

Science Controversies and Public Policy:
A Case Study of Genetically Engineered Food

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ABSTRACT

Public cynicism toward the government's capacity to regulate in the public interest is apparent. Therefore garnering support for certain policies can be difficult, especially where a scientific controversy emerges. Scientific and technological innovations bring about social change which generally results in public resistance. The purpose of this thesis is to illuminate the difficulties of using science to formulate policy in an area of controversy, the example used is that of genetically engineered (GE) food.

This thesis is divided into three sections. The first is an analysis of the positions taken by four interest groups with regard to key issues associated with the regulation of GE food. The arguments advanced have a common tie: that the scientific risk assessment process used to licence GE crops is insufficient because it precludes socio-economic considerations. The second section is devoted to the question of whether the federal government allowed the controversy to develop by adopting a promotional approach toward the technology and neglecting to take into account how the public's understanding of science differs from that of scientists. The last section is an analysis of the final reports issued by three committees mandated by the federal government to study different aspects of the regulation of GE food. The argument presented is that the three committees were given limited mandates which precluded other important considerations from the final reports. The thesis concludes by accepting that there are no clear methods of securing public approval but that the government has compromised its neutrality and the credibility of the licensing approval process by relying on positivist and promotional approaches toward the technology.

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DEDICATION

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Introduction

Biotechnology, as with other scientific discoveries and technological improvements, is controversial because it brings about social change. Genetically engineered (GE) food is but one specific illustration of problems inherent in the relationship between science and public policy in Canada. While being framed as a scientific issue, public resistance is met because food is an emotive issue. The framing becomes one of an ethical and social nature as opposed to scientific. As a result, the controversy surrounding genetically engineered foods has many facets, of which concerns relating to economic, moral, and social issues are predominant. Moreover, there is a deep-seated disillusionment with government's capacity to regulate in the public interest. There are questions as to whose interests are being represented in the regulatory process and if the regulatory regime is capable of protecting the public from unforeseeable harm. As a result, calls are heard from various societal actors that they be represented in the policy process. From the government's perspective, obtaining input from these actors lends legitimacy to its final policies and transparency to the process. In effect, GE food is a further illustration of decreased public deference to both government and science. This comes at a time when the former employs the latter to formulate policy in a number of areas.

Developing policies in science-based matters is problematic for two reasons. First, the scientific and policy worlds have different goals and standards which, in turn, lead to different approaches for characterizing and communicating uncertainty

and risk. These differences can render communication amongst scientists, industry, politicians, and the public difficult. Second, the role of scientific knowledge in the policy making arena has been put into question because the assumed status of that knowledge - as objective and neutral in public decision making - has been challenged by some scientists, policy makers, and the public. Moreover, there are new demands to recognize that scientific knowledge can take more than one form in the decision making process. Finally, on all sides, there is an increased demand for more public participation.

Public participation in the debate and policy making arena is perceived as difficult to achieve because the average citizen does not have a strong understanding of the science of biotechnology. Unless there are clear social benefits, it is dubious whether greater scientific understanding correlates to increased trust. Therefore, the problem for the Canadian government to overcome, if it intends to promote the public interest, is how to reconcile scientific advances and public resistance. In the case of GE food, the public's perception of risk is amplified by what is perceived to be a conflict of interest, with the government acting as both a regulator and promoter of the product. Trust must be developed in both the institutions of science and in government in order for biotechnology to gain public acceptance.

My thesis will be a case study addressing the question of how to set and determine public policy in regard to science and technology controversies with a focus on the example of genetically engineered foods. Given that biotechnology is framed in scientific terms, the public debate is limited. Nevertheless, the issue extends beyond merely opening up the process to public consultations. The different perceptions of risk and whether the change instigated by science is socially acceptable

need to be addressed as well. The Canadian federal government has recognized problem areas with regard to the operations of the regulatory regime and subsequent critic concerns. It has attempted to rectify these by mandating three committees to study different areas of contention concerning GE food. This thesis will review and analyze the final reports of these committees, a necessary, and not yet accomplished, contribution to existing literature.

Studies of risk controversies can focus on many different areas such as the storage of nuclear waste or the fluoridation of drinking water. GE food has been chosen as a specific example because it is a timely question. The focus of this thesis is primarily on agricultural crops, yet these are merely the first generation of products, the next generation includes pharmaceuticals, fish and animals. Thus we are only witnessing the beginning of a host of new products and applications of biotechnology which will open a range of social issues and questions. To date, most media attention has been devoted to GE foods in the context of international as well as domestic controversies. Indeed, a political study of genetic engineering could focus on recent Supreme Court decisions concerning intellectual property rights and the ownership of GE mice or canola. Attention could also be paid to international trade disputes such as the court challenge launched at the World Trade Organization by Canada, the United States, and a few other nations against the European Union's moratorium on GE food. While these are important, the primary focus of this thesis is from a risk perspective. That is, how to manage real and perceived risks in order to resolve the controversy.

The first chapter will provide an outline of the existing regulatory regime as it applies to GE food. While brief, the chapter will cover the guiding features of the risk

assessment process used by the federal departments and agencies to arrive at the licence approvals of GE food.

The second chapter will outline competing viewpoints and arguments that are currently taking place between stakeholders involved in the biotechnology debate. Those involved include the biotechnology industry, government, non-governmental organizations and the public. I will argue that meaningful debate is limited due to the belief that scientific knowledge is necessary to participate, which consequently excludes some stakeholders and some approaches. If the controversy is to be resolved, social concerns and the fallibility of scientists need to be a part of any science policy discussion.

Two leading scholars in the science and public policy debate have divided stakeholder arguments into four approaches: positivist, group politics, sociology of scientific knowledge and social structural.¹ The positivist approach accepts the orthodox scientific view and analyzes the issue of genetically modified food from that standpoint. The group politics approach focusses on the activities of various groups, such as government bodies, corporations, citizens' organizations and expert panels to explain the controversy. The third approach, sociology of scientific knowledge or constructivist, is concerned with the nature of both scientific-knowledge and social claims as they apply to the controversy. Constructivism holds that a scientific controversy is the product of social processes and is made overt by the disputants involved within it. Finally, the social structural approach (as its title suggests) uses concepts of social structure and class to analyze society and provide insights into the issue in question.

¹ Brian Martin and Evelleen Richards, "Scientific Knowledge, Controversy, and Public Decision-Making," in *Handbook of Science and Technology Studies*, ed. Sheila Jasanoff, Gerald E. Markle, James C. Peterson and Trevor Pinch (Newbury Park, CA: Sage, 1995), 4-9.

Although many scholars have developed approaches to study public controversies, I have chosen this particular division because it covers a range of approaches that are the most applicable to the GE food controversy. Using the sociology of scientific knowledge approach, I will argue that the Canadian government is relying on the positivist approach which will not successfully resolve the controversial facets of GE food. The reason for this is that the government has a responsibility in a liberal democracy to provide an open dialogue and a balanced approach to science-based controversies. Yet a distinct lack of balance in the presentation of biotechnology in government strategies has been apparent; the dominant tone is one of advocacy for the technology. Science, it appears, is being used as a weapon against critics.

Chapter three will cover some of the inherent problems between scientific and public processes. These have different goals, and consequently, evidentiary standards. It will therefore be necessary to define and discuss scientific risk assessment, risk management, risk minimisation, risk communication and the public interest. These are central to the debate. How they are conceived of and dealt with require attention being paid to both the positive and negative dimensions of public interest: that is to say, promoting well-being and minimising harm.

This chapter will be largely theoretical and will address specifically the paradox between public policy and science-related issues. Risk management relies on scientific risk assessments to estimate the probable harm to persons and environments resulting from specific types of substances or activities. When scientists attempt to take into account varying perceptions of the risk in question, they are constrained by the scope and limitations of their scientific assessment in recommending specific

courses of actions. This becomes a problem when the public interest is determined by using the concept of risk assessment, either because mistakes can be made or because the risk assessment itself is narrow.

Finally, it will be necessary to discuss the concept of substantial equivalence as this is the starting point for regulating GE foods in Canada. The process of substantial equivalence involves a comparison of levels of nutrients, toxins, and vitamins of a GE plant and the plant from which it was derived. If these levels are relatively similar then the novel plant is regulated in the same manner as the original plant. Thus, this approach fails to consider the negative dimensions of the public interest and of scientific risk.

Chapter four will address initiatives taken by the government of Canada to improve the policy debate. The government mandated the Canadian Biotechnology Advisory Committee, the Royal Society of Canada and the Canadian General Standards Board with various tasks to study different issues related to biotechnology. The Royal Society of Canada's Expert Panel on the Future of Food Biotechnology examined the scientific underpinnings of the Canadian system. The committee of the Canadian General Standards Board on the "Voluntary Labelling and Advertising That Are and Are Not Products of Genetic Engineering" was mandated to analyze appropriate labeling strategies. Respectively the two reports were released February 4, 2001 and April 2004. The CBAC Project One: The Regulation of Genetically Modified Foods was left with examining issues that fell between the other two mandates. These included issues such as the governance and transparency of the regulatory system with reports being released on a continuing basis. This chapter will

summarize these mandates and final reports to determine if they offer a sufficient basis to address the gap between science and social issues.

In conclusion, I will state that developing public policy in scientific regulatory issues is a difficult feat for any government. It will be demonstrated that traditional political processes are now unable to deal effectively with many of the emerging issues on which decisions are required because they do not secure public approval. Therefore, if the role of the government is to defend the public interest on questions of policy and values, it must incorporate social problems and develop inclusive policies to represent the wide spectrum of social and scientific interests. Questions to be addressed include:

1. How can the public's perception of science and scientific risk be understood? To what degree should the federal government consider these perceptions when formulating public policy?
2. How should the government determine public policy in science-based matters and which approaches need to be considered?
3. How can meaningful public participation be improved?

This thesis will be a valuable contribution to a new, but quickly growing, body of literature in the fields of science and public policy, and more particularly that of genetically modified foods. This addition will occur through using the case of genetically modified food in the larger context of scientific policy process. To date, there has not yet been a full analysis of the federal government's response to the GE controversy which incorporates the final reports of the three committees. Although the thesis will rely on only the Canadian example, it needs to be recognised that science now permeates all aspects of daily life, and thus, all governments are grappling

with the issue of reconciling public concerns with scientific advancements and the question of formulating policy in the public interest. First, though, it will be necessary to discuss the current approach regulating the biotechnology industry.

Chapter One: The Canadian Regulatory Regime

Biotechnology policy first emerged as part of a larger government innovation strategy in the early 1980s. It was one of a series of policies designed to promote new technologies. The National Biotechnology Strategy of 1983 outlined the government's commitment to encouraging commercial progress through promoting research and development, investment, and market acceptance of the new technology. In response to product licence applications, a new framework was introduced in 1993. This framework provided the foundation to guide regulatory departments on the environmental assessment of unconfined releases of GE foods. It established the category of "plants with novel traits" to regulate crops derived through different processes, such as genetic engineering or traditional cross-breeding.

Here, then, no distinction is made between the different processes of arriving at a new trait or characteristic; the focus of the risk assessment is placed on the final product. Moreover, products derived through biotechnology are regulated under existing legislation and structures, new laws and agencies were not created. In keeping with the category, the federal government employs a broad definition of biotechnology: "the application of science and engineering in the direct or indirect use of living organisms, or parts or products of living organisms in their natural or modified forms."² This definition can apply to such practices as the use of yeast to produce beer or moving genes between unrelated species of animals or plants. In Canada, therefore, regulators do not see a need for a unique form of regulatory

² Canadian Food and Inspection Agency, Science Branch, Office of Biotechnology, "Biotechnology? Modern Biotechnology? GM? GMO? GE? PNTs? What do these terms mean?" <<http://www.inspection.gc.ca>> (Retrieved 1 March 2004).

oversight for GE food because potential risks are the same as those found in conventional products. For example, toxicity and allergenicity are found in the final product, not the process. While these are important risks against which protection is needed, they are not a complete picture of what concerns the public. A genetically engineered organism or food, according to the federal government, is one that “was modified using techniques that permit the direct transfer or removal of genes in that organism. Such techniques are also called recombinant *DNA* or *rDNA* techniques.”³ The term genetic modification (GM) is frequently used interchangeably with the term genetic engineering. While it is not incorrect to do so, GE will be employed in this thesis because it refers to the precise selection of known genetic traits. Genetic modification refers to both modern and traditional breeding techniques.

Genetic engineering differs from conventional breeding techniques in that it allows the introduction of genes to plants or animals where it would not occur naturally: therefore it has an inherently unlimited character. It is this aspect that is of much concern. Recognition of broader social and ethical issues occurred in 1998 with the introduction of the Canadian Biotechnology Strategy, a document that built on the NBS of 1983 and the framework of 1993. The CBS was an attempt to balance both industrial development and social concerns. It also sought to delineate a clearer separation between the promotional and regulatory functions of government departments. The image the CBS portrayed was one where Canada is “the ‘responsible leader’ balancing risks and benefits, and addressing multiple values and goals on both the domestic and world stages.”⁴

³ Ibid.

⁴ Michael Prince, “Regulators and Promoters of Genetically Modified Foods in the Government of Canada: An Organizational and Policy Analysis,” Canadian Biotechnology Advisory Committee (November 2000): 39 pages. Online. Retrieved from Canadian Biotechnology Advisory Committee Home Page. World Wide Web. <<http://www.cbac-cccb.ca>> (Retrieved 28 September 2003), 13.

The regulation of biotechnology products cuts across multiple departments and agencies. Biotechnology comprises a series of techniques, each with a wide scope of possible applications and benefits and risks. Therefore, when a product is introduced to the licencing process, it can follow a number of different pathways through the regulatory system. As the table below demonstrates, numerous acts govern the environmental and health safety of GE foods.

Table 1.1. Legislative Responsibility for Biotechnology in Canada

Department(s) or Agencies	Act	Products Regulated
Canadian Food and Inspection Agency (CFIA)	<i>Feeds Act, 1997</i>	Feeds, including novel feeds
CFIA	<i>Fertilizers Act, 1997</i>	Fertilizer supplements, including novel supplements (chemical and microbial)
CFIA	<i>Fish Inspection Act, 1997</i>	Fish and marine plants
CFIA	<i>Health of Animals Act, 1990</i>	Veterinary biologics
CFIA	<i>Plant Protection Act, 1997</i>	Plants in the agricultural and forestry sectors
CFIA	<i>Seeds Act, 1997</i>	Plants, including plants with novel traits and trees
Health Canada	<i>Food and Drugs Act, 1997</i>	Foods, drugs, cosmetics and medical devices derived through biotechnology
Pest Management Regulatory Agency	<i>Pest Control Products Act, 1995</i>	Pest control products
Department of Fisheries and Oceans	<i>Fisheries Act, 1999</i>	Transgenic aquatic organisms
Environment Canada Health Canada	<i>Canadian Environmental Protection Act, 1999</i>	All animate products of biotechnology for uses not covered under other federal legislation

Source: CFIA "Legislation and Agricultural Products" and Prince 16.

