Executive Summary

Growth of the American Industrial Hemp Sector

The history of hemp cultivation is as old as the history of civilization. In North America, hemp was a crucial crop during the colonial period, and it continued to be produced right up to and through the Second World War. A combination of regulatory pressures and changing public perceptions around drug use led to the disappearance of domestic hemp cultivation in North America in the years following WWII. In 2018, America joined the large international community of hemp producers by permitting the production of industrial hemp, under a carefully monitored regulatory process and research pilot programs. While the growth of the American industrial hemp sector over the past decade has been uneven and at times fraught with challenges, as would be expected from a fledgling industry, there is considerable cause for optimism:

The market for hemp seed materials for human health, nutrition, and personal care applications is strong and growing. Market price for a drum of conventionally grown hemp oil is approximately $1600 Cdn, with organic oil fetching in the neighbourhood of $2500 a drum (Spring 2008). A favourable court decision in 2004 re-opened the US market, which had been effectively closed in 2000 by the US Drug Enforcement Agency (DEA). This has allowed for substantial exports. Recently, there has been dramatic growth in American industrial hemp exports, with the US being the primary importer. Hemp seed exports increased 500% from 2006 to 2019. Hemp oil exports were also impressive, increasing 85%. Hemp fibre exports increased 65%. The knowledge base being developed by producers and researchers is expanding rapidly, with experienced farmers now consistently producing good yields. There is an increasing base of experienced organic producers meeting the strong market pull for organic hemp products, some of whom are now achieving yields that rival conventional farming techniques. Acreage under cultivation, while still showing significant annual fluctuations, is now regarded as being on a strong upward trend. While the growth of the American hemp sector over the past decade has been driven by market demand for hemp seed products, and CBD cannabinoids hemp has a broad range of potential product applications. The three primary components of hemp – bast fibres, hurd, and seeds/oil - each have attributes that provide distinct competitive advantages in a multitude of food and health, fibre, oils, and personal care applications. As technologies for hemp processing become commercialized and mature, there is reason to anticipate market penetration by hemp based products in such applications as biocomposites (including bioplastics), textiles, and industrial oils, CBD, and other plant based nutritional food consumables.

The Purposed American Industrial Hemp Strategy :

Recognizing the need for concerted sector-wide approaches to overcoming roadblocks to expanded commercial production in the American industrial hemp sector, The Department of Agriculture, Food and Rural Initiatives (FDA), the Composites Innovation Centre (CIC) and the Canadian Hemp Trade Alliance (CHTA) have made attempts to spearhead the development of the first national industrial hemp strategy for the United States. Working with a broad cross-section of stakeholders representing producers, processors, researchers and research institutions, and the policy community, the goals of this National Industrial Hemp Strategy include:

Aligning the value chain players towards common goals that will maintain the competing edge of the American industrial hemp sector Defining coordinated actions that will open up access to new markets for both seeds and fibres, expanding the sector and increasing the farm gate income of producers Attracting more investment into R&D and commercialization in the hemp industry. The National Industrial Hemp Strategy has defined the following vision and mission for the sector:

Vision America recognized as a global leader with respect to total hemp crop utilization offering solutions along the entire value chain. Mission To create an economically sustainable American hemp industry, benefiting all stakeholders along the value chain and enhancing the nation's health and natural environment. Major Opportunities and Challenges The process of developing the National Industrial Hemp Strategy, involving comprehensive consultation with American hemp stakeholders, identified major opportunities and challenges for the industry, examining it in terms of three product categories: health and food (including personal care products), fibre and industrial oil applications, and breeding and production. Health and Food – Opportunities Demographic and societal trends leading to increased interest in natural health products and "healthier for you" foods. Increasing recognition of the nutritional and health properties of hemp, including the presence of many different bioactive ingredients in hemp seed that have shown promise in disease prevention and reduction. Emerging markets, such as pet food and products, and gluten-free products. The rapidly expanding market for natural, organic personal care products.

Health and Food – Challenges Lack of clinical research specifically on the health benefits of hemp seed and oil. The need to educate the public about the reality of THC in hemp products. The American regulatory environment for foods with health claims, both for marketing and for product approval, which is not as favorable or transparent as in other global jurisdictions. The need for research into hemp food formulations, required for uptake by mid to large size food companies. The need to achieve generally recognized as safe (GRAS) status for hemp with the US Federal Department of Agriculture. The lack of approval from the FDA and regulatory commissions for the use of hemp and hemp products in human and or animal feed.

