potential risks or because their use may lead to spillover problems (chapter 2). On this issue, the House of Representatives Standing Committee on Industry, Science and Technology (1992, p. 245) noted:

> The process of manufacture by itself [underline original] is not a good indication of the dangers which may be inherent in the product.

Other factors that can influence the effectiveness of product standards include:

- the clarity of regulatory requirements — regulatory requirements that are clear and understandable can help producers meet obligations and help consumers understand what obligations have been met in producing GM products;
- consistency in enforcement — consistent application of agreed principles of enforcement across producers can enhance efficiency and equity for both producers and consumers;[5]
- efficient and equitable remedies for non-compliance — in general, aligning the expected costs of non-compliance with the expected costs of an adverse consequence due to poor compliance can provide efficient remedies or penalties;[6] and
- consistency with international standards — maintaining greater consistency with international standards can keep compliance costs down for Australian producers and reduce the risks of international trade disputes.

Standards relating to GM products are also more likely to be effective if consumers have confidence in the regulatory system responsible for developing and enforcing

[5] This does not mean that the same specific enforcement practices, styles and approaches need to be applied in each circumstance. See IC 1995 for a discussion of enforcement practices and principles.

[6] That said, punitive damages and equity issues may also need to be taken into account in setting remedies and penalties.

them. An absence of such confidence can restrict the ability of governments to use product standards to signal information to consumers about the safety of GM products, because consumers may not trust or use the information. Consumer confidence in the regulatory system may also reduce consumer anxiety about particular GM products, or GM products in general. It may also reduce the potential for concerns over some GM products to harm the reputation of other GM products:

> The trouble is that amid all the noise virtually anything to do with 'genetic engineering', whatever the benefits, is in danger of becoming taboo. (Johnston 1999, p.3)

The ability of governments to define, and enforce, product standards that efficiently address information and spillover problems will also depend on policy makers' access to appropriate information and analytical tools. If regulators, or those involved in influencing regulatory decisions have a poor understanding of GM products and their effects (direct and indirect) then standards may be set inaccurately. If standards are too strict they can excessively restrict production (including the production of new products that may have beneficial effects on human health or the environment). If they are too lenient they can fail to protect or inform consumers adequately (or protect the environment). Periodic review of products standards can influence their effectiveness by helping to ensure they keep up with technological developments, and changing priorities, problems and opportunities.

4.3 Moratoriums and bans

Moratoriums and bans can be introduced to eliminate, or significantly reduce, the negative impacts of an activity or a product by legally prohibiting that activity/product, either temporarily (moratoriums) or permanently (bans).

Moratoriums or bans may be applied to:

- all GM products;
- classes of products, such as GM foods or GM pharmaceuticals; or
- selected products, such as a particular GM crop or food product.

Most public debate has related to bans or moratoriums on the use of genetic modification in agriculture, covering either all agricultural applications or selected products. This may reflect the more widely accepted benefits, and fewer environmental concerns, of gene technology in medical applications (Biotechnology Australia 1999b; Grove-White et al 1997).

Calls for bans or moratoriums on the use of genetic modification in agriculture and food production have come from several sectors. The Organic Federation of Australia (1999b) called in 1999 for a blanket moratorium on genetically engineered foods in Australia. Further, a number of environmental groups have called for a five year blanket ban on the growing of all GM crops in Australia outside the laboratory (Australian Environment Review 1999). Some business leaders have made similar calls (Shears 1999).

New Zealand has introduced a 12 month voluntary moratorium on releasing GMOs into the environment and on most field testing while a Royal Commission of Inquiry is held into genetic modification (Ministry of Research, Science and Technology 2000).

In Australia, only Western Australia and Tasmania have decided to introduce any broad based moratoriums or bans.[7] Western Australia has introduced a two year moratorium on the commercial growing of GM crops, although contained and field trials are allowed to continue. Tasmania has decided to impose an interim moratorium on the importation, field trials and commercial growing of GM crops. Tasmania has indicated, however, that trials in laboratories, plant houses and other contained facilities would not be prohibited (Llewellyn 2000).

Moratoriums or bans on selected GM products have also been discussed, and several have been introduced in Europe. Germany, Austria and Luxembourg have banned the use of GM corn, for example (Hansen 1998; Reuters 2000). Hansen (1999) has called for bans on certain applications of gene technology, including the use of 'terminator technology' and antibiotic resistance marker genes.[8]

Advantages of moratoriums or bans

Moratoriums and bans can be used to counter information problems some consumers may have in making choices about GM products. Prohibiting the sale of GM products may prevent consumers from purchasing GM products that are not in their best interests, but which they may have otherwise purchased due to a lack of adequate information. If 'cross-species' products were banned, for example, this may help vegetarians who wish to avoid food products that contain genes taken from an animal.