For the purposes of this thesis, attention will be placed on the operations of Health Canada, the Canadian Food and Inspection Agency (CFIA) and Agriculture Canada, as these are the departments and agency involved primarily in the regulation of agricultural products derived through biotechnology. As the table demonstrates,

through a number of different acts, the CFIA is the lead agency in regulating these products. It reports to the Minister of Agriculture and regulates both the performance and the environmental safety of agricultural crops under development. Agriculture and Agri-food Canada (AAFC) is responsible for promoting Canadian agricultural products, through international trade and investment in research and development. Environment Canada is not involved in reviews of environmental assessment standards under the Canadian Environmental Protection Act, because agricultural products are regulated under other agricultural acts that provide for these assessments. Health Canada is responsible for setting standards related to the safety of the food supply and human health related issues, including GE foods. In sum, three principles are employed during the safety assessment process. First, build on current legislation where possible. Second, regulate based on the characteristics of the product with a focus on its uses and traits rather than the methods to produce it. This entails a comparison of molecular, compositional and nutritional data of the modified organism to its traditional counterpart. Third, where a comparison cannot be made, individual case-by-case assessments have to be made. However, as new types of products become more familiar, it may be possible to reduce the regulatory requirements or provide exemptions from regulation.⁵

The regulatory system successfully permitted the rapid introduction of GE products into the Canadian marketplace. Between 1994 and 1998, 38 new plant varieties received federal government safety approval.⁶ Agricultural producers as

⁵ Canadian Food and Inspection Agency, Science Branch, Office of Biotechnology, "General Questions and Answers on Agricultural Acts and Regulations," <<http://www.inspection.gc.ca/>> (Retrieved 30 April 2004). See too G. Bruce Doern, "Inside the Canadian Biotechnology Regulatory System: A Closer Exploratory Look," Canadian Biotechnology Advisory Committee (November 2000): 35 pages. Online. Retrieved from Canadian Biotechnology Advisory Committee Home Page. World Wide Web. <<http://www.cbac-cccb.ca>> (Retrieved 28 September 2003), 4.

⁶ Canadian Food and Inspection Agency, Science Branch, Office of Biotechnology, "Agricultural Products of Biotechnology: A Brief Status Report," <<http://www.inspection.gc.ca/>> (Retrieved 7 July 2004).

well as the biotechnology industry reaped certain benefits. Nevertheless, the regulatory regime became the subject of criticism. By the late 1990s a controversy emerged in Canada regarding GE food and the government's capabilities (and lack thereof) to protect Canadians from risk. The seemingly swift introduction of GE food, the federal government's focus on "plants with novel traits", and the lack of labelling obscured awareness of GE food in Canada. This led to critic charges that the regulatory regime lacked transparency, was created to serve the needs of industry, and only focussed on a narrow conception of risk. All of these arguments held the potential to harm biotechnology development in Canada - the topic of the next chapter.

Chapter Two: The GE Controversy

In recent years, numerous scientific risk controversies have emerged in which calls have been made for governments to take precautionary action through strong regulation. Examples among these include cellular telephones, global warming, and the storage of nuclear waste. The risks these present are based on probabilities and therefore, the risks, if any, are uncertain. The sense of risk is, nevertheless, heightened where the choice is involuntary, as is the case of GE food. Governments are presented with a dilemma when a controversy emerges in which claims cannot be substantiated or where the possibility of risk is remote. On the other hand, failing to acknowledge risks or manage them properly can be devastating, as the earlier cases of Three Mile Island in the United States or the BSE crisis in Europe demonstrated. Therefore, to avoid a risk controversy, the government should be prepared to acknowledge early unforeseeable risks as well as formulate methods to convey credible information.

A risk controversy can be defined as a collection of risk factors, whether real or perceived, that become an area of dispute among stakeholder interest groups. By employing this definition, this chapter will demonstrate that there is indeed a controversy and that the subsequent risk concerns relate to the scientific basis of genetically engineered food. Some scientists consider GE crops to be comparable to their conventional cousins, while others question GE science in general as well as the social benefit of the product. Thus, the outcome of the controversy may not be determined by the objective or probabilistic assessment of the risk factors involved,

but rather by ethical or social considerations. Indeed, both the controversy's evolution and its outcome are partly determined by and reflect the competing strategies of those involved.⁷ Consequently, a study of the competing interests and of their respective priorities in shaping public policy in the matter of GE food is necessary.

While the public controversy over biotechnology is less dramatic in Canada when compared to Europe or Africa, it is nonetheless a reality as this chapter will demonstrate. Concerns regarding the presence and regulation of genetically modified food have been raised on a number of fronts, and may be grouped as socio-economic, health, environmental, ethical, and moral in nature. These concerns are primarily “unscientific” and may, for that reason, fall under the rubric of social rationality, as compared to the approach of government and industry, which may be labelled scientific rationality. According to two scholars in the field of the social aspects of genetic modification, Grant Isaac and Jill Hobbs, the fundamental difference between the two rationalities lies in the role each grants to science and technology in society. What this role is determined to be defines the risk-benefit analysis.⁸

This chapter will illustrate the competing visions of what public policy ought to reflect with regard to biotechnology. Those involved in the debate over genetic modification are the government, the public (in a passive sense), industry and nongovernmental organizations. These last two may be grouped together as interest groups. To determine what constitutes an interest group, the following criteria may be of assistance: “(1) a non-governmental body that has taken a public position with

⁷ William Leiss, “The Public Controversy over Genetically Modified Foods,” Isuma: Canadian Journal of Policy Research 1(2) (Autumn 2000), 80.

⁸ Grant E Isaac and Jill E. Hobbs, “GM Food Regulations: Canadian Debates,” Isuma: Canadian Journal of Policy Research 3(2) (Fall 2002), 107.

respect to GM foods; (2) one that has sought to influence the perception of government, business or the public about GM foods; or (3) a group that clearly has an obvious organizational interest in the results of the debate over GM foods.”⁹

Ascertaining the public’s role in the controversy of genetically modified food is difficult because the public is not a homogenous group with clearly defined interests. Rather the public can be broken down into various “publics” or groups with competing goals and values. Constructivism holds that both the public and science act in social contexts, as opposed to in isolation, which is where previous academic literature had usually placed them. As Edna Einsiedel makes clear, research throughout the 1970s and 1980s followed modernist assumptions by granting science the sole claim to expertise and by designating the public the passive recipients of scientific wisdom. Contemporary research has focussed on the constructivist approach, whereby attention is drawn to the uncertainty of scientific knowledge and the inseparability of science from its social and institutional contexts. At the same time, these heterogeneous publics behave in social contexts and shift their attention and levels of knowledge with the rise and fall of scientific issues.¹⁰ For this reason, there are fundamental differences in public awareness and acceptance of GE food as well as in levels of confidence as to their being safe.

Through the role of consumer, people are confronted daily with technological developments in foods. They have the choice of responding in a number of ways: “with passive acceptance (by buying, but not feeling positive about it), with positive appreciation (by showing clear consumer preference for the new product), with

⁹ Cristine de Clercy et al., A Survey of the GM Industry in Saskatchewan and Western Canada, Public Policy Paper 16 (Regina: Saskatchewan Institute of Public Policy, 2003), 30.

¹⁰ Edna F. Einsiedel, “Understanding ‘Publics’ in the Public Understanding of Science,” in Between Understanding and Trust: The Public, Science and Technology, ed. Meinoff Dierkes and Claudia von Grote (Amsterdam: Harwood Academic Publishers, 2000), 205-207.

reluctance (by leaving the new product mostly on the shelves), or with clear protest behaviour (by boycotting the new product).”¹¹

Stakeholder interest groups all have a desire in gauging public perceptions and attitudes to a new technology. As Anneke Hamstra argues, technological developments are often the focus of government policy and, because governments are to an extent dependent on public support for their policies, they must respond to public sentiment about new technology. The industry developing the new technology has reason to be interested in public attitudes in order to determine the market success of a product and the potential impact of technology on its corporate image. Finally, the success of non-governmental organizations in influencing decision-making depends on public support. NGOs articulate public concerns regarding the negative effects of a technology or its application and by so doing create public awareness. Therefore they frequently use and initiate studies of public opinion.¹²

The value of public opinion polls, however, is questionable; while possibly helpful, the results may also be easily skewed or of little value because public opinion shifts over time. For example, Jill Hobbs argues that Canadian public perception of genetically modified food has shifted from being a science and technology issue to one of food safety and public health. As a consequence, overall support declined between 1997 and 2000. Moreover, poll respondents were also more positive when the term in question was “biotechnology” as opposed to

¹¹ Anneke M Hamstra, “Studying Public Perception of Biotechnology: Helicopter or Microscope?” in *Between Understanding and Trust: The Public, Science and Technology*, ed. Meinoff Dierkes and Claudia von Grote (Amsterdam: Harwood Academic Publishers, 2000), 180.

¹² Hamstra, 180-1.

“genetic engineering.”¹³ Therefore terminology alone can be shown to influence attitudes and hence responses. This could partly explain the different results of surveys conducted by government or non-governmental stakeholders. Polls conducted by government on biotechnology regulations produce findings significantly more positive than those arising from surveys done by staunch opponents of GE food. For example, a poll conducted by The Council of Canadians, as reported by Greenpeace, in January 2000 found that 56% of Canadians lack confidence in the government’s ability to protect their health and safety with regard to GE food.¹⁴ However, a poll conducted on behalf of the Biotechnology Assistant Deputy Minister’s Coordinating Committee found that “there is a general presumption that someone, somewhere, is in charge of monitoring and regulating food safety and that appropriate decisions are being made.”¹⁵ Thus, it can be concluded that the results of surveys can be swayed depending on the terminology and phrasing of questions.

Moreover, attempts to gauge public understanding of science are insufficient because the survey questions are posed in a context-free science, when, in fact, people use scientific information in a context-sensitive way.¹⁶ This position is reiterated by Hans Peter Peters:

It is a truism that technologies are sociotechnical systems that are developed not by scientific innovation alone but rather by the interaction of science, politics, industry, and consumers. Even when assessing the risk of a technology in a narrow sense, one has to consider not only the details of its

¹³ Murray Fulton et al., “Transforming Agriculture: The Benefits and Costs of Genetically Modified Crops.” Canadian Biotechnology Advisory Committee (March 2001): 104 pages. Online. Retrieved from Canadian Biotechnology Advisory Committee Home Page. World Wide Web. <<http://www.cbac-cccb.ca>> (Retrieved 28 September 2003), 62.

¹⁴ Greenpeace Canada, “Labelling *by the Numbers*, Canadian Polling Data for Genetically Engineered (GE) Food, 1994 -2002.” <<http://www.greenpeace.ca/e/index.php>> (Retrieved 29 February 2004).

¹⁵ Pollara Research and Earncliffe Research and Communications, “Public Opinion Research into Biotechnology Issues,” <<http://biotech.gc.ca>> (Retrieved 1 February 2004).

¹⁶ Steven Yearley, “What does Science mean in the “Public Understanding of Science,” in Between Understanding and Trust: The Public, Science and Technology, ed. Meinoff Dierkes and Claudia von Grote (Amsterdam: Harwood Academic Publishers, 2000), 224.

technical design but also the socioeconomic context of its implementation and use.¹⁷

For example, by means of a series of studies, Hamstra found that respondents made a distinction between applications of biotechnology in the areas of food as opposed to medicine or the environment. A further distinction appeared to whether genetic modification was applied to living beings or to plants or microorganisms. In the latter case, the ethical aspects of biotechnology directed opinion; while in the former area, concern was placed on the usefulness of the final product.¹⁸

In sum, measuring the public's opinion about biotechnology, or any scientific issue for that matter, is a difficult task because a number of variables can affect survey responses. This is not to imply that public opinion cannot be known, it is rather a suggestion that the poll itself be taken into consideration when assessing the results. Furthermore, an obvious yet undiscussed issue is the role of stakeholder groups in forming and shaping public opinion. Interest groups, through media exposure, have the capacity to distort risk perception. This raises the question of the reliability of the information received, when the underlying rationale is seen to be motivated by the communicator's specific economic or social agenda. Indeed, Alan McHughen argues that the public debate surrounding genetic modification can be labelled dysfunctional because there is a lack of factual information available to the public. On the one hand, proponents, such as industry, or government, or the scientific community, withhold information about the real risks and benefits, while, on the other, opponents launch emotional campaigns based on scientific

¹⁷ Hans Peter Peters, "From Information to Attitudes? Thoughts on the Relationship Between Knowledge About Science and Technology and Attitudes Toward Technologies," in Between Understanding and Trust: The Public, Science and Technology, ed. Meinoff Dierkes and Claudia von Grote (Amsterdam: Harwood Academic Publishers, 2000), 281.

¹⁸ Hamstra, 187.

misinformation and personal attacks.¹⁹ As public confidence in government continues to deteriorate,²⁰ NGOs have come to be seen to represent the public interest and civil society.²¹

The Consumers Association of Canada (CAC), for example, is a national voluntary organization that claims to represent Canadian consumers in a number of public policy areas. As such, it is concerned with communicating reliable and unbiased information.²² Adopting the stance that the consumer has the right to know, the CAC has taken a public position on biotechnology, questioning not the science itself but rather advocating labelling of food products containing GEOs. A survey conducted for the CAC showed that nine out of ten Canadians want mandatory labelling.²³ Similar concerns have been heard in the House of Commons; two private members bills requiring mandatory labelling have been introduced and defeated, the first in 1998 by a member of the Bloc Québécois and the second by a Liberal MP in 2002. The federal government has developed a voluntary code, through the Canadian General Standards Board, which would allow a maximum five percent of the food within a final processed product to be genetically engineered and still be considered GE-free. The federal government's position is that if consumers want GE-free products, industry will cater to that demand and label accordingly.²⁴ Indeed, the government claims to recognize the desire for non-safety related information and argues that consumer choice can be accommodated through legislation designed to

¹⁹ Alan McHughen, Pandora's Picnic Basket: The Potential and Hazards of Genetically Modified Foods (New York: Oxford University Press, 2000), 1-7.

²⁰ McHughen, 8.

²¹ de Clercy et al., 48.

²² Ibid 34.

²³ Stephen Chase, "Canadians want GM foods labelled, poll finds," The Globe and Mail, 4 December 2003, A4.

²⁴ Ibid.

implement voluntary labelling by food manufacturers.²⁵ Four broad guidelines have been developed and accepted by government and industry:

- require mandatory labelling if there is a health or safety concern, for example the presence of allergens or a significant nutrient or compositional change. This type of labelling is required for any food, not specifically GM food.
- ensure labelling is understandable, truthful and not misleading.
- permit voluntary positive labelling on the condition that the claim is not misleading or deceptive and the claim itself is factual.
- permit voluntary negative labelling on the condition that the claim is not misleading or deceptive and the claim itself is factual.²⁶

The CAC has rejected this initiative and re-affirmed its position by withdrawing from the Canadian General Standards Board's committee altogether. It argued that the maximum voluntary five percent standard benefitted only industry and was too weak as compared to the European Union's maximum one percent limit.²⁷

Mandatory labelling is often presented as an issue of consumer choice. However, it would also necessarily entail addressing to a greater degree the problems of cross-pollination, segregation systems and, in general, co-existence of GE and non-GE fields. At present, there is no incentive for producers of GE food to label their products, and this is the source of the significant credibility issues associated with a voluntary system. Indeed, if labelling were introduced, these producers could expect opposition to their product, especially for "input-trait" products, such as herbicide or pesticide resistant crops, that have little direct consumer benefit.²⁸ Additionally, producers will cheat when there is an economic incentive to do so.²⁹

²⁵ Canadian Food and Inspection Agency, Science Branch, Office of Biotechnology, "Labelling of Genetically Engineered Foods in Canada," <<http://www.inspection.gc.ca>> (Retrieved 29 February 2004).

²⁶ Ibid.

²⁷ Consumers Association of Canada, "Consumers' Association withdraws from national labelling committee for genetically modified foods citing need for mandatory labelling," Press Release, 28 July 2003.

²⁸ Fulton et al., 64.

²⁹ Ibid.