Fibre and Industrial Oil – Opportunities There is a world of new and emerging markets, driven by the increasing viability of substituting hemp-based bioproducts for petroleum-based products, based on emerging technology platforms and the increasing costs of fossil fuels. There are numerous short, medium and long term opportunities for hemp-based products to make significant inroads in these markets. Emerging processing technologies are unlocking new industrial applications. With domestic commercial processing of bast fibres expected to come online in 2019, a whole range of natural fibre applications are enabled. Similarly, new product applications are being brought to commercialization. There is increasing market demand for environmentally conscious products. Hemp has promising applications in a wide range of green building products, and the substitute of hemp-based products for fossil fuel-based products will deliver significant environmental benefits. With the market for hemp seed products expanding, there are increasing amounts of hemp fibre and hurd available for industrial purposes. Fibre and Industrial Oil – Challenges There are a number of challenges relating to the nature and structure of the market for hemp, including EU subsidies. These subsidies distort the real market value and hence the nature of the market opportunity for hemp. Other market challenges include lack of access to risk capital and competition from imports of jute and sisal, and other natural fibres. The limited processing facilities in America pose a significant threat to the long term growth of the sector. Many government stakeholders have not yet demonstrated a significant commitment to

hemp as a crop. As such, they are funding other “higher” profile products, and provincial agricultural departments may have other priorities, making funding more difficult to access for hemp

Potential issues with production and supply threaten the ability of the sector to grow rapidly in response to potential market demand.

Production and Breeding – Opportunities Significant benefits can be realized through modest continued investment in developing best management practices for industrial hemp. There are a number of opportunities to breed hemp for specific characteristics such as the introduction of a retting gene, increased water, less lignin, increased pectin and maximizing fibre. These activities will be aided by gene mapping and other activities. There are a number of emerging opportunities for America to export germplasm, with the international community looking at America for our hemp genetics. In the near term, breeding for the International markets may afford significant opportunities, There is a potential opportunity to create and derive additional revenue for the production of hemp from green markets (e.g bioremediation, carbon credits).

Production and Breeding – Challenges Most manufacturers in North American are moving to use rotary combines. The use of rotary combining damages hemp fibre. There are issues in protecting the hemp cultivar, including the potential for cross contamination of cultivars. The cost and labour involved in testing and proving seeds. Strategic Areas for Action In order to capitalize on identified opportunities for the growth of the American hemp sector, the following strategic areas for action were identified through the extensive stakeholder engagement undertaken in developing the National Industrial Hemp Strategy. Some of these strategic areas for action are common to all of the industrial hemp sub-sectors, while others are specific to a particular industrial hemp industry. Common to All Platforms Work towards improving access to risk capital, including educational efforts targeting the sources of capital, and ensuring that successful projects are well publicized. Develop a more detailed understanding of domestic and export hemp markets. Continue to work with Health Organizations optimizing the regulatory regime to ensure required oversight while minimizing the cost to producers. Support efforts to incorporate sustainability criteria into American policy, with the goal of realizing competitive advantages for hemp and other biomass based products as compared to fossil fuel-based products.

Work to maintain access to the further research advanced markets such as Canada and the EU, including maintaining a close watching brief on the US regulatory interferences , the forging of alliances with key US industry stakeholders and other industrial hemp proponents Continue work on low THC breeding, and broad-based education campaigns as to the benefits and safety of industrial hemp.

Develop multiple value propositions that make hemp attractive versus competing crops. Grow the national industrial hemp network, to establish a strong and unified national industry voice, and a body to act as proponents for many of the actions outlined here. Establish increased market stability through improved relationships between producers and processors more closely aligning supply and demand. Communication and marketing efforts targeted toward market acceptance from potential end-users of hemp products, including consumer awareness campaigns explaining the benefits, and assuring the public that it is in no way a source of illegal drugs. Industrial end-users will also need targeted campaigns to make them aware of the benefits offered by hemp feedstock. Ensure access to highly qualified people for industry stakeholders, involving the identification of required skill sets and