[7] Although several local councils have decided to ban the growing of GM crops in their local area.

[8] Terminator technology refers to a technique that genetically makes plants infertile. Antibiotic resistant marker genes are used as markers to identify the transfer of genetic material from one organism to another. By making the transferred genetic material resistant to a specific antibiotic, a user can expose cells to that antibiotic and locate those cells that have been genetically modified (because they will be the ones that continue to grow and divide).

Moratoriums and bans can also be used to override consumer choices where these may otherwise reduce community welfare, such as through potential environmental damage or the breach of community standards. A moratorium or ban on the use of GM products in agricultural production, for example, may be used to avoid possible cross pollination problems or the development of more resilient weeds or pests (chapter 1).[9]

Arguments in favour of moratoriums or bans have included:

- the potential to rapidly minimise risks;
- the potential to offer certainty to domestic producers and consumers about what is (or is not) an allowable practice; and
- opportunities to promote Australian produce as GM-free.

On this latter point, it has been argued that prohibiting the production of GM crops in Australia may help some Australian producers sell GM-free or organic products, particularly in overseas markets (and in doing so overcome potential or perceived spillovers from GM crops to non-GM crops which may otherwise harm the sales of GM-free products — chapter 2). Similarly, it has been argued that such prohibitions will help in maintaining and developing a 'clean and green' image for Australian agricultural products. The size of these potential benefits will partly depend on the extent to which Australian producers as a collective group can successfully sell both GM and GM-free products. The more the production of GM and GM-free crops can co-exist (perhaps through segregation and certification systems), the smaller these potential benefits from moratoriums or bans are likely to be.

Such arguments for prohibiting GM products need careful assessment. Some producers may gain from such prohibitions, others may lose. Moreover, it has been argued that Australia can sell both GM and GM-free products through the use of segregation and certification systems such that these benefits of bans or moratoriums may not exist in practice (although the costs would remain). Assessment of these arguments must also consider the effects on Australian consumers and the environment.

Some sections of the community consider moratoriums and bans an appropriate response to the potentially uncertain or unknown effects of GM products (chapter 1). It has been argued that they may provide consumers, producers and

[9] To be effective such a ban would probably have to be aimed at the production or use of GM products in agriculture rather than at the sale of such products to consumers (because otherwise producers would be able to continue to produce GM products for overseas markets).

governments with the chance to develop their understanding of GM products before making decisions about their use. The Organic Federation of Australia (1999a, p. 2) notes:

> ... [it] supports first and foremost a moratorium or freeze on the further introduction of genetically engineered crops or foodstuffs into Australia. There are still opposing views as to the safety of GE foods for human health and environmental health.

Disadvantages of moratoriums and bans

While bans and moratoriums may offer benefits to the community, they also have some significant drawbacks. In particular, they are relatively blunt policy instruments, and can have the effect of prohibiting socially beneficial activities as well as harmful ones. By providing a standardised response to a potentially wide range of activities or products, and over a wide range of consumers, they can fail to account for the various circumstances under which activities involving GM products may provide net benefits. Risks and benefits may vary, for example, across geographic location, or among GM product varieties or types. They may also vary across individuals in the community, who will often have different preferences, value systems and beliefs about GM products.

The wide range of potential applications of gene technology suggests that GM products are not a homogeneous group of products for which standardised responses are likely to be appropriate. A House of Representatives Standing Committee on Industry, Science and Technology (1992, p. 86) notes:

> The Committee considers that it would be an over-simplification to treat all products produced by genetic manipulation techniques as being equally hazardous.

Further, bans and moratoriums that apply for long periods may lack flexibility in responding to change. Progress in technology, increasing knowledge of the impacts of GM products, potential changes in the economic, social and environmental contributions of some GM products, and changes in the environment, can all alter the balance of risks and benefits from GM products. Consumers' preferences and attitudes towards GM products may also change.

In addition, if other policy options are introduced, or if organisations, industry and secondary sources of information begin to address some of the information impediments that may be restricting consumer choice (chapter 2), then some of the reasons for imposing a ban or moratorium may diminish.