Furthermore, the question needs to be raised regarding the utility and relevance of labelling where there is no scientific evidence to suggest a health hazard or risk. Due to the fact that regulation of GE food is based on substantial equivalence, that is a comparison between a GE plant and its closest conventional variety, an approved GE crop does not need to be distinguished from a non-GE crop. Proponents of this view argue, first, that genetic modification has been occurring for thousands of years through conventional methods of breeding. Second, they note that GE foods, when compared to conventional counterparts, do not present greater risks, for example in the form of higher levels of contaminants or toxins. If they did, they would be so labelled, as any food product deemed a threat to human health would. Furthermore, North Americans have been consuming GE food since 1994 with no demonstrably adverse repercussions. Through a specific illustration, Alan McHughen argues the following:

If we have no hesitation in eating a tomato and bean salad, why do we question eating a tomato with a bean gene? Foods that we can safely eat separately can be safely eaten together. Ultimately, all those genes and proteins are mixed up together in our gut anyway. What a GM tomato carrying a bean gene does is add them together earlier.”³⁰

Finally, from a practical point of view, mandatory labelling would require new, expensive, and time-consuming segregation techniques. If the process required testing for the presence of GEOs, rather than complete segregation, the cost and time required will increase as the number of potential GE traits in processed food products grows. For this reason, Hobbs argues, segregation is more feasible. And yet, it will be the non-GE products that will prove more costly since it is more expensive to substantiate the absence rather than the presence of GEOs.³¹ One

³⁰ McHughen, 88.

³¹ Fulton et al., 65.

preliminary assessment suggested that mandatory labelling would result in price increases of nine to ten percent of the retail prices of these products. At the present time, the total cost to Canadians is estimated to run between \$700 and \$950 million per year.³²

Although not addressed by the CAC, mandatory labelling represents another area of concern surrounding GE products, that is their inadequate regulation. Most of the debate arises out of a lack of confidence in the Canadian regulatory system. While this topic will be discussed at greater length in the next chapter, attention here will be paid to issues of contention raised by non-governmental groups.

Greenpeace Canada, an international organization with 84,000 members in Canada³³, opposes the release of any GE organisms on the grounds that they are environmentally destructive and a threat to human health. It also disputes the safety of genetic engineering in general. The basis of these claims relates to the scientific uncertainty of genetic manipulation. According to Greenpeace, food safety may be adversely affected in two ways:

- gene disruption or instability may lead to new toxins being produced; and
- the new protein produced by the foreign gene may cause allergies or toxicity.³⁴

In addition to staging protests and providing information, Greenpeace has submitted a number of petitions under the *Auditor General Act*. The purpose of these petitions has been to put the entire biotechnology regulatory regime into question. For example, two petitions were filed regarding the possibility of the presence of StarLink corn in the human food supply. StarLink was a corn genetically engineered with a toxin from bacteria that rendered the plant insect-

³² Ibid.

³³ Greenpeace homepage, <<http://www.greenpeace.ca/e/index.php>> (Retrieved February 28, 2004).

³⁴ Greenpeace Canada, Genetic Engineering Briefing Pack, "GE Food: Safe to Eat?" May 2002. <<http://www.greenpeace.ca/e/index.php>> (Retrieved February 28, 2004).

resistant. The corn, while never approved for human or animal consumption in Canada due to the increased risk of allergic reaction in humans, was found in Canada's animal feed system in the fall of 2000. StarLink corn had entered Canada from the United States, where it had been approved for animal feed. The contamination was more serious there, where the corn was detected in taco shells, corn chips and other corn products. "Dozens of people reported allergic or other adverse reactions. Distributors began recalling over 300 corn products, but the enormous difficulty of extracting StarLink from seed stocks, grain elevators, shipping routes, food processing plants and supermarkets soon became apparent."³⁵ In response, the federal government and some biotechnology experts have argued that the controversy was unnecessarily magnified and that the regulatory system resolved the question satisfactorily. Nevertheless, the StarLink episode presented an opportunity for GE opponents to find gaps within the regulatory regime and attempt to undermine its credibility. For example, through the petition submitted July 23, 2001, Greenpeace posed a number of leading questions to the federal departments involved. Some of the questions are as follows:

Would the Ministers supply a detailed chronology of events and actions undertaken by the Federal Government surrounding the genetic contamination of Canada by the illegal StarLink transgenic corn? Who acted and when? What kind of co-ordination between Ministers was in place or put in place? What kinds of tests were done? How many tests? On what? and when? What were the dollar amounts, per department, of public funds spent specifically to prevent StarLink genetic contamination in Canada? Was Canada notified by the US government of the StarLink contamination?

³⁵ Katherine Barrett, "Food Fights: Canadian Regulators are under pressure to face the uncertainties of genetically modified food," *Alternatives Journal* 28 (2002), 28.

Did Canada notify any of our trade partners about the possible StarLink contamination in Canadian products exported?³⁶

The potential of new allergens and toxins from GE food has been recognized by a number of organizations and institutions. The Royal Society of Canada presented similar arguments in Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada. Although not advocating a moratorium on GE food, the Panel did recommend a strengthening of the Canadian regulatory system. With regard to toxicity,

the Panel found that regulatory requirements related to toxicological assessment of GM food appeared to be ad hoc and provided little guidance either as to when specific studies would be required or what types of studies would be most informative. In particular, the Panel was unaware of any validated study protocols currently available to assess the safety of GM foods in their entirety (as opposed to food constituents) in a biologically or statistically meaningful manner.³⁷

Thus, the issue for the Royal Society of Canada, was not the presence of GEOs but rather their proper management and application. Toxicology assessments are inadequate largely because safety regulation is based on substantial equivalence. Given the uncertainty of genetic modification and its potential application in new areas, such as pharmaceuticals, the Royal Society recommended that longer-term studies be required for all GE products. Direct testing for harmful outcomes would be preferable because it would address the potential for harm in an outright manner, the primary motivation for the regulatory process.³⁸

³⁶ Canadian Food Inspection Agency, Science Branch, Office of Biotechnology, Response of the Federal Departments and Agencies to the Petition filed July 23, 2001 by Greenpeace Canada under the Auditor General Act: StarLink Corn and Canada's Feeds, Seeds, Food Supply, and Ecosystems, December 10, 2001.

³⁷ Royal Society of Canada, Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada (Ottawa: Royal Society of Canada, January 2001), 48.

³⁸ Royal Society of Canada, "Expert Panel on the Future of Food Biotechnology: Summary Statement," (Ottawa: Royal Society of Canada, April 2001), 2.

On the other hand, the Canadian Biotechnology Advisory Committee claimed that, despite the inherent limitations, substantial equivalence remains an appropriate approach. The committee did not find any strong indication that substantial equivalence precludes GE food to avoid adequate regulatory oversight.³⁹ According to the CFIA, despite the common misperception, substantial equivalence has not yet been applied to plants with a novel trait (that is, plants derived through genetic engineering) with respect to determining potential adverse effects on the environment. Nevertheless, with respect to food safety assessments, substantial equivalence, as a concept, is used in Canada and around the world. Additional tests are necessary the more the novel plant deviates from the conventional plant or where no comparison can be made at all. The CFIA has said that “[n]o one can predict anything with 100% assurance, but the regulatory system that exists provides that every possible precaution is taken in assessing the safety of new products to the environment and human health before they are made available to the grower or consumer.”⁴⁰

Another area of controversy is the question of balance in the regulatory process. The first issue relates to a perceived conflict when the government acts as both a regulator and a promoter of GE food. A second concern of some stakeholders is that the federal government must also include social as well as scientific considerations of a GE plant during the application process. This will be discussed first with specific attention paid to Monsanto’s Roundup Ready (RR) wheat.

³⁹ Canadian Biotechnology Advisory Committee, Report to the Government of Canada, Biotechnology Ministerial Coordinating Committee, The Regulation of Genetically Modified Foods, (Ottawa: CBAC, August 2002), 27.

⁴⁰ Canadian Food and Inspection Agency, Science Branch, Office of Biotechnology, “Long Term Testing / Substantial Equivalence,” <<http://www.inspection.gc.ca/english/sci/biotech/reg/equive.shtml>> (Retrieved 1 March 2004).

Both the Government of Saskatchewan and the Canadian Wheat Board recognize the potential benefits of many GE crops; however they have each opposed the introduction of RR wheat. This particular wheat variety is resistant to Roundup Ready herbicide which allows farmers to eliminate weeds without killing their wheat crop. The motivation behind the opposition is primarily economic. In the words of the Canadian Wheat Board, “economic harm could include lost access to premium markets, penalties caused by rejected shipments, and increased farm management and grain handling costs. Unfortunately, scientific data demonstrating the food safety of RR will not, by itself, prevent this harm.”⁴¹ The Canadian Wheat Board, which labels itself the largest wheat and barley marketer in the world, requested the federal government add a cost-benefit analysis to the other regulatory assessments taking place.⁴²

The economic impact of GE wheat was a part of the federal GE wheat review process until 2002. However officials removed the clause from the regulations at that time.⁴³ The CWB also appealed directly to Monsanto to withdraw its application for an environmental safety assessment then before the CFIA.⁴⁴ The fear was that the majority of international buyers of Canadian wheat would boycott all wheat since there was no effective method of segregating GE and non-GE wheat for export. Canadian wheat exports total \$3 billion per year and a survey conducted by the CWB of international buyers indicated that 80% would not accept any GE wheat.⁴⁵

⁴¹ Ken Ritter, Canadian Wheat Board, “Letter to Mr. Peter Turner, President, Monsanto Canada Inc.,” May 22, 2003.

⁴² Canadian Wheat Board, “CWB asks Monsanto to put the brakes on roundup ready wheat,” News Releases, May 27, 2003.

⁴³ Jason Warick, “Province prepares to fight GM wheat,” Star-Phoenix, Aug. 8 2003, A1.

⁴⁴ Ritter.

⁴⁵ Warick.

In sum:

Currently, any company that is introducing a new grain variety into the present grain registration process does not have to consider the agronomic, environmental, market access and quality issues the introduction of that new variety may have on the industry. It is clear that advancing technology, an increasingly complex global business/trading environment and the increasing consumer demands around environmental and food safety issues have created new pressures on our grain production system and these issues will have to be considered in the development of a modern grain variety approval process.⁴⁶

In response, Monsanto Canada argued that regulatory approval in Canada would give legitimacy to RR wheat in the country and abroad. With regard to any increased costs to farmers, Monsanto Canada said farmers ultimately have the option of not purchasing seeds or growing RR wheat.⁴⁷ The corporation, however, succumbed to opponent pressure at least for the present time. It deferred commercialization and ceased field level research but does plan to re-introduce the product in the next few years. The decision was reached after consultation with consumers in the wheat industry and after a corporate review in which it was determined that the wheat was not commercially attractive.⁴⁸

The federal government was involved in the development of RR wheat, which could in fact be a conflict of interest. Specifically, Monsanto itself invested \$1.3 million in development, while Agriculture Canada invested \$500 thousand and provided access to scientific expertise and genetic material developed over years of research.⁴⁹ After Agriculture Canada ended the collaboration in January 2004, the

⁴⁶ Jim Stalwick, Manager, Strategic Planning Unit, Department of Agriculture, Food and Rural Revitalization, Government of Saskatchewan, "Letter to Rachel Whidden," January 23, 2004.

⁴⁷ Angela Hall, "GM wheat 'devastating' for farmers, CWB warns," *Star-Phoenix*, May 28, 2003, A7.

⁴⁸ Monsanto Canada, "Monsanto to realign research portfolio, development of Roundup Ready Wheat deferred," Press Release, May 10, 2004.

⁴⁹ Dennis Bueckert, "AgCan ends testing of GE wheat developed with Monsanto," *Canadian Press*, January 9, 2003.

question remains as to the reliability of acting as an independent, transparent regulator while simultaneously developing, investing in, and promoting RR wheat under a confidential agreement.

The CBAC acknowledges “the fear that in seeking to promote the exploitation of technology to capture its economic benefits, the government may downplay the risks of the technology and accentuate its benefits.”⁵⁰ Yet it also argues that promotion and regulation can be separate functions within a single department. Indeed, this is not unprecedented. For instance, the United States Department of Agriculture operates with conflicting mandates, different branches of the Department fulfil different responsibilities, including regulation and promotion.⁵¹

In effect, the development of biotechnology is part of a larger policy to further economic growth through a knowledge-based economy. Thus the federal government is caught in a delicate position between the competing needs of balancing the public interest and promoting industrial growth. In the attempt to capture the commercial and economic potential of biotechnology, the federal government must offer a friendly and internationally competitive regulatory regime with the following characteristics: timely decision-making, transparency, low cost, international credibility and responsive to the needs of industry.⁵² Because multinational biotechnology corporations will seek the least cumbersome regulatory regime with high international standing, the Canadian government, to attract this investment, must develop its regime to be in line with international practices.⁵³ Federal departments also play a role in international activities such as trade missions or negotiations that

⁵⁰ Canadian Biotechnology Advisory Committee, The Regulation of Genetically Modified Foods, 15.

⁵¹ Ibid.

⁵² Bill Jarvis, “A Question of Balance: New Approaches for Science-Based Regulation,” in Risky Business: Science-Based Policy and Regulatory Regime, ed. G. Bruce Doern and Ted Reed (Toronto: University of Toronto Press Inc., 2000), 310.

⁵³ Ibid 311.

deal with the nature and direction of Canada's regulatory policies.⁵⁴ One such example is pressuring other countries to accept Canadian GE food, whether through international arbitration processes or diplomatic talks.

Susan Sherwin describes the government's duty to act in the public interest as taking the initiative to develop and implement policies that will protect citizens' well-being and preserve society's institutions.⁵⁵ She goes on to note that the Canadian Biotechnology Strategy (CBS) makes no explicit references to the public interest, rather only underlying inferences. For instance, the vision of the CBS is:

*To enhance the quality of life of Canadians in terms of health, safety, the environment and social and economic development by positioning Canada as a responsible world leader in biotechnology [italics in original].*⁵⁶

In effect, the CBS highlights only the positive aspects from biotechnology, while making no reference to potential harms.⁵⁷ The following statement from the CBS illustrates this: "All Canadians - producers and consumers across the country, including people in smaller communities and rural areas - will benefit from the new transformation."⁵⁸ The government of Canada maintains that most of its citizens have confidence in the regulatory system and trust the government's approach: "While most Canadians express concern about potential risk, they are both resigned to its inevitability and confident that somewhere, someone is in charge of trying to

⁵⁴ Canadian Biotechnology Advisory Committee, The Regulation of Genetically Modified Foods, 15.

⁵⁵ Susan Sherwin, "Towards an Adequate Ethical Framework for Setting Biotechnology Policy," Canadian Biotechnology Advisory Committee (January 2001): 43 pages. Online. Retrieved from Canadian Biotechnology Advisory Committee Home Page. World Wide Web. <<http://www.cbac-cccb.ca>> (Retrieved 28 September 2003), 12.

⁵⁶ Ibid 12.

⁵⁷ Ibid 14.

⁵⁸ Canada, The Canadian Biotechnology Strategy: An Ongoing Renewal Process (1998): 29 pages. Online. Retrieved from Canadian Biotechnology Strategy Web Page. World Wide Web. <<http://biotech.gc.ca>> (Retrieved 8 October 2003), 2.

mitigate that risk.”⁵⁹ Therefore, the federal government is acting as a proponent of biotechnology and of science-based risk management. Where the Canadian Biotechnology Strategy makes reference to public concerns, it refers to them as “information gaps” and “lack of consumer awareness,”⁶⁰ thereby dismissing any basis for concern and substituting instead questions of ignorance or resistance to change.⁶¹

In essence, in seeking knowledge-based growth through the research, development, and commercialization of GE food, the government can reap many technology-related benefits. These have the potential to decrease public spending on agricultural support programs and research and development. For example, genetic engineering promises improved crop techniques for farmers and scientific solutions for production risks.⁶²

In sum, it has been established that the government is adhering to and promoting what many academics refer to as scientific rationality or positivism.