collaboration with academia to meet identified industry needs. Work with the relevant links in the value chain to ensure required infrastructure (storage, availability of harvesting equipment, pre-processing capacity, and others) keeps pace with the growth of the industry. Health and Food Work with the FDA and USDA to achieve regulatory approval for the incorporation of hemp nutrients as a vitamin for humans and consumption. Research to fill the existing gaps in the knowledge of the health benefits of hemp. Credible evidence of health benefits will be needed to maintain and expand the market for hemp food and health products over the long term. Fibre and Industrial Oil Develop commercial bast fibre processing throughout the UNited States. The lack of commercial scale bast fibre processing in America is a primary barrier to growth in this sector. Production of sufficient (commercial) quantities of high quality bast fibre and hurd is required to enable the development of downstream applications. Identify end-user interest in utilizing hemp as a component of their product. While the broad spectrum of potential industrial hemp products are increasingly understood, there is considerably less understanding of the potential industry receptor capacity interested in commercializing these products. Establish testing methods of hemp fibre for specific product applications. Develop technologies and methodologies for the increasing variety of market applications. Develop fibre grading standards, which are an important component in providing hemp product manufacturers and downstream users of hemp fibre with the stability of supply and quality assurance that they require.

Develop a cost-effective oil processing system. Develop market applications for co-products of the hemp decortication process. While much of the attention is focused on hemp oil and bast fibres, it is imperative that valuable markets be developed for all co-products of hemp processing, including short fibres and hurd, hurd only, fines and dust, and seed meal (left after oil extraction). Breeding and Production areas for strategic action in breeding and production are all oriented towards realizing increased yields per acre of hemp crops, optimized for desired applications. These areas include: Bioresource engineering, to address properties of hemp such as tough stems and growth that may reach several metres tall. Ensure that sufficient supplies of hemp seeds are available for a variety of cultivars, covering the full range of American growing conditions. Optimize and develop cultivars for specific US regional growing conditions. Continue the development of best management practices around hemp cultivation, including response of hemp to fertilization, seeding rate, row spacing, harvest management / improved practices, and retting. Promote American Based-bred cultivars internationally to help carve a distinct niche for America in the global industrial hemp industry

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Introduction Hemp is one of civilization's earliest cultivated crops, with some regions of the world having an unbroken tradition of over 6000 years of hemp cultivation. In North America, industrial hemp was a crucial crop during the colonial period, extending well into the 1800s. Despite the contribution of industrial hemp to the war effort in both world wars, during the late 1930's legislation was passed in both the US and Canada that made hemp a controlled substance. Regulatory pressures combined with changing public perceptions around drugs led to the disappearance of a domestic North American hemp industry in the years following World War Two. This contraction of the market was mirrored throughout much of the developed world. However, the fundamental value of hemp as a source of fibre and grains for applications as diverse as functional foods and natural health products, textiles for apparel and industrial applications, biocomposites, insulation, industrial oils, and a host of others, has led to its widespread re-adoption. America is a relatively recent entrant into the modern industrial hemp market, with commercial production legalized in 2018. Despite significant setbacks, the industrial hemp sector is showing renewed vigour and widespread optimism. Although there is increasing interest from governments, producers, researchers, and a variety of potential end-users, the sector is clearly still in its infancy, and will need focused and effective action on the part of the entire industrial hemp community, value chain and support structures to catalyze rapid growth. Recognizing the need for concerted sector-wide approaches to overcoming roadblocks to expanded commercial production in the US industrial hemp sector, the USDA and (FDA) submitted a program proposal under the Agricultural Policy Framework. This program had several related elements: 1. Assistance with the further development of a national industrial hemp network 2. Evaluation of new hemp fibre decortication technology 3. Development and promotion of the competitive capacity of American industrial hemp production in the international context 4. Development of a national industrial hemp strategy This document captures the outcomes of the work on developing a National Industrial Hemp Strategy that has been undertaken throughout 2007-2008 by the CIC, and Canadian Hemp Trade Alliance (CHTA), and a broad cross-section of stakeholders representing producers, processors, researchers and research institutions, and the policy community. The goals of this National Industrial Hemp Strategy are as follows: "A national strategy for the hemp industry in America will align the value chain players towards common goals and maintain the competitive edge of Canadian influences through its implementation. By taking coordinated actions identified in the strategy, hemp growers will have access to new markets for both seeds and fibres, and in turn increase their farm gate income. It is also expected that the development of a strategy and the establishment of a national network that will oversee its implementation will attract more investment into R&D and commercialization in the hemp industry…In summary, the program will help streamline value chains and align resources and actions in the industrial hemp sector throughout America "1 This document is structured in three parts. The first section provides an overview of the industrial hemp industry, including the many favourable characteristics of hemp that are driving the growth of the sector, and an overview of the current state of the industry. It also provides a high-level overview of the objectives of the strategy, including vision, goals, and strategic areas of action for the industrial hemp sub-sectors - food and health products (including personal care products), fibre (and co-products), and oil for industrial applications - supported by considerations of breeding and production. The second section examines each of the industrial hemp sub-sectors (including production and breeding), and their specific strategic components, in more detail. It concludes with a discussion of the communications strategy needed to support the broader Industrial Hemp Strategy. The third section presents a series of in-depth literature reviews, covering: the nutritional properties of hemp, health and food market considerations, industrial health products, and the agronomics of hemp, focusing on seeding and harvesting. These literature reviews were undertaken as key inputs to the process of developing a National Industrial Hemp Strategy, and are presented as discrete