Other arguments against the use of bans and moratoriums include:

- reduced incentives for industry to develop GM products or technologies that may provide net benefits to Australia and Australians in the future;[10]
- welfare losses due to the higher costs of producing products that could have been produced using gene technology (and which may include more intensive use of scarce natural resources such as agricultural land and water);
- welfare losses to some consumers or producers if GM products are no longer sold or produced in Australia;
- the potential adjustment costs of introducing a prohibition on current activities that involve GM products;
- the potential for trade disputes and the resulting loss of trade (which could affect a range of products) if bans or moratoriums are introduced on the sale or importation of GM products;
- limitations on individuals' freedom of choice; and
- the potentially high costs of monitoring and enforcement, and the possibility of 'black market' operations where GM products may be harder to control (Wartburg 1999).

It has also been argued that introducing a moratorium or ban means that individuals, society or the environment may forego unknown potential benefits and advantages (Wartburg 1999).

Factors influencing the cost effectiveness of moratoriums and bans

As with other policy options, whether bans or moratoriums are justified depends on the expected costs and benefits associated with them, and how these compare with the net benefits of alternative policy options. Bans and moratoriums are generally more likely to be effective policy options when:

- the risks of adverse outcomes are severe, irreversible and hard to foresee;
- the expected benefits of the activities to be restricted are small;

[10] These negative incentives may diminish to the extent that researchers and producers of GM products anticipate that restrictions will be lifted in the future.

- they can be closely targeted at those activities or products that pose unacceptable risks and they avoid prohibiting current or future activities or products that offer net benefits; and
- there is a degree of flexibility and opportunity for review and re-assessment.

While bans and moratoriums can represent effective policy options, they are a highly restrictive approach and such decisions should not be made without careful analysis.

4.4 Summing up

Licensing schemes, product standards, and moratoriums and bans can be used by governments to address information and spillover problems that may otherwise constrain consumer choice and reduce community welfare.

Licensing schemes may be particularly effective where risks are significant, irreversible, not well known or hard to assess, and where market responses are unlikely to be adequate. In these circumstances, pre-market assessments and monitoring arrangements associated with licensing may be particularly useful.

Product standards may form part of a licensing scheme or be used separately. They have the potential to improve incentives for more efficient and equitable outcomes compared to relying on market responses and product liability laws. They may do this by making producers' responsibilities clearer, more explicit, more enforceable and, where necessary, more comprehensive.

However, licensing schemes and product standards impose costs on producers and the community, and these should be considered in their design and implementation. The most restrictive or onerous arrangements may not necessarily be in the community's best long term interests.

Both licensing schemes and product standards are likely to more cost effective if requirements reflect the risk of different types of GM products and their different uses, and the potential benefits they may offer the community. Requirements which focus on outputs rather than inputs are more likely to allow organisations flexibility in how they meet regulatory objectives, minimising restrictions on innovation and best practice production processes. Arrangements that are consistent with international standards, and are clear and enforceable, are also likely to be more effective.

Moratoriums and bans can prohibit the development and/or use of GM products. They may be useful in response to very significant information or spillover problems (if the benefits outweigh the costs and more efficient options are not available). While they may also be used strategically to assist some GM-free producers, effects on GM producers and consumers, and the community as a whole, need to be considered before making such decisions. By providing a standardised response to a potentially diverse range of activities and products, and over a range of consumers, they may fail to account for the various circumstances under which GM products may provide net benefits to the community.

In all cases, policy options should be selected only after carefully assessing their costs and benefits across the community. All policies should be subject to regular review to ensure they remain relevant and represent the most cost effective means of achieving government objectives.

Appendix A: Field Trials in Australia

There were 45 applications for field trials of genetically modified (GM) organisms in Australia in 1998–99, up 29 per cent on the number in 1997–98 (Ernst and Young 1999). Tables A.1 and A.2 summarise GM plants used in field trials and the location of deliberate releases of GM organisms in Australia.

Table A.1 **Genetically modified plants in field trials within Australia 1991–99**

Crop	*Trait*	*Crop*	*Trait*
Canola	• Improved agronomic performance	Cotton	• Insect resistance
	• Herbicide tolerance		• Herbicide tolerance
	• Resistance to fungal disease		• Water logging resistance
	• Photoperiod insensitivity		• *Verticullium* wilt tolerance
	• Reduced antinutrional content	Wheat	• Modified grain qualities
	• Dwarfing cultivars	Barley	• Barley yellow dwarf virus resistance
	• Reduced pot shatter	Oilseed poppy	• Pharmaceutical content
Sugar cane	• Modified sucrose metabolism	Subterranean clover	• Herbicide tolerance
	• Improved juice colour	White clover	• Alfalfa mosaic virus resistance
	• Leaf scald disease resistance	Lupins	• Herbicide tolerance
Field peas	• Pea weevil resistance		• Virus resistance
	• Enhanced nutritional value		• Enhanced nutritional value
	• Ascochyta blight resistance	Tomatoes	• Fruit ripening and flavour development
Potatoes	• Virus resistance		• Herbicide tolerance
	• Reduced browning		• Insect resistance
Pineapples	• Flowering and ripening improvement	Grapevines	• Reduced browning
Papaya	• Virus resistance	Lentils	• Herbicide resistance
Lettuce	• Virus resistance	Apple	• Gene market trials
Carnation	• Modified colour	Chrysanthemum	• Modified colour
Roses	• Modified colour		

Source: Higgins (2000).