According to this view,

technology yields innovations and enhances efficiency; enhanced efficiency leads to economic development and growth, in turn, producing higher incomes. As incomes go up, demand increases for more stringent social regulations such as for food safety and environmental protection. The result is a regulatory race to the top made possible by scientific advancements.⁶³

Therefore, by promoting science as the basis for a strong regulatory regime and as the sole guide for approval of genetically modified food, the federal government is promoting positivist goals, where science is seen as having the closest approximation

⁵⁹ Canada, Canadian Biotechnology Strategy, Summary of Public Opinion Research into Biotechnology Issues in Canada (March 2003): 6 pages. Online. Retrieved from Canadian Biotechnology Strategy web page. World Wide Web. <<http://biotech.gc.ca>> (Retrieved 8 October 2003), 5.

⁶⁰ Canada. The Canadian Biotechnology Strategy: An Ongoing Renewal Process, 2-3.

⁶¹ Sherwin, 14.

⁶² Isaac and Hobbs, 106.

⁶³ Ibid 108.

to the truth.⁶⁴ However, whether or not science proves to be correct, positivism will not resolve the controversy because it fails to address the wide range of public concerns. Consequently, many point to the need of studying the controversy from a constructivist or social rationality viewpoint. Constructivism holds that scientific knowledge is socially created or constructed. The assumption that disputes over facts can be resolved by the impersonal or objective rules of experimental procedure is taken to be false. Rather, resolution to a controversy is achieved from pressures and constraints, for example accepted knowledge, vested interests, social objectives, or by the adjudicating community.⁶⁵ To illustrate, science and technology are only one facet of society. As such, when science brings change, all impacts should be dealt with in a socially responsible manner, not simply left to competitive forces. The debate over mandatory versus voluntary labelling illustrates the difference between scientific and social rationality. On the one hand, the CAC is arguing in favour of adopting mandatory labelling legislation based on the consumer's right to know, while opponents argue that there is no scientific evidence of risk or hazard to justify it.⁶⁶

William Leiss argues that scientific risk assessment is constrained in dealing fully with risk controversies because risk issues, as they play out in society, are not driven by science. Here is but one contested domain within the issue.⁶⁷ Therefore, given the lack of balance in its presentation of biotechnology, the government has “played into the hands of those who would like to ‘own’ biotechnology issues for themselves... it is not an ‘optimal’ outcome when any particular stakeholder interest group owns a set of issues...*in persisting along this path, governments may have*

⁶⁴ Martin and Richards, 506-526.

⁶⁵ Ibid 510-515.

⁶⁶ Isaac and Hobbs, 108-109.

⁶⁷ Leiss, “The Public Controversy over Genetically Modified Foods,” 81.

actually undermined the technological and economic prospects of the sector they have sought to promote [italics in original].”⁶⁸ Indeed, by failing to acknowledge any shortcomings or by addressing them directly (even if only to negate them), the federal government may have permitted the GE controversy and consequently undermined the credibility of its regulatory departments and agencies.

However, inclusiveness of public concerns in a scientifically-based regime is inherently difficult to achieve. Scientific and public processes have different goals and different evidentiary standards. Furthermore, scientific and social rationalities can, at times, seem diametrically opposed to one another. The concepts of scientific risk assessment, risk management, and risk communication will be dealt with in the next chapter in order to illustrate the dilemma of setting public policy in regard to science controversies.

⁶⁸ Ibid.

Chapter Three: Formulating Science Policy

Public policy is increasingly informed and driven by developments in science and technology. There are few areas of policy where science and technology do not play a role either as a source of public concern or as a potential solution to pressing problems.⁶⁹

As demonstrated in the previous chapter, biotechnology has become controversial - its processes affect the building blocks of life, individual genes and gene structures. Politicians and the public alike have raised concerns about the potential for unknown future risks to the food supply, human and animal health and the environment. At its core fears primarily concern the uncertainty of genetic engineering and its irreversibility. The controversy surrounding biotechnology is both technical and ethical, and, in this respect, it reflects the different perceptions of the society in which people want to live. Exploring these perceptions is necessary if society is to get beyond misunderstanding and achieve some degree of consensus on the subject. The controversy surrounding genetic engineering centers largely on the process itself, as opposed to the product. For this reason the primary areas of dispute concern the proper management of GE crops and consumer choice.

In order to capture the benefits of GE food, the federal government must minimize the supposed risks through strong, consistent and investment-friendly regulations. Developing policy in any science-based matter is inherently difficult for decision-makers, especially in areas of uncertainty or where ethics are involved. Because science permeates most aspects of society and requires political decisions to be made as to its uses, political processes must be adapted to embrace scientific methods. The traditional model of bureaucracy needed was not developed to deal

⁶⁹ Canada, Industry Canada, Canada's Innovation Strategy: Achieving Excellence. Investing in People, Knowledge and Opportunity (Ottawa: Information and Distribution Centre, 2001): 64.

with many scientific issues and has not yet evolved to the point where points of contention can be easily reconciled.⁷⁰ This inadequacy is evident in several related ways. First, decision makers do not have a scientific background, and consequently they may have difficulty communicating with scientists or understanding scientific advice. Second, the languages and standards of science policy are different from subjects such as social policy, for example. Third, scientific advice is no longer blindly equated with ‘truth’. The public is increasingly cynical about science and expects government to ensure error-free performance. In addition to the dilemma of reconciling science and public policy, decision-makers must also defend policy in areas of perceived scientific risk. As such, the focus of this chapter will be on the difficulty in setting science policy and the resulting necessary strategies to legitimate scientific decisions as representing the public interest.

Science policy and regulation can be defined as “regulatory decision making where scientific knowledge and personnel constitute significant or effective inputs into, or are distinctive features of, the relevant decision-making process.”⁷¹ The following activities are characteristic of science-based policy:

- Research, model building, and analysis
- Monitoring, data gathering, and assessment
- Technology and indicators for research and development
- Performance measurement and reporting activities
- Priority setting and foresight in science and technology - early identification of issues for which scientific advice or research will be needed, particularly where potentially significant risks may be involved
- Acquisition of best available scientific advice drawing upon a wide range of expert sources and institutional arrangements both within and outside government

⁷⁰ G. Bruce Doern and Ted Reed, “Canada’s Changing Science-Based Policy and Regulatory Regime: Issues and Framework,” in Risky Business: Science-Based Policy and Regulatory Regime, ed. G. Bruce Doern and Ted Reed (Toronto: University of Toronto Press Inc., 2000), 10.

⁷¹ Ibid 5.

- Publication of scientific advice and analysis underlying policy and regulatory decisions as well as the associated research findings of scientists.⁷²

With specific regard to biotechnology, the federal government has undertaken to promote:

- Investing public monies in research and development either through public sector agencies or through grants or other types of financial assistance to university-based researchers or private sector researchers;
- Establishing cost-sharing programmes for industries to develop collaborative relationships with universities and provincial research groups;
- Encouraging and funding the exchange of personnel amongst federal, provincial, university and industry research units;
- Working to harmonize domestic and international regulations with biotechnological development in Canada.⁷³

Through these roles, the federal government is attempting to fulfil its numerous responsibilities in the areas of public health, legal claims, international agreements, patents, and so on. Regulating biotechnology is especially sensitive because in addition to being a matter of scientific research, biotechnology has been a longstanding tool of economic development.⁷⁴ Indeed, beginning in the 1980s, new policies, initiated by the private sector, were formulated in recognition of first, the overburdening of government science and second, of knowledge as a tool of wealth creation. This policy shift led to increasing the level of industrial research and development and making Canadian science economically competitive.⁷⁵ And, in terms of economic return and competitiveness, the biotechnology strategy has been successful. According to Industry Canada, the biotechnology industry has grown

⁷² Ibid.

⁷³ Michael McDonald, "Biotechnology, Ethics and Government: A Synthesis." Canadian Biotechnology Advisory Committee (October 2000): 27 pages. Online. Retrieved from Canadian Biotechnology Advisory Committee Home Page. World Wide Web. <<http://www.cbac-cccb.ca>> (Retrieved 28 September 2003), 4.

⁷⁴ Prince, 2.

⁷⁵ John de la Mothe, "Government Science and the Public Interest," in Risky Business: Science-Based Policy and Regulatory Regime, ed. G. Bruce Doern and Ted Reed (Toronto: University of Toronto Press Inc., 2000), 38.

faster than any other industrial sector. There are approximately 300 biotech firms in Canada, employing nearly 10,000 people and generating \$1 billion in sales, of which 40% are exported.⁷⁶

In order to maintain and attract biotechnology investment, Canada's science regulatory regime must be accommodative. As a result of globalization, that is, interdependence of national economies, increased information flows and homogenized international standards, a shift has taken place in the country's institutions. Science-based regulations can no longer be formulated unilaterally or with a view toward the country's public infrastructure alone. Rather, the government's role now includes "supporting future research and development, issuing intellectual property rights (patents), and encouraging the commercialization of biotechnology products. They also include marketing and securing market access around the world, and, streamlining biotechnology product approvals so that regulatory systems are competitive with our major trading partners."⁷⁷ Thus the government's role is designed to serve the needs of multinational corporations which are trying to get their product as quickly and cost-effectively as possible to the market. Therefore the costs of regulations need to be minimal and access to markets and products guaranteed.⁷⁸ The following three factors are of influence: First, the speed of technological change ensures that those corporations and regulatory regimes that do not stay on the leading edge are made irrelevant. Second, the portability of capital, for example knowledge and patents (which are often developed with government assistance), separates

⁷⁶ Canada, Industry Canada, Research and Analysis Team, Life Sciences Branch, "Economic Profile of the Canadian Biotechnology Sector." (March 31 2000): 11. <<http://www.bhrc.ca/Intelligence/EconProfile.pdf>> (Retrieved 30 March 2004).

⁷⁷ Prince, 2.

⁷⁸ Jarvis, 309.

investments from geography. Third, multinational corporations control major sectors under monopoly conditions.⁷⁹

Yet, by promoting the biotechnology sector as part of the 'knowledge-based economy', the federal government may be simultaneously undermining what the regulatory system was intended to accomplish: protecting the public interest and promoting the public good.

The public sector, by reorienting its research and policies towards supporting private interests and away from traditional public concerns, has created a situation that could seriously limit the public good coming from that effort. Inadequate basic research, inappropriate patent systems and strategies and gaps in market-making research and information threaten the further expansion on agri-food innovation and development.⁸⁰

In essence, tension between public and private interests establishes the basis of policy choices. While the federal government seeks to develop a long-term strategy to maximize the potential advantages of science-based regulations, what some authors term the 'damage function', that is the public interest, requires a conservative approach to institutional change. To a degree, politicians are hostage to the risk aversion of their constituents. Change for the sake of change or for purely fiscal motives may entail social and political costs.⁸¹

In sum, pursuing science-based regulations as a tool of economic development is both a practical reality and a dilemma. If indeed this strategy can also protect the public interest and the public good is an area that warrants further study. Moreover, as the next section will demonstrate, developing science policy and incorporating science into public policy is also problematic and therefore deserves attention.

⁷⁹ Ibid.

⁸⁰ Peter W.B. Phillips and Dan Dieker, "Public Good and Private Greed: Strategies for Realizing Public Benefits from a Privatized Global Agri-food Research Effort" (paper prepared for the AARES Pre Conference Workshop on Biotechnology, Adelaide, Australia, 22 January 2001), 1.

⁸¹ Jarvis, 321.

According to Ann Kinzig and David Starrett, two scholars who have written about science policy, science and policy processes have different goals, standards and approaches and, consequently, it may prove difficult to incorporate one into the other. To elaborate, the goal of the scientific process is to advance knowledge and reduce the reach of the unknown. Each advance is built on knowledge acquired earlier and, therefore, the cost of ‘incorrect knowledge’ is high. In essence, being wrong throws in doubt the foundation of previous advances. For this reason, procedures have been developed with the objective of minimizing this possibility.⁸² On the other hand, the goal of the policy process is to address societal ills or challenges. Errors constitute costs, both political and social, for example, and harm to constituents, the economy, or the environment.⁸³ Different goals entail divergent ‘evidentiary standards’. Scientists demand relatively high evidentiary standards, for example requiring only a small probability that an incorrect conclusion has been drawn. Standard risk analysis has two variables: benefits-harms and probabilities. “Both can be quantified - (i) in terms of a positive or negative magnitude of benefit/harm, and (ii) as the likelihood of an event’s occurrence (ranging from zero to one).”⁸⁴ Technical risk, in this neutral sense, is a product of benefits-harms and probabilities. By contrast, the policy process may entail either “looser or stricter” evidentiary standards, which are also based on the costs of being wrong.⁸⁵ These standards are based on the notion, employed by decision makers, of acceptable risk. Leiss and Chociolko have advanced three conditions that constitute the basis for

⁸² Ann Kinzig and David Starrett et al., “Coping With Uncertainty: A Call for a New Science-Policy Forum,” *Ambio*, Royal Swedish Academy of Sciences, 32 (5) (August 2003): 330.

⁸³ *Ibid.*

⁸⁴ Macdonald, 17.

⁸⁵ Kinzig and Starrett et al., 330.

acceptable risk; these illustrate what is meant by looser or stricter evidentiary standards:

- The level of risk itself is below some threshold (no observable effect level), or, in the case of a risk-risk comparison, a risk is incurred to avoid another risk of greater magnitude.
- On the intuitive level benefits clearly appear to outweigh risks.
- There is no manifestly unjust distribution of risks and benefits, for example, no sacrifice of lives or health of some specific and identifiable individuals in the name of the general good.⁸⁶

Three other distinctions can be made between science and public policy.

First, scientific training favours concentrated specialisation in one area over the cross-disciplinary understanding necessary in policy making. Decision makers must offer advice across a wide range of different issues and respond to shifting political agendas. Second, scientific research requires time horizons, in which data are tested against hypothesis, and this is followed by a conclusion. The policy process requires a political context and predetermined goals. It also involves risk and compromise. Third, scientists strive for objectivity and testability. They may be reluctant to recognize the political objectives that decision makers want to meet. As such, whether and how science is incorporated into the policy process depends on the recognition decision makers give to the need for scientific input and on the capacity of decision makers to obtain the research and science required. For a start, a degree of scientific literacy is needed, including a sensitivity to the value of science and an appreciation of its place in decision making.⁸⁷ Further difficulty arises when scientists fail to provide information that could be considered useful or even crucial in the policy arena, partly due to failing to study the appropriate phenomena. Strict

⁸⁶ William Leiss and Christina Chociolko, Risk and Responsibility (Montreal: McGill-Queen's University Press, 1994), 33.

⁸⁷ Willie Smith and Steven Kelly, "Science, technical expertise and the human environment," Progress in Planning 60 (2003), 324-5.

evidentiary standards entail reductionist approaches whose variables can be tightly controlled and manipulated. By failing to study areas that require a greater scope, crucial findings can be missed.⁸⁸

The objective language of evidentiary standards can be used to disguise what is essentially a debate over values. In other words, evidentiary standards are subjective and by no means neutral.⁸⁹ The results of one study of risk demonstrated that experts in risk-assessment held contradictory views about risk depending on how choices were framed, either in terms of loss or gain. The study showed that most participants made self-contradictory choices. More than that, it indicated that some biases were deeply ingrained and thus potentially not eradicable.⁹⁰ Subjective evidentiary standards can also be seen when policymakers and scientists alike use science as a tool for promoting or ignoring an issue. For example, the scientific and social ramifications of genetic engineering remain uncertain and may lead to numerous possible outcomes, all of which involve trade-offs.