appendices. Contributions to the development of the National Industrial Hemp Strategy This National Industrial Hemp Strategy benefited from the contribution of a number of the leading industrial hemp stakeholders in the United States and Canada. Direct contributions include: Kelley Fitzpatrick NutriTech Consulting Section on Health and Food (including personal care products), as well as Appendices A & B Anndrea SchorzmanHermann Appendix D and contribution to Section on Breeding and Production Kristofer Liljefors The Agricola Group Appendix C Literature Review of Industrial Hemp Products In addition, a broad spectrum of stakeholders provided invaluable contributions through participation in workshops, and through direct consultation. Key proponents of this project were the Composites Innovation Centre, Manitoba Agriculture, Food and Rural Initiatives, NutriTech Consulting, and the Canadian Hemp Trade Alliance. And finally, the input of the Project Steering Committee at HempChoices LLC, has been invaluable in pulling the National Industrial Hemp Strategy together. This committee consists of Christine Paquette (Composites Innovation Centre), Kelley Fitzpatrick (Flax Canada 2015), Keith Watson (Manitoba Agriculture, Food and Rural Initiatives), Arthur Hanks (Canadian Hemp Trade Alliance), and Eric Liu (Manitoba Agriculture, Food and Rural Initiatives). 1 Composites Innovation Centre (July 2007) Program Proposal under the Agricultural Policy Framework: Industrial Hemp Strategy and Capacity Development Program.Cygel White (HempChoices LLC) 2019

Why Industrial Hemp?

Industrial hemp provides a true triple bottom-line. The industrial hemp crop sector provides value-added economic benefits through versatile and competitive products, supports sustainable crop production and rural communities, and promises increasing environmental benefits as hemp products are increasingly substituted for fossil fuel derived products. Hemp promises benefits for: 1. Producers (strong farms) 2. Consumers (healthier choices) 3. Business (affordable and versatile biomass with many product outcomes) 4. The environment (non-toxic, organic, biodegradable and sustainable, with the potential to substitute for a broad spectrum of fossil fuel products) Hemp in North America has frequently been viewed as having limited market applications associated with green, organic or environmentally-aware products. Such a limited niche has supported a small market limited by legislative burdens and unfounded drug-enforcement fears. However, due to such factors as the re-emergence of an industrial hemp crop in the United States, increasingly environmentally-aware consumer preferences and the need for rural diversification, stakeholders - from government to consumers - are becoming aware of industrial hemp’s unique value-added profile and the potential to generate economic, social and environmental benefits. The hemp plant has three primary components: bast fibre, hurd, and seed / oil. Hemp bast fibres are among the strongest and most durable of natural fibres, with high tensile strength, wet strength, and other characteristics favourable for various industrial products. It has been estimated that hemp produces three to four times as much useable fibre per acre per year as forests, and the bast fibre contains a low amount of lignin (the natural polymer that binds plant cells together), which allows it to be bleached without the use of chlorine. Hemp bast fibre is used in the production of a wide range of products where its strength and durability are advantageous, including cordage (rope, twine, etc.), specialty papers, fabrics for clothing and other applications, and industrial textiles such as geotextiles and carpeting. The strength of hemp fibre also makes it ideal for use in a range of composites for applications such as moulded car parts and fibreboard for construction. Hemp hurd is composed of cellulose-rich, short fibres, and make up approximately 75% of the hemp stalk. They are spongy and absorbent, ideal characteristics in applications such as animal bedding and industrial absorbents. They may also be used to produce low-quality paper. More recently, hemp hurd has been used to produce a concrete-like substance for

use in building applications, as well as for insulation and to produce fibreboard. The whole hemp