Table A.2 Locations of deliberate releases of genetically manipulated organisms in Australia (to June 1999)

State	*Organism*	*State*	*Organism*
Australian Capital Territory	Barley	**South Australia**	Barley
	Clover		Canola
	Field pea		Field pea
	Potato		Indian mustard
	Pseudomonas		Potato
	Rhizobium		*Pseudomonas*
	Wheat		Wheat
New South Wales	Baker's yeast	**Tasmania**	Canola
	Canola		Indian mustard
	Clover		Poppy
	Cotton		Potato
	Field pea	**Victoria**	Canola
	Fowlpox virus		Carnation
	Helicoverpa armigera		Clover
	single-enveloped		Field pea
	Nucleopolyhedrovirus		Grapevine
	Indian mustard		Indian mustard
	Potato		Potato
	Tobacco		Rose
Northern Territory	Cotton		Tomato
Queensland	Apple		*Salmonella*
	Bovine herpes virus	**Western Australia**	Canola
	Canola		Clover
	Cotton		Cotton
	Papaya		Field pea
	Pineapple		Lentil
	Potato		Lupin
	Pseudomonas		*Salmonella*
	Sugarcane		
	Tomato		

Australia-wide (general release)

Organism	*Modification*
Agrobacterium	No Gall pesticide
Carnation	Improved vase life and altered flower colour
Cotton	Insect-resistant (restricted to parts of Queensland and NSW)

Source: GMAC Annual Report (1999).

B Regulatory arrangements for GM products

In Australia, genetically modified (GM) products are subject to control under five main regulatory systems.

- Foods are regulated under State and Territory Food Acts, with the Australia New Zealand Food Authority (ANZFA) responsible for developing food standards under the *Australia New Zealand Food Authority Act 1991 (Cwlth)*. The Australia New Zealand Food Standards Council makes the final decisions on food standards.

- Therapeutic goods are regulated under the *Therapeutic Goods Act 1989 (Cwlth)*, which is administered by the Therapeutic Goods Administration (TGA).

- Agricultural and veterinary chemicals are regulated under a suite of Commonwealth Acts administered by the National Registration Authority (NRA) and accompanying State/Territory legislation.

- Industrial chemicals are regulated through the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) under the *Industrial Chemicals (Notification and Assessment Act 1989 (Cwlth)* and accompanying State/Territory legislation. The National Occupational Health and Safety Commission administers NICNAS.

- Imports and exports are regulated under a suite of Commonwealth Acts administered by the Australian Quarantine and Inspection Service (AQIS) and Environment Australia.

The Interim Office of Gene Technology Regulator (IOGTR) and its expert advisory body, the Genetic Manipulation Advisory Committee (GMAC), underpin the above mentioned arrangements by overseeing an administrative system which provides advice on the biosafety risks of research and release activities involving GM organisms and products. In particular, the IOGTR oversees the use of GM organisms and products in contained research (such as in laboratories), field trials and general releases into the open environment. This role involves assessing research and release activities regarding GM organisms and products for risks to

human health and the environment. The IOGTR and GMAC do not have statutory powers and their controls are currently voluntary.

The Commonwealth Government has proposed new regulatory arrangements including the establishment of an Office of the Gene Technology Regulator (GTR) which will regulate (with legislative backing) all aspects of the research and release of living GM organisms. The GTR will also regulate the sale of GM products where no other existing regulatory body (see above) has responsibility.

The proposed arrangements are intended to form part of a national system of regulation and oversight with the States and Territories passing complementary legislation. The establishment of a ministerial council comprised of ministers from Commonwealth and State and Territory governments is also proposed to oversee developments and applications of gene technology, and to issue principles and guidelines for the GTR.

The GTR and the ministerial council will be supported by three advisory bodies: the Gene Technology Technical Advisory Committee (based on GMAC), the Gene Technology Ethics Committee and the Gene Technology Community Consultative Group.

These regulatory arrangements are in addition to other laws that apply to non-GM and GM products, such as product liability laws, competition laws and common laws. For further information on existing and proposed regulatory arrangements for GM organisms and products see http://www.health.gov.au/tga/genetech.htm.

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