These futures will differ in terms of environmental protection, social justice, economic growth...Scientists can help illuminate those futures and trade-offs, but they are not more expert than any other citizen when choosing among the trade-offs. There is nothing objective about valuing environmental protection over political freedom, or economic growth over social justice, and no set of evidentiary standards can ultimately allow society to navigate among these complex considerations... Policymakers invoke scientific uncertainty as the justification for inaction on certain issues, when ultimately their positions have more to do with the weight of economic and environmental considerations.⁹¹

This last difficulty, that of scientific expertise being neither neutral nor objective, explains the increased level of public cynicism toward scientific regulatory

⁸⁸ Kinzig and Starrett et al., 330.

⁸⁹ Ibid.

⁹⁰ Macdonald, 17.

⁹¹ Kinzig and Starrett et al., 330-1.

policy. The government's capacity to rely on science to legitimate policies has been reduced, as both the public and politicians are less confident in science. As such, demands have been made to integrate different areas of concern, including economic and social issues, into the policymaking process. This position has not been favoured by the Canadian government. Scientific evaluation for genetically modified organisms for socio-economic parameters was under discussion at the Convention on Biological Diversity in 1992 but was rejected by the Canadian delegates.⁹² This will be discussed in greater detail in the next section of this chapter. For the time being, it can be said that the dismissal of socio-economic concerns allowed the controversy to develop in Canada. Thus today, it is suggested that the future of biotechnology depends on public acceptance:

The role of the scientist and the policy maker are critical in increasing understanding and engaging the public in a discourse on the future of biotechnology. In many ways the biotechnology debate has come to represent a testing ground for a new contract between science and citizens...Different perceptions of the technology, in particular its risks and benefits need to be resolved if the discussion is to progress past the gridlock of misunderstanding.⁹³

This position is further reiterated by William Leiss, a leading scholar in the field of risk communication, who argues that the Canadian federal government has thus far managed the risks of genetic engineering fairly well but not the risk issues. In the controversy surrounding GE food, the government failed to establish a relation between science and the public.⁹⁴ To elaborate: the ability to manage risk issues requires the federal government to compete effectively with other stakeholders within the controversy.⁹⁵ This means, for example, addressing concerns outside of the

⁹² McHughen, 143.

⁹³ Smith and Kelly, 359.

⁹⁴ William Leiss, *In the Chamber of Risks: Understanding Risk Controversies* (Montreal: McGill-Queen's University Press, 2001), 21.

⁹⁵ William Leiss, "The Public Controversy over Genetically Modified Foods," 81.

scientific risk assessment. By relying solely on scientific assessments, policy makers are constrained because these assessments are necessarily limiting and preclude the possibility of taking into account other perceptions of risk.⁹⁶

The government of Canada has come to recognize the problems that exist between science policy and the public. In 2000, the federal government issued a document entitled A Framework for Science and Technology Advice: Principles and Guidelines for the Effective Use of Science and Technology Advice in Government Decision Making. While it remains to be seen whether all or even some of the elements will be implemented, the key recommendations include:

Early Issue Identification - anticipating public policy issues arising from new knowledge.

Inclusiveness - ensuring that advice is drawn from many disciplines, all sectors and, when appropriate, international sources.

Sound Science and Science Advice - applying due diligence to advice to ensure its quality, integrity and reliability.

Transparency and Openness - ensuring that processes are transparent, and that stakeholders and the public are consulted.

Review - keeping stewardship regimes up to date as knowledge advances [italics in original].⁹⁷

Despite acknowledging that there are areas needing improvement in science policy, the Canadian government's position with regard to biotechnology remains entrenched in the *Canadian Biotechnology Strategy* (CBS) of 1998. There only the benefits of biotechnology are addressed, while the primacy of science in the regulatory process is assumed. The CBS recognizes the need for public input and participation as a means of legitimising the government's approach to biotechnology; yet it is questionable whether it will be successful in gaining public acceptance and resolving the controversy. Thus the following section will be devoted to the study of

⁹⁶ Ibid 80.

⁹⁷ Canada, Industry Canada, "Canada's Innovation Strategy," 64.

risk and resolving science controversies. Much academic literature on risk controversies and the public understanding of science points to the need for an all-encompassing approach to the debate over biotechnology. The overarching theme in risk controversy studies is the necessity of using a constructivist as opposed to positivist approach. As such, the recommendations advocated to resolving or studying risk controversies have this similarity. Leading scholars in the field of risk studies cited here: are Steven Yearly, Vincent Covello, Ortwin Renn, Anneke Hamstra, William Leiss, Jon D.Y. Miller, Rafael Pardo, and Debra Levine. The recommendations suggested in the literature are applied to the government's approach to biotechnology to determine if public acceptance of GE food will occur.

First, however, some definitions are necessary to provide a point of reference for the reader regarding risk. All of the following definitions are those provided by the government of Canada and were chosen because of their applicability to this thesis:

Risk is the probability of negative consequences to an event or activity, and it is constantly present in everyday life. Risks that exist in day-to-day activities often lose their intensity because they become familiar. In contrast, risks in new activities are often magnified due to their newness. This is true of any new technology, including biotechnology.

Risk assessment is a scientific process that determines the health and environmental dangers, if any, in a new product or technology. The goal of a risk assessment is to get an idea of the size and likelihood of a negative effect related to a particular activity or product.

Risk management involves examining the risk assessment data (including the risk/benefit comparison), as well as identifying and analysing potential risk management options. There are several options for risk management, such as regulations, national guidelines, education, and voluntary compliance. These

options are examined and factors such as expected effectiveness and feasibility, as well as the implementation process are analysed.⁹⁸

The definition of risk offered by the government is narrowly conceived and only describes one type of risk. However, Doern and Reed have identified two risks: objective and perceived. Objective risk corresponds to the definition provided above. It is the one experts know, seek to measure and is the preserve of the formal sector. Perceived risk is identified and handled informally by freelance risk managers such as NGOs or industry. This notion relates to the theory or view that risk is culturally determined or socially constructed. "Risk was constructed in a variety of ways because reality was fashioned from different experiences and judgments of risk and benefit."⁹⁹ Consequently, much to the frustration of the scientific community, calls have been made to formally include perceived risk in the scientific regulatory systems. Ortwin Renn defines perceived risk in the same way as Doern and Reed yet takes the delineation between the two types of risk further. He rejects the definition of risk as an objective property of a hazard or event. Rather, he argues, it is a social construct and in part a product of the social experience. It includes communication about the possible consequences of a hazardous event. If an event manifests itself and develops into a reality, the appropriate term is an hazardous event, as opposed to Doern and Reed's term of objective risk. Renn maintains that hazardous events are largely irrelevant in the social context unless they are observed and communicated.¹⁰⁰

⁹⁸ Canada, Industry Canada, "Risk Assessment, Perception and Management," <<http://strategis.ic.gc.ca/engdoc/main.html>> (Retrieved 30 March 2004).

⁹⁹ Doern and Reed, 10-11.

¹⁰⁰ Ortwin Renn, "Risk communication and the social amplification of risk," in Communicating Risks to the Public: International Perspectives, ed. Vincent T. Covello, Jeryl Mumpower, Stuart F. Spicker and Pieter Jan M. Stallen (Norwell MA: Kluwer Academic Publishers, 1991), 289.

Public acceptance of government regulations and policies relies on credibility and trust. Generally speaking, Canadians have a high level of trust for their regulatory agencies but also expect these agencies to protect them from harm and unforeseeable risks. Nevertheless, as the last chapter proved, questions have been raised regarding the regulatory approach to GE food in Canada. Many actors involved in the controversy do not see the government as acting in the public interest. The key element to resolving scientific controversies is effective risk communication, and that is difficult to achieve. It requires,

the act of conveying or transmitting information between parties about (a) levels of health or environmental risks; (b) the significance or meaning of health or environmental risks; or (c) decisions, actions, or policies aimed at managing or controlling health or environmental risks. Interested parties include government, agencies, corporations, and industry groups, unions, the media, scientists, professional organizations, public interest groups, and individual citizens.¹⁰¹

Political and social repercussions should also be added to the above definition.

Risk communication is considered credible and trustworthy if the communicator has met public expectations in managing risks and demonstrated competence in doing so. Risk communication and management are closely connected: good communication cannot compensate for poor management and vice versa.¹⁰² To illustrate this point, one need only look at the debate surrounding GE food in England, where NGOs are seen by most of the British population as representing the public interest. Indeed, in this regard, they have successfully gained more credibility than the government. According to Steven Yearly, the public's understanding of the

¹⁰¹ Ortwin Renn and Debra Levine, "Credibility and trust in risk communication," in Communicating Risks to the Public: International Perspectives, ed. Vincent T. Covello, Jeryl Mumpower, Stuart F. Spicker and Pieter Jan M. Stallen (Norwell MA: Kluwer Academic Publishers, 1991), 177.

¹⁰² Ibid 179, 197.

institutions and politics of science is a function of its attitude and responsiveness. Once trust in these is undermined, the decline is difficult to reverse. For this reason, research needs to be focussed on the fuller understanding of the main features of the scientific enterprise and the context in which scientific research is carried out. Yearly offers two suggestions to regain the public's trust: first, increase the recognition of the regulatory role of science and, second, engage public debate about the new demands.¹⁰³

The definition of risk employed by the Canadian government indicates that it expects scientific controversies to moderate because, with time, the public's fear of change will lessen. While this may be partly true, the controversy will not disappear unless the scope is broadened beyond science-based regulations. William Leiss has developed the term risk issues management and argues that this is an aspect of the controversy that the Canadian government needs to develop beyond traditional risk management. As defined by the government of Canada above, the basis of risk management is formed by scientific risk assessments of the phenomenon in question. Risk issues management, on the other hand, is a reflection of the notion that risk issues, as they are debated in society at large, are not based on scientific risk assessments. Instead, risk assessments are but one of many disputed aspects of the issue.¹⁰⁴ To illustrate, risk issues management can refer to the management of the confrontation between the various actors involved in the debate over GE food described in chapter one. Or it could refer to public concerns regarding the uncertainty of the science behind biotechnology. Leiss argues that the government has been unsuccessful as a risk issues manager. First, it does not recognize the

¹⁰³ Yearley, 234-235.

¹⁰⁴ Leiss, *In the Chamber of Risks: Understanding Risk Controversies*, 10.

distinction between risk management and risk issues management. Second, its role is to define and defend the public interest which requires inclusiveness in the scope of social interests, and this it failed to accomplish when the controversy erupted in 1999.¹⁰⁵ Admittedly, the ability to incorporate social and economic considerations into one framework is extremely difficult. However, it did occur on at least one occasion, during the licencing approval process of the recombinant bovine somatotropin (rbST) growth hormone.

RbST was intended to increase milk production in dairy cows. This hormone has been approved for use in the United States but was rejected by the Canadian regulatory authorities on the stated basis of animal welfare. Indeed the product was found to cause mastitis in dairy cows, leading to inflamed udders and larger amounts of pus in milk. This rationale falls outside of the scientific risk assessment process for genetically engineered food. The final product, a glass of milk from a cow treated with rbST, would be indistinguishable from milk produced by a cow free of growth hormone. Due to a delay at Health Canada, an opportunity arose for dairy industry stakeholders to participate in the licencing approval process. On that occasion they advocated primarily socio-economic concerns unrelated to the final decision to deny the licence approval. The Dairy Farmers of Canada, the National Dairy Council and the Consumers' Association of Canada all expressed the concern that the public would reject milk from cows injected with bovine growth hormone. No institutionalized policies were developed to broaden the debate beyond traditional risk assessments nor did Health Canada officials attempt to communicate risks. Therefore, Mark Macdonald concludes that an institutionalized policy to recognize

¹⁰⁵ Leiss, "The Public Controversy over Genetically Modified Foods," 81.

socio-economic concerns may be unnecessary since the existing regulatory system appeared to be flexible enough to accommodate competing views and interests.¹⁰⁶

However, the case of rbST is an isolated example. Regulatory intervention requires a scientific justification of risk pertaining to either a recognized risk, a question of the data determining the risk-benefit profile, or a hypothetical risk, a question concerning the analytical method of the experimentation procedure.¹⁰⁷ Following the scientific method, safety is determined when the product under review has not been found to be unsafe. No scientific claim can be made that the product is risk-free or perfectly safe. Here it is important to recall that the scientific process has developed procedures to guard against being wrong. To illustrate: a claim cannot be made that a GE food is risk-free, if only because the unit of measurement or instrument to determine the level of toxicity may not yet have been developed. For this reason the toxin could be present but simply undetectable and unknown.¹⁰⁸

Communicating this type of argument to the public is of little value. The purpose of risk management is not to pacify public fears but rather to reduce and prevent actual risks identified through scientific risk assessments. Consequently, Leiss's call for a government strategy to recognize risk issues management is warranted. Referring to public concerns and skepticism as gaps in understanding and misinformation, as the CBS does, does not correspond to recommendations available in risk controversy literature. The implication of the knowledge gap presumes that negative attitudes toward science and technology are a result of ignorance or irrational

¹⁰⁶ Mark R. Macdonald, "Socioeconomic versus Science-Based Regulation: Informal Influences on the Formal Regulation of rbST in Canada," in Risky Business: Science-Based Policy and Regulatory Regime, ed. G. Bruce Doern and Ted Reed (Toronto: University of Toronto Press Inc., 2000), 158-159.

¹⁰⁷ Isaac and Hobbs, 109.

¹⁰⁸ McHughen, 19, 90.

beliefs. On the contrary through enlightenment and information, the lay public will accept scientific claims and draw conclusions similar to those reached by scientists. In turn this requires that many risk communication efforts be geared toward closing the knowledge gap on the assumption that diminishing the different perceptions between the public and experts will resolve disagreements between the two groups.

Undoubtedly, the lay public's understanding of science is quite low and this does translate into higher levels of skepticism within the Canadian public. Jon D. Miller and Rafael Pardo argue that only those they label civic scientifically literate are able to comprehend a science controversy and science policy. Those who are moderately scientifically literate are capable of receiving and using information about science policy. The authors cite one study demonstrating that four per cent of Canadians fall in the first category and 17 per cent fall in the second.¹⁰⁹ A correlation was also made between being scientifically literate and holding positive views of the potential of science and technology in society.¹¹⁰ Attentiveness to science and technology issues was another area of focus, with one study demonstrating that approximately one in ten Canadians was attentive to science issues. Those who fell into this category were also likely to hold positive overall views of science. Attentiveness has a twofold implication: first, an individual will attempt to influence the political process and, second, this will affect the degree to which the government should promote public participation in developing science policy or, at the very least, attempt to garner public support. The authors reach the conclusion that harbouring either negative or positive views depends on factors such as gender, educational

¹⁰⁹ Jon D.Y. Miller and Rafael Pardo, "Civic Scientific Literacy and Attitude to Science and Technology: A Comparative Analysis of the European Union, the United States, Japan, and Canada," in *Between Understanding and Trust: The Public, Science and Technology*, ed. Meinoff Dierkes and Claudia von Grote (Amsterdam: Harwood Academic Publishers, 2000), 108.

¹¹⁰ *Ibid* 105.

attainment and age. Therefore, information or advertising campaigns will be ineffective, because these educational and demographic characteristics are not easily influenced in the short term.

The notion of increasing scientific knowledge to gain public acceptance or improve attitudes toward a new technology is disputed by Hans Peter Peters. His position differs substantially from the arguments put forth by Miller and Pardo. First, Peters argues that tests to determine scientific literacy are deficient because they exclude social and political knowledge which are necessary for an understanding of the role of science and technology in society. “Knowledge of this kind includes information about the complex relationships of science and technology with industry and government; the institutional arrangements in which science and technology development are carried out; the conflicts between scientific authority based on claims to truth and the lay public’s demands to participate...”¹¹¹

Peters further argues that there is no certain relationship between knowledge level and attitudes about science. Rather, a variety of factors affect either knowledge or attitude. As such, he maintains that focus needs to be placed on areas other than knowledge to explain differences between laypeople and scientists. The first difference is the layperson’s passive and the expert’s active relationships to technology. For scientists, technology is a tool for achieving a goal. For a layperson, technology is uncontrollable and as such, something against which he or she requires protection. Second, laypeople question the neutrality of experts even when they accept the scientific method employed by experts. Peters believes “this lay epistemological view is consistent with constructivist notions of science and is

¹¹¹ Peters, 267-268.

perhaps more mature than the naive positivist epistemologies of many scientists.”¹¹² Furthermore, technologies are sociotechnical systems that are not developed solely by scientific innovation but by their interactions with industry, the political system and consumers. Peters repeats the argument used by many others involved in the GE controversy: “Even when assessing the risk of a technology in a narrow sense, one has to consider not only the details of its technical design but also the socioeconomic context of its implementation and use.”¹¹³

Anneke Hamstra suggests that most empirical studies of consumer acceptance look at education, level of understanding, and the biotechnology product in question. However, this is an ineffective method for determining acceptability. Rather than trying to solve problems by assuming they stem from public ignorance or scientific illiteracy, questions should be focussed more narrowly on which products and production methods are desirable from a societal view.¹¹⁴ Indeed, according to Leiss, perceived usefulness of a product plays a role in the question of public acceptability. Three conclusions of one European survey demonstrated first, that the perception that biotechnology is useful is a pre-condition of support; second, that people would accept a risk or loss if there was a demonstrated utility; and, third, that moral doubts affect acceptance.¹¹⁵

In Canada, the process for determining the licence approval of a GE plant is based on substantial equivalence. Substantial equivalence involves a comparison of levels of nutrients, toxins, and vitamins of a GE plant and the plant from which it was derived. If these levels are relatively similar then the transgenic plant is regulated in the same manner as the original plant. This approach is the international scientific

¹¹² Ibid 281.

¹¹³ Ibid.

¹¹⁴ Hamstra, 182-195.

¹¹⁵ Leiss, In the Chamber of Risks: Understanding Risk Controversies, 29-30.

standard of determining acceptability of GE crops. Nevertheless, for some this approach is flawed because it does not take into account the potential adverse effects of future unpredictable problems of GE. According to the Royal Society of Canada, “the designation of a candidate GM crop variety as ‘substantially equivalent’ to other, non-GM, varieties essentially pre-empts any requirement in Canada to assess further the new variety for unanticipated characteristics.”¹¹⁶ Levidow et al. seek to discredit risk assessment by arguing that it cannot be applied to GEO regulation, since, given the novelty of transgenes, regulators have no prior norms with which to calculate risk. They therefore must devise them.¹¹⁷

Thus the criticism of the government’s regulatory approach comes from a number of directions, all of which agree that its risk assessments lack scientific credibility and that they exclude a number of views and perceptions of risk. Furthermore there is the problem of communicating substantial equivalence to the public. One common strategy of risk communication is a risk comparison between a new technology or substance with one already in existence. This is, in essence, substantial equivalence, that is a comparison between an existing plant with one that is genetically modified. Risk comparison is based on the notion that risks can be appreciated by people if they are placed in a comparative perspective. Vincent Covello argues that it is seldom relevant or appropriate to compare risks with different qualities to determine acceptability even if the comparison is technically accurate. He provides three reasons to support this view. The first relates to psychological and social differences. Risks that are voluntary and result from

¹¹⁶ Royal Society of Canada, Elements of Precaution, 180.

¹¹⁷ Les Levidow, Susan Carr, David Wield and Rene von Shomberg, “European biotechnology regulation: framing the risk assessment of a herbicide-tolerant crop,” Science, Technology, & Human Values 22(4) (1997), 472.

lifestyle choices are more likely to be accepted than involuntary and imposed risks. Second, people recognize that risks are cumulative, that each additional risk adds to their overall risk burden. The fact that a person is exposed to risks resulting from voluntary lifestyle choices does not lessen the impact. Finally, people perceive many types of risk in an absolute sense. Involuntary increased risk is a physical and moral insult whether the increase is small or even smaller than risks from other exposures.¹¹⁸

In sum, if the federal government intends to resolve the risk controversy, it must improve its credibility and ability to communicate risk information effectively. Five attributes have been suggested to improve credibility:

- a) Perceived competence (degree of technical expertise assigned to a message or a source);
- b) Objectivity (lack of biases in information as perceived by others);
- c) Fairness (acknowledgment and adequate representation of all relevant points of view);
- d) Consistency (predictability of arguments and behavior based on past experience and previous communication efforts);
- e) Faith (perception of “good will” in composing information).¹¹⁹

Given these criteria, the federal government should cease the promotion of biotechnology. This ban should include only promotional messages as well as research and development contributions and investments. Leiss argues that others, such as provincial governments or industry, can promote biotechnology.¹²⁰ A long-term risk communication program should also be launched. Renn and Levine conclude that the credibility of government decisions is related to the degree

¹¹⁸ Vincent T. Covello, “Risk comparisons and risk communication: Issues and problems in comparing health and environmental risks,” in Communicating Risks to the Public: International Perspectives, ed. Vincent T. Covello, Jeryl Mumpower, Stuart F. Spicker, Pieter Jan M. Stallen (Norwell MA: Kluwer Academic Publishers, 1991), 112-113.

¹¹⁹ Renn and Levine, 179-180.

¹²⁰ Leiss, “The Public Controversy Over GM foods,” 82.

institutions conform to the expectations of the people. Thus, their major recommendation is to assess the concerns of the targeted audience before drafting the message. They concede that value-driven differences are the most difficult to reconcile, but credibility is lost altogether if third-party concerns are not addressed in a clear and honest message.¹²¹ Finally, Leiss argues that the federal government should refer all controversial matters to independent expert panels.¹²² This last recommendation was adopted by the government in 1998 and 1999 to improve the policy debate and its credibility. It mandated the Canadian Biotechnology Advisory Committee, the Royal Society of Canada and the Canadian General Standards Board with various tasks to study social issues related to biotechnology. Thus the following chapter will offer a brief overview of the reports issued by these bodies and will attempt to determine if these will be sufficient in resolving the controversy, given the recommendations and critiques developed in this chapter.

¹²¹ Renn and Levine, 212.

¹²² Leiss, "The Public Controversy Over GM foods," 83.

Chapter Four: Improving the Policy Debate

The emergence of the controversy surrounding GE foods is a result of the federal government's lack of foresight. The opportunity to garner public support arose in the 1980s when the need for biotechnology regulation first appeared. However, the regulatory framework developed at that time between industry and government officials excluded the public, which was consulted only after the basic structure had been determined. How the government decided to promote the new sector determined how it would regulate it.¹²³ The regulatory regime occurred in three phases which together encouraged the rapid introduction of GE foods into Canada: research and development innovation, science-based regulations, then recognition of broader social issues.¹²⁴

In retrospect, and as a long-term policy, the strategy failed because it did not define key social problems associated with the introduction of GE technology. Rather, problems were viewed as hurdles to innovation and concerns regarding safety were addressed through a closed scientific process portrayed as independent of broader social and ethical issues. In this scenario, the public's role was confined to that of a passive recipient of information. Could understanding and confidence in genetic engineering grow? In fact, the strategy proved ineffective as demands for participation increased in parallel with a decline in public confidence.¹²⁵ Other

criticisms regarding the lack of transparency of the regulatory process, along with

¹²³ William Leiss and Michael Tyshenko, "Some Aspects of the 'New Biotechnology' and Its Regulation in Canada," in Canadian Environmental Policy: Context and Cases, 2nd ed., ed. Debora L. VanNijnatten and Robert Boardman (Don Mills: Oxford University Press 2002), 337.

¹²⁴ Elizabeth Abergel and Katherine Barrett, "Putting the Cart Before the Horse: A review of biotechnology policy in Canada," Journal of Canadian Studies 37(3) (Fall 2002), 154.

¹²⁵ Ibid 155.

socio-economic concerns, and demands for consumer choice (i.e. mandatory labelling) have arisen as well. In the eyes of critics, the closed approval process of GE crops, with the biotechnology industry as their sole beneficiary, undermined the legitimacy and credibility of the regulatory regime.

In the late 1990s and early 2000, the government mandated three separate committees to study different aspects of biotechnology regulation in Canada with the intention to encourage public debate and the public's understanding of science. The purpose of these committees was to obtain the participation and input of various interests thereby enhancing the legitimacy of the government's policies. For it believes that more participation equals greater legitimacy for GE foods. The other part of the political equation concerns policy output, that is policy must flow from public participation if it is to be seen as legitimate. Output legitimacy comprises "social standards of acceptability and appropriateness...[it] generally captures the belief that decisions and policy outcomes promote the common welfare of the political community through effective problem-solving and distributive justice."¹²⁶ To date, output legitimacy regarding biotechnology policy is low. How to improve it through greater public input is the subject of this chapter. In the process, the committees mentioned above need to be analyzed, along with their mandates and recommendations.

Numerous studies and opinion polls testify to the lay public's low understanding of science in general and biotechnology specifically. In light of this, some question whether debate is necessarily meaningful when the average lay person does not have a scientific background and may not understand genetic engineering.

¹²⁶ Grace Skogstad, "Who Governs? Who Should Govern? Political Authority and Legitimacy in Canada in the Twenty-First Century," Canadian Journal of Political Science 36(5) (December 2003), 956.

Still, more information needs to be made available to improve the public understanding of science. Nonetheless, increased understanding does not necessarily correlate to higher levels of acceptance. As was demonstrated in the previous chapter, people view science from within a social context, and consequently, there needs to be a value or utility attached to it if it is to gain acceptance. Lessons can be learned from previous science-in-society experiences; while not related to GE food, the BSE crisis in Europe served to increase levels of distrust between citizens with government and science. Public acceptance requires trust in science and technology on the one hand, and in public institutions on the other. Many controversial areas of GE are unrelated to scientific concerns or are indicative of a general resistance to accept increased scientific risk, whether real or perceived.

The purpose here is not to argue for a diminution of state-centred authority and in favour of participatory democracy, where a plurality of interests influence governing. The situation is not as black and white, rather, the premise is accepted that “when policy debates are conducted in public and pluralistically open forums, a wider range of issues, interests and policy options is likely to be considered...Not all public discussion and debate will enhance the legitimacy of decision making. But when it is conducted in a way that allows citizens to make sense of what is happening, then it has considerable potential to do so.”¹²⁷

Therefore this chapter will evaluate the Canadian government’s response to the GE controversy by analyzing the independent reviews thus far conducted to determine if the controversy can be resolved, or at the very least, if public concerns can be allayed with regard to key issues. The first section will provide a general background to the committees, their composition, and their mandates while the

¹²⁷ Ibid 969.

second section will summarize the recommendations pertinent to the topic of this study. The adequacy of these recommendations, in the sense that they reflect public concerns, will be discussed. It will be argued that the committees have served the purpose of improving the public debate and responding to calls for greater input in the decision-making process. That being said, some of the key issues have not been addressed through recommendations because the focus has been restricted to science and the promotion of biotechnology for industrial and economic growth.

Background

The first report, completed in January 2001, by the Royal Society of Canada, is entitled, Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada. The Expert Panel prepared the report at the request of Health Canada, the Canadian Food Inspection Agency and Environment Canada in November 2000. Composed mostly of university scientists in the biological and agricultural sciences, the Panel also had experts in the areas of law and philosophy. Of the three review committees, that of the Royal Society possesses the greatest degree of transparency and arm's-length relationship from government. Indeed, the Panel could not be privy to any confidential information regarding the regulatory process because, as a public body, it could not maintain that confidentiality. In addition, the report was released before review or comment by the regulatory departments. The Royal Society's mandate, as provided by the federal government, appears to reflect a genuine desire on the part of the government to have an impartial body review the regulatory regime. The Expert Panel was directed:

- ◇ To forecast:
 - the types of food products being developed through biotechnology that could be submitted for regulatory safety reviews by Health Canada and/or

- the Canadian Food Inspection Agency over the next 10 years;
 - the science likely to be used to develop these products; and
 - any potential short- or long-term risks to human health, animal health and the environment due to the development, production or use of foods derived from biotechnology.
- ◇ To assess approaches and methodologies developed in Canada and internationally to evaluate the safety of foods being developed through biotechnology, including those being developed by the World Health Organization, the Food and Agricultural Organization and the Codex Alimentarius Commission.
 - ◇ To identify:
 - the scientific capacity that will be needed to ensure the safety of new foods derived from biotechnology; including human resources for research, laboratory testing, safety evaluation, and monitoring and enforcement; and
 - any new policies, guidelines and regulations related to science that may be required for protecting human health, animal health and environmental health.¹²⁸

The second committee was created in 2000 at the behest of the Canadian Council of Grocery Distributors (CCGD), who sought to develop a national voluntary labelling standard of GE foods. The standard itself, entitled “Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering,” took four years to complete (2004) through the Canadian General Standards Board. The committee was composed of three categories of representation: 17 users, 18 producers and 18 individuals belonging to general interest groups. Arriving at a consensus concerning the acceptability of the voluntary labelling standard occurred when 70 per cent of members voted in favour of it.¹²⁹

The intent of the standard is to “provide[s] further guidance for food companies and

¹²⁸ Royal Society of Canada, Elements of Precaution, 1-2.

¹²⁹ Canada, Canadian General Standards Board, “Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering: Frequently Asked Questions,” <www.pwgsc.gc.ca/cgsb/> (Retrieved 8 April 2004).

manufacturers... [and] provide[s] consumers with consistent information upon which they can make their consumption choices.”¹³⁰

The development of a national standard on voluntary labelling was supported in principle by the Royal Society of Canada, the Canadian Biotechnology Advisory Committee, Health Canada, and the Canadian Food and Inspection Agency. These bodies delegated all authority and responsibility to the CGSB in this matter. Funding for the project was provided by the CCGD in return for funding from the federal government’s Agri-Food Trade 2000 fund and Agriculture and Agri-Food Canada.¹³¹ The standard was required to be consistent with the Food and Drugs Act, the Food and Drugs Regulations, the Consumer Packaging and Labelling Act and Consumer Packaging and Labelling Regulations, the Competition Act and other, international, agreements.¹³²

The third body, the Canadian Biotechnology Advisory Committee (CBAC) was created in 1999 in response to a proposal by the Canadian Biotechnology Strategy (CBS) of 1998. Thus it represents an attempt to balance industrial development with social and ethical issues. The CBS represents a different approach to regulation. In effect, the CBAC attempts to include more approaches within and outside the scientific regulatory approach. It is composed of twenty members with expertise in the fields of science, nutrition, ethics, business and the environment. The CBAC is housed within Industry Canada and reports to the Biotechnology Ministerial Coordinating Committee which is comprised of the ministers of Health Canada, Industry Canada, the Department of Fisheries and Oceans, Agriculture and

¹³⁰ Ibid.

¹³¹ Ibid.

¹³² Canada, Canadian General Standards Board, “National Standard of Canada, Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering,” <www.pwgsc.gc.ca/cgsb/> (Retrieved 8 April 2004).

Agri-Food Canada, Natural Resources Canada, Environment Canada, and the Department of Foreign Affairs and International Trade.

The CBAC has a dual mandate:

[To provide] comprehensive advice on current policy issues associated with the ethical, social, regulatory, economic, scientific, environmental and health aspects of biotechnology. It is also tasked with providing Canadians with easy-to-understand information on biotechnology issues, and providing opportunities for Canadians to voice their views on the matters on which CBAC is offering advice to the Government.¹³³

To fulfil its mandates, the CBAC divides its activities into two categories: topics and projects. Topics include increasing public awareness and creating a forum for public participation. Projects are the result of studies intended to provide advice to government officials. Consultations with experts, stakeholder groups and the general public also occur.¹³⁴ In sum, the CBAC is acting to promote greater public debate through consultations and to incorporate public concerns into recommendations made to government departments and agencies. As with the Royal Society Expert Panel, it has assumed the role as representative of the public interest.

To achieve a balanced debate and discussion, group participants, with the assistance of the CBAC, developed 'the genetically modified food and feed dialogue tool' (GMFF). This was seen as necessary to formulating an inclusive approach to the wide range of participant representation. Examination of the policy issue under discussion consisted of five themes: health, environment, socio-economic considerations, ethical considerations and broad social considerations.¹³⁵

¹³³ Canadian Biotechnology Advisory Committee, "Background," <<http://cbac-cccb.ic.gc.ca>> (Retrieved April 1, 2004).

¹³⁴ Canadian Biotechnology Advisory Committee, "Publications," <<http://cbac-cccb.ic.gc.ca>> (Retrieved April 1, 2004).

¹³⁵ Canadian Biotechnology Advisory Committee, "Dialogue Tool," <<http://cbac-cccb.ic.gc.ca>> (Retrieved 1 April 2004).

Incorporating these different considerations is one way of giving equal weight to non-scientific concerns, according to Abergel and Barrett:

While the acceptability-spectrum is not without potential problems, recognition by the CBAC that significant government effort and resources are required to ascertain and more seriously consider public opinions and broader social and ethical issues indicates both the failure to do so in the past, and the currently enormous consequences of public rejection of GM technology.”¹³⁶

The GMFF is by no means required to achieve consensus but rather simply to facilitate dialogue. According to the CBAC, the GMFF results could be used for policy-making or for information and education. In effect, after examining the policy issue from the five considerations listed above, participants then rate the degree of acceptability or supportability for each area of consideration. After doing so, the group “explores those possible conditions or mitigants that could affect the receptivity of the case in question. Participants conclude by making suggestions for further work that could improve understanding and subsequent social dialogue on the case.”¹³⁷

Analysis

The Royal Society of Canada provided 53 recommendations aimed at improving biotechnology regulations. The report focussed on the current regulatory regime and its capacity for approving future products derived from genetic engineering. It did not study products that are currently on the market. In the words of Dr. Marc Fortin, a member of the Panel,

The scientific recommendations of the expert panel are premised on the belief that scientists do not have all the answers when it comes to the safety of GMOs and their effect on human health and the environment. We don't have all the answers. The scientific community is uncertain about the safety of

¹³⁶ Abergel and Barrett, 153.

¹³⁷ CBAC, “Dialogue Tool”.

GMOs. The panel's recommendations speak to the need to find answers and to reduce this scientific uncertainty.¹³⁸

The report was highly critical of many elements of the regulatory process and went beyond the standard scientific risk-benefit analysis. Consequently, its recommendations entailed a strengthening of the scientific review process. While charged with examining the scientific aspects of the regulatory regime, the Expert Panel emphasized that questions about health and environmental hazards are also tied to value judgments which, Abergel and Barrett say, "influence the way problems are framed, tests are designed, standards are set and final conclusions drawn."¹³⁹ Risks, whether related to health, the environment, philosophical or socio-economic issues, cannot be framed in isolation from one another. For the purposes of this chapter, only aspects relating to the controversy surrounding the Canadian regulatory regime will be discussed. It should be noted, however, that much of the Expert Panel's report focusses on the "second generation" of GE products and foods. These refer primarily to pharmaceutical products but can be extended to GE fish and livestock. Of relevance to this chapter are the Expert Panel's conclusions pertaining to substantial equivalence, transparency of the regulatory process and questionable scientific conclusions.

Substantial Equivalence

The Expert Panel concluded that substantial equivalence is open to two interpretations and is therefore an ambiguous method upon which to base regulatory decisions. Determining if a GE plant is substantially equivalent to its non-GE counterpart basically ensures licence approval and precludes further assessment.

¹³⁸ Canada, House of Commons, Standing Committee on Environment and Sustainable Development, "Meeting with Royal Society Expert Panel," March 13, 2001.

¹³⁹ Abergel and Barrett, 151.

This is because the approval process commonly uses the first of the following two interpretations.

[t]o say that the new food is “substantially equivalent” is to say that “on its face” it is equivalent (i.e. it looks like a duck and it quacks like a duck, therefore we assume that it must be a duck). Because “on its face” the new food appears equivalent, there is no need to subject it to a full risk assessment to confirm our assumption...“substantial equivalence” does not function as a scientific basis for the application of a safety standard, but rather as a decision procedure for facilitating the passage of new products, GM and non-GM through the regulatory process.¹⁴⁰

The second interpretation, accepted by the Society, is referred to as the safety standard interpretation. This entails a stringent scientific analysis demonstrating that a new crop poses no more threat to the environment or human health than its traditional counterpart, despite the presence of novel genes.¹⁴¹ The difference between the two interpretations is that in the first, new plants do not undergo a full environmental safety assessment if it can be demonstrated that they do not function differently in the environment compared to their counterparts. The Panel expressed concern that arriving at the above finding could be based upon “unsubstantiated *assumptions* about the equivalence of the organisms, by analogy with conventional breeding [*italics in original*].”¹⁴²

Scientific Review

The burden of proof in health and safety assessments is on the developers, the biotech industry, of GE products. In itself, the Panel did not find this to be problematic, but it did question whether government scientists were in a position to conduct independent scientific reviews. Moreover, it questioned barriers to transparency and scientific peer review due to the restrictive nature of what falls

¹⁴⁰ Royal Society of Canada, *Elements of Precaution*, 181-182.

¹⁴¹ *Ibid* 183.

¹⁴² *Ibid* 182.

under Confidential Business Information. These two areas contribute to eroding the scientific basis for risk regulation. “The claim that the assessment of biotechnology risks is ‘science based’ is only as valid as the independence, objectivity and quality of the science employed.”¹⁴³

Therefore the Panel called for a greater separation between government regulators and government promoters of GE foods. While it is true that different departments and agencies play different roles with regard to biotechnology, it is not entirely clear if the separation is thoroughly delineated. For instance, initially, Agriculture Canada was responsible for both promoting and regulating GE food, while the CFIA was later created to monitor the technology. According to one co-chair of the Panel, Prof. Brian Ellis: “[T]o address that conflict of interest, the CFIA was spun off and given a separate mandate. It doesn’t do the development of biotechnology, but it still has carried with it some promotional mandate, as witnessed by some of the literature it distributes and the way in which it treats biotechnology.”¹⁴⁴ The other co-chair, Dr. Conrad Brunk, further argued that, “[T]he agency [CFIA] said to us very clearly...that they feel the need to maintain certain relationships - collegial relationships - with the industry they regulate because this does require a certain amount of cooperation and collegiality.”¹⁴⁵

Compounding this problem is the lack of transparency in the review process. Decision Documents, released by the CFIA, serve to summarize the conclusions for the approval of a GE plant, but they do not include actual scientific data explaining the judgments reached. The only method of obtaining this information is through the Access to Information Act. Confidentiality is needed to ensure that commercial

¹⁴³ Ibid 212.

¹⁴⁴ Canada, Standing Committee on the Environment and Sustainable Development.

¹⁴⁵ Ibid.

dealings and research are not obtained by competitors, who would thereby gain an unfair advantage. Nevertheless, much of the information that might be classified as Confidential Business Information need not be kept secret for this reason. The Expert Panel disputes, for example, that data concerning environmental consequences be treated as proprietary. It further argues that the regulatory departments adopt codified regulations in order to determine what to disclose from the application and approval process. When discussing the issue of confidentiality with senior managers of the regulatory departments involved, the Panel found that,

their responses uniformly stressed the importance of maintaining a favourable climate for the biotechnology industry to develop new products and submit them for approval on the Canadian market. If the regulatory agencies do not respect industry interests in protecting the confidentiality of product information as well as data obtained from extensive health and environmental testing, industry in turn will be deterred from engaging in the regulatory approval process.¹⁴⁶

In light of what it saw as a lack of transparency, the Panel called for independent peer review of research findings to strengthen scientific objectivity. Indeed, the claim that the regulatory process is science-based is compromised when one of the tenets of science, peer review, is compromised in favour of close relationships with the biotech industry.¹⁴⁷ To this end, the Panel called for increased funding to university researchers to conduct independent reviews and independent biotechnology scientific research.¹⁴⁸ At the same time, it noted that much public research has been “co-opted” by commercial interests thus reducing scientific resources available to the government.¹⁴⁹

¹⁴⁶ Royal Society of Canada, Elements of Precaution, 213.

¹⁴⁷ Ibid 214.

¹⁴⁸ Canada, Standing Committee on the Environment and Sustainable Development.

¹⁴⁹ Royal Society of Canada, Elements of Precaution, 217.

The Royal Society's Expert Panel report substantiated many concerns expressed by critics of the regulatory regime with respect to the uncertainty of genetic engineering and the secretive nature of the scientific review process. One of the suggestions made in the previous chapter was that in order to resolve science-based controversies, the government must respond to all claims. The Expert Panel did serve to require the government to acknowledge and respond to numerous concerns, many outside of the realm of the scientific risk assessment.

Implementation of Recommendations

With regard to substantial equivalence, Health Canada, the CFIA, Environment Canada, Agriculture and Agri-food Canada, the Department of Fisheries and Oceans, have agreed with the recommendation to use it as a safety standard, rather than as a decision threshold.¹⁵⁰ However, its commitment to this is unclear. A recent CFIA document describes the safety assessment of GE crops as considering the following:

- composition of the novel food compared to non-modified counterparts;
- nutritional information for the novel food compared to the non-modified counterparts;
- potential for new toxins; and
- potential for causing allergic reaction.¹⁵¹

This list does not appear to deviate from substantial equivalence nor is it different from the CFIA's approach prior to the release of the Royal Society's report.

¹⁵⁰ Canada, Health Canada, Canadian Food Inspection Agency, Environment Canada, Agriculture and Agri-Food Canada, Department of Fisheries and Oceans, Action Plan of the Government of Canada in response to the Royal Society of Canada Expert Panel Report *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada* (November 23, 2001): 31 pages. Online. Retrieved from CFIA Web Site. World Wide Web. <www.inspection.gc.ca> (Retrieved 23 January 2004), 4.

¹⁵¹ Canadian Food and Inspection Agency, Science Branch Office of Biotechnology, "The Safety of Biotechnology-derived Food Crops," <www.inspection.gc.ca> (Retrieved 8 April 2004).

The government's language pertaining to transparency is more vague than the Expert Panel's recommendation. It has re-affirmed its commitment to placing the burden of proof with the proponent of the product under assessment. Approval does not occur until the proponent satisfies all of the regulatory bodies' concerns of health and environmental safety.¹⁵²

In terms of accessible information and transparency, the government has stated that it will:

- publish more detailed information of its description of the review process;
- commence discussions with industry on allowing more product information to be made available;
- investigate how other countries disclose information about individual submissions;
- study approaches used elsewhere to develop a model for public and expert consultations.
- have an external expert sit on Health Canada's Food Rulings Committee.¹⁵³

In response to the Panel's recommendations of independent peer review, the government proposed to share product assessments with other countries to validate its safety judgments.¹⁵⁴ This response was in keeping with another of the Panel's concerns, Canada's limited research capabilities. Still, international sharing did not, in the Panel's eyes, replace the need for peer review. In its response, the government chose not to address this latter concern.

Thus, while the regulatory departments agreed in principle to improved transparency, objectivity and neutrality, as of 2004 no reference had been made to the Report's concerns that CFIA officials lack objectivity. Nor was the need for independent public science acknowledged. Nevertheless, the government stated that

¹⁵² Canada, "Action Plan," 14.

¹⁵³ Ibid 15-16.

¹⁵⁴ Ibid 5, 16.

further action aimed at improving transparency would be forthcoming pending the recommendations of the CBAC.

Canadian General Standards Board

In April 2004, The CGSB developed a national standard, “Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering.” This standard’s mandate was considerably more specific than that of the Royal Society Expert Panel report. By relying on private authority to develop the standard, that is the CGSB and CCGD, the Canadian government has adopted a market-based approach to respond to demands for labelling GE products. The capacity for industry to accommodate consumer desires is not yet known, and many Canadians expect the government to formulate policy in this area.

The CGSB’s standard was the result of a four year process involving multiple interested participants. It outlined the requirements for labelling a product, whether processed or single-ingredient, as GE or non-GE. To qualify as non-GE, the food product had to contain no more than five percent genetic engineering.¹⁵⁵ The claim has to be accurate, not misleading, and verifiable. The standard applies to both domestic and international producers.

The implementation and the technical aspects of labelling were not raised in the national standard. In effect, the CGSB’s report does not explain who bears the burden of cost of ensuring untainted crops and finished food products. It can only be assumed that this is the responsibility of the agricultural producer who is seeking to fulfil a niche market. Moreover, the problem remains that segregation techniques are not in place to ensure complete separation between GE and non-GE products.

¹⁵⁵ Canada, Canadian General Standards Board, Voluntary Labelling and Advertising of Foods That Are and Are Not Products of Genetic Engineering, National Standard (Gatineau: CGSB, April 2004), B2.

Voluntary labelling is seen as inadequate by those who advocate mandatory labelling based on the consumer's right to know. The rationale for voluntary labelling is that GE foods present no health risk and consequently mandatory labelling does not fall under the Food and Drugs Act. The rise in food costs as a result of developing segregation techniques as well as testing procedures must be considered. It is assumed that consumers will not want to bear the costs of mandatory labelling, if it is indeed they who do and not industry. A system of voluntary labelling, however, will serve the niche market of consumers who desire the product and are willing to pay for it. The option of mandatory labelling is further precluded because the national standard has to comply with ongoing negotiations at the international level.

Canada is chairing the Food Labelling Committee at the Codex Alimentarius Commission, an international body recognized by the World Trade Organization, whose food standards are seeking to form a basis for trade agreements and trade stability. Developing internationally acceptable labelling standards is important for Canada if the country is going to increase trade in foods by ensuring access to markets whose governments are signatories to the same international standards.¹⁵⁶ No agreed-upon guidelines have yet been established, Nevertheless in 1996, the Executive Committee of the Codex Committee on Food Labelling issued a report stating that it recognizes,

the opinion claiming that while consumers may claim the right to know whether or not foods had been prepared by such means, it also noted that the claimed right to know was ill-defined and variable and in this respect could

¹⁵⁶ CGSB "FAQs".

not be used by CODEX as the primary basis of decision-making on appropriate labelling.¹⁵⁷

This statement rejects mandatory labelling based on the consumer's right to know.

Critics of voluntary labelling argue that it is too weak to be effective. As a result, they maintain that the federal government's approach to GE foods is ineffective - consumers have the right to know what they are consuming. Refusing to label products keeps the public ignorant in the face of perceived (but not proven) scientific and health risks. According to the Bloc Québécois, 90 percent of Canadians want mandatory labelling. Furthermore, the BQ disputes the belief that there is an economic saving from no labelling or in the use of GE food. What, it asked, would be the cost associated with withdrawing products if contamination were to occur and the cost of lost markets that followed?¹⁵⁸

The Canadian Biotechnology Advisory Committee recommended that the voluntary system be reviewed after five years to assess if it had met consumer demands. If it is not successful then mandatory labelling, among other options, should be considered.¹⁵⁹ Such labelling is outside the purview of the CGSB and will have to come from either Health Canada or the CFIA. Only they have the authority, statutory and regulatory, to require mandatory labelling of a product. Additionally, in a country where authority rests within government, not private authority, labelling may have to be introduced to respond to public demands. According to Grace Skogstad: “[W]here self-initiated accountability is not forthcoming, the second option is for governments to make it mandatory. In the instance of GE products, if

¹⁵⁷ Canadian Food and Inspection Agency, Science Branch Office of Biotechnology, “Summary of Comments on the Communiqué ‘Labelling of Novel Foods Derived Through Genetic Engineering (December 1, 1995)’,” <www.inspection.gc.ca> (Retrieved 8 April 2004).

¹⁵⁸ Canada, House of Commons, Standing Committee on Agriculture and Agri-Food, Labelling of Genetically Modified Food and its Impacts on Farmers, Fourth report, Hansard, June 2002.

¹⁵⁹ Canadian Biotechnology Advisory Committee, The Regulation of Genetically Modified Foods, 43.

private authority cannot satisfy Canadians' labeling demands, governments will have little option but to make it mandatory."¹⁶⁰ Moreover, mandatory labelling may be necessary as newer, more controversial products, such as GE fish and animals, enter the Canadian market. Thus it can be concluded that voluntary labelling standards are not going to subdue the controversy.

Canadian Biotechnology Advisory Committee (CBAC)

The CBAC was created in 1999 to report on areas pertaining to the social and ethical considerations of biotechnology in order to assist government in policy making. It also acts as a forum for public participation. Reports are issued on an ongoing basis on topics ranging from intellectual property to regulation. In the context of this paper, discussion will focus on the report entitled, "Improving the Regulation of Genetically Modified Foods and Other Novel Foods in Canada," released in 2002. This report provided a number of recommendations that fall under four themes: governance, precaution, consumer choice and social and ethical considerations.

i) Governance. Included among the recommendations of the CBAC are:

- Clear separation of promotional and regulatory activities. This entails a review of departmental operations and effective communication to the public of the delineation.
- A "single window" office be established with one spokesperson designated to communicate and respond to regulatory decisions.
- The Auditor General review and report on assessments and decision making. This review includes examining the independence of the regulatory functions.

ii) Precaution

- The risk-based scientific approach to licence approval be strengthened and maintained.
- Precaution be applied to every stage of development. The standard should be

¹⁶⁰ Skogstad, 969.

highly conservative where there is the possibility, however remote, of catastrophic harm.

- Product review be instituted after 10 years of approved decisions, research should be made available for independent peer review.
- Other reviews be undertaken concerning the implications of biotechnology and the adequacy of the regulatory regime. These should occur at least every 10 years.
- A program be implemented to monitor long-term health and ecological effects of GE foods.

iii) Consumer Choice and Labelling

- Assist Canadians to make informed consumption choices through a centralized food information system.
- Develop and encourage a voluntary system of labelling.

iv) Social and Ethical Considerations

- Develop a method to address social and ethical issues by supporting their study and analysis.¹⁶¹

The above recommendations are by no means an exhaustive list of all the recommendations put forth by the CBAC. Instead, they illustrate critics' concerns for transparency in decision-making. They are also an attempt to respond to doubts regarding the acceptability of the science used in GE policy, which is seen as neither objective nor value-free. As of May 2004, the government has not issued a response to the CBAC's reports, as it did following the work of the Expert Panel. Thus the following section will be devoted to analyzing the capacity of the recommendations to resolve the controversy.

The CBAC was not able to obtain input from over 50 Canadian nongovernmental organizations. Although it sought their participation in the invitation-only consultation meetings, these NGOs boycotted the consultation process.¹⁶² The basis of the nationwide boycott was to put into question, through

¹⁶¹ CBAC, The Regulation of Genetically Modified Foods, xii-xix.

¹⁶² Canadian Biotechnology Advisory Committee, "Dialogue Tool."

media exposure, the legitimacy of the CBAC, as an industry-led group. It was argued that the committee was biased to the degree that it was operating within the limits set by the Canadian Biotechnology Strategy. The CBS, it should be remembered from chapter one, is essentially a promotional document of biotechnology. It outlines primarily the benefits to be reaped by consumers, the economy and agricultural producers; little recognition is given to potential harms or concerns. Likewise, the CBAC retains the same tension between promotion and regulation. For example, its 1999-2000 annual report outlines three functions. These are:

- to optimize the economic, health, safety and environmental benefits of biotechnology in a sustainable way in Canada through the CBS
- to ensure that the science base that supports the government's regulatory role is maintained and is internationally competitive
- to incorporate social and ethical considerations into policy making.¹⁶³

While a number of the CBAC's recommendations are a step in the right direction, the committee is precluded from considering a wide range of ethical and social issues. The narrow framing, with the presumption of inevitability, limits understanding of the risks involved, because it cannot provide a complete risk-benefit analysis. Thus, the government may be missing crucial concerns altogether.

The recommendations could also serve to reinforce criticisms of the regulatory process. For example, stating openly that the approval of a GE product requires only a scientific assessment of safety and excludes social considerations such as the loss of international export markets, is not sufficient to resolve the GE controversy. The case of Roundup Ready Wheat serves as an illustration. The opposition posed by the governments of the prairie provinces fell on deaf ears within

¹⁶³ Canadian Biotechnology Advisory Committee, Annual Report 1999-2000 (CBAC: Ottawa February 2001), 9.

the federal regulatory bodies because the licencing process relies on a market-based approach. The Canadian government and industry both maintain that the decision to adopt the technology should be made by agricultural producers: they have the choice of accepting or rejecting the product. Critics respond by arguing that international markets need to be secured prior to the licence approval. Without a means of segregating crops, entire export markets can be lost. Thus it can be assumed that when a GE product is under licencing review, which in itself has the potential of limiting the market access, a controversy will be ignited with doubts raised as to the ability of the Canadian government to represent the public interest.

In sum, the CBAC recommended that ethical issues should be debated in Parliament while the scientific risk assessment remain an administrative function. This strategy will not be successful unless social and ethical issues are incorporated into policy development in the early stages.¹⁶⁴ As the Royal Society of Canada postulated, value judgments are inherent in the science-based regulatory framework; the two cannot be separated. The government's strategy of constructing risk narrowly succeeded in getting the first generation of crops into the marketplace; it overlooked that "there is no guarantee that the public will passively accept a 'definition of the situation' that institutions seek to impose arbitrarily on public discourse."¹⁶⁵

From a pragmatic view, GE foods are already in the Canadian market and have been for approximately ten years. These decisions are not reversible, and therefore the issue should revolve around proper management. This approach is consistent with the CBAC's recommendations. It acknowledges the need for

¹⁶⁴ Abergel and Barrett, 152-153.

¹⁶⁵ Leiss and Tyshenko, 338.

improvement within the system but not for overhauling it. Furthermore, Canada cannot attain the same level of debate as seen in the European Union because of the former's international activities and commitment to research and development. The country is seeking to standardize elements of the regulatory process in order to meet international standards. This entails homogenizing regulatory agencies, their activities and safety assessments, with those of other countries. Canada is seeking, thus far successfully, to capitalize on the biotechnology industry through research and development investment. Nevertheless regaining public confidence is not only necessary for the government to protect the public good but also for industry to ensure a market for its products. Thus both have a vested interest in reconciling the debate.

One solution is to have a comprehensive risk-benefit analysis. Grant Isaac and Jill Hobbs argue that the Royal Society, the CGSB and the CBAC were all given partial and limited mandates.¹⁶⁶ For example, the mandates of the RSC and the CBAC only allowed them to critique how the technology was regulated rather than why it was being developed. Indeed, the RSC's recommendations were formulated only from the perspective of risk; the matter of benefit was excluded. The CBAC was prevented by the CGSB from examining labelling of GE foods, one of the issues at the heart of the matter. As an example of the need for a comprehensive analysis, Isaac and Hobbs cite the example of mandatory labelling. They argue that the enthusiasm for mandatory labelling is misplaced: "[I]f it has been declared safe and someone still has doubts, then their demands should not be on labelling, but on the

¹⁶⁶ Isaac and Hobbs, 112.

regulatory process by which the product was declared safe in the first instance.”¹⁶⁷

In sum, an analysis of the role of biotechnology in society is required.

Similarly, William Leiss and Michael Tyshenko point to the narrow framing of risk regulation as only a partial response to public concerns.¹⁶⁸ To reiterate, the process of determining safety is in the final product not in the process itself; risks are determined to be the same as those in conventional products, for example toxicity, allergenicity and so on. The authors maintain - and it is supported by the continually mounting controversy - that many members of the public would like to see the process itself regulated. Genetic engineering is limitless: every new stage of development leads to improved potential to manipulate further the genomes of all plants, animals and people. This is the reason for comments such as the following: “Are we supposed to wait until we are confronted with those actually existing products, along with their makers’ assurances that they are ‘safe’, and only then express our repugnance?”¹⁶⁹ Their position is supported by studies, mentioned in the previous chapter, which demonstrate that because laypeople view technology and science as uncontrollable, protection is required.

Accordingly, Leiss and Tyshenko propose that the government create a truly independent regulatory body that can act pre-emptively and that will consider the broad features of all aspects of genetic engineering, which include ethical and scientific judgments.¹⁷⁰ They believe this action is warranted even if it is only to placate public concerns. However it does not need to be seen as pandering to unsubstantiated fears nor as adding another layer of bureaucracy. Rather, a

¹⁶⁷ Ibid.

¹⁶⁸ Leiss and Tyshenko, 336.

¹⁶⁹ Ibid.

¹⁷⁰ Ibid 337.

regulatory body with an ongoing role to monitor issues is, in a practical sense, more efficient than fighting rearguard action.¹⁷¹

¹⁷¹ Ibid 338.

Conclusion

The constructivist approach to analyzing a scientific controversy first presented in the introduction is consistent with the acknowledgment of the importance of both social and scientific rationalities. It recognizes that scientific change needs to be dealt with in a socially responsible manner, that all facets of social change need to be dealt with including the repercussions of scientific uncertainty. Much of the academic literature presented throughout this thesis rejects positivist notions of the infallibility of science and presents underpinnings of constructivist arguments. In effect, constructivism does not assume that science necessarily equates into objective truth. Moreover, the approach is useful in explaining the lay public's perceptions of risk and science and how these differ from those of a scientist. It will be remembered that constructivism holds that controversies result from social processes. Risks and hazardous events, whether real or perceived, are the products of social experiences. By failing to consider different perceptions of risk and by adopting an essentially positivist approach, the federal government has reduced the scope of discussion to scientific arguments. This is problematic because social considerations do not play a role in the approval process of GE food nor is there a balanced dialogue about all the risks and benefits.

Science-in-society issues are only going to gain in primacy as science and technology continue to evolve. Therefore, a host of literature concerning the public's understanding of science is emerging in an effort to gauge public support (and lack thereof) in order to facilitate the social changes science carries. Determining this

understanding is not an easy task, many variables play a role. For example, the terminology or context employed can be used to sway opinion. Increasingly, science is not considered objective by the public, nor is it accepted as a source of authority. Therefore demands are being made to have social concerns given the same weight as scientific concerns.

As such, this thesis has demonstrated that developing public policy in science-based matters is difficult for any government. A further problem arises where a controversy emerges and the public's perception of risk is heightened. Responding to this perception can be futile where there is no known risk present. Nevertheless, failing to acknowledge public concerns in the early stages of the development of a technology can have disastrous consequences, both for the future of the technology and the credibility of the regulatory regime. Where no government attempt is made to pacify public concerns, a "risk information vacuum" can emerge in which different social interest groups attempt to fill the information void. The example of GE food serves as illustration. The federal government's regulatory approach has taken a promotional orientation, thereby resulting in criticisms of industry bias even to the extent of the scientific assessment process.

In a country where cynicism toward the political process is increasing, the government can no longer assume public approval for its final policies. Trust in institutions cannot be separated from trust in science where the two are intertwined. Therefore the federal government is increasingly relying on public and interest group participation to legitimize its final policies. This strategy is not always effective if the policy output does not reflect or reinforce the input. Moreover, the case of biotechnology is, in many ways, a reflection of a more general demand on the part of

the public to be involved in decision-making. From the government's perspective, interest group participation is desirable because it plays a role in shaping public opinion. Through media exposure, interest groups are able to cast government policy into doubt; therefore obtaining their support is beneficial from the government's standpoint. This is not to be inferred as support for participatory democracy: no interest groups call for a weakening of government decision-making power. Rather, participation lends transparency to an untransparent process.

GE food has not been the subject of significant debate within the House of Commons. It has received limited attention through two private members' bills concerning mandatory labelling as well as consideration by two standing committees. As a result of low exposure in the House, much of the debate occurred in the media and between different interest groups. This is an undesirable state of affairs because the controversy surrounding GE foods extends beyond questions of health and environmental safety and into moral and ethical issues. Much public resistance is a desire to avoid "playing God." It is also a result of a view that science is not objective or neutral. Indeed, as the academic literature demonstrates, some members of the public view technology as out-of-control and consequently entailing undesirable social change. Therefore calls have been made to acknowledge all facets of change that genetic engineering will bring, whether they are social, environmental, or economic. Fundamental ethical differences and different views of social life cannot always be resolved or a consensus achieved. Nevertheless, an open debate where opposing views contest one another is beneficial to resolving the controversy.

The route the government has taken thus far is through mandating the Royal Society of Canada, the Canadian General Standards Board and the Canadian

Biotechnology Advisory Committee to study the various components of the regulatory regime. Launching three committees to respond to this demand is a necessary step to garnering public acceptance of GE food. However, policy output also needs to be a reflection of the input. By virtue of their limited mandates, the regulatory reviews failed to consider all aspects of the controversy. In other words, their mandates were insufficient to get at the heart of the matter, which is the desirability of GE food at all. For this reason, whatever the final policy, it will be insufficient and controversial.

Admittedly, Canadians have been consuming GE foods for a number of years with no deleterious effects known yet. Nevertheless, as the Royal Society made clear, this is just the beginning of a host of new products and new applications of biotechnology. Much of the available academic literature to date draws a similar conclusion, which is the need for institutional reforms to resolve the controversy surrounding GE foods and restore public trust. By continually framing the issue as one that is purely science-based the government has prevented the airing of many concerns.

Many do not refute the need for a science-based approach given the incommensurability of different ethical values. Yet some academic literature suggests that scientists and lay people understand technology in different terms. The former view the application of science within its social context. Consequently concerns relate to the repercussions of an application to society as a whole. Where there is a clear benefit, acceptance is easily secured. Yet, in the case of genetic engineering, many applications do not readily offer a net societal benefit, as was demonstrated in the controversy surrounding bovine growth hormone.

The case of biotechnology is unique because it involves irreversible technology. Therefore, meaningful participation is difficult to achieve because many fears cannot be eased from a scientific perspective. Further, much public resistance has too often been discredited as arising from scientific misunderstanding and misinformation. However, a strong body of literature exists today to refute this notion. Therefore, to obtain public support, risk communication messages must be framed in such a way so as to provide the larger social context in which the technology exists. Hence the CBAC's attempt to grant non-scientific judgments the same standing as their scientific counterparts.

Finally, the communicator of the message has to have credibility. It is not yet clear if the federal government has achieved this status. Its role in promoting the biotechnology industry muddles the picture and appears to undermine its commitment to the public interest. Promoting knowledge-based growth is not unprecedented - the federal government promotes a number of industrial sectors. Therefore, communicating the separation of these roles may be effective if the government can achieve a balance between the two. Yet, too much time may have elapsed before social and ethical concerns were acknowledged, thereby allowing the controversy to erupt. Launching independent reviews is a step towards credibility, but it is by no means the end of the journey.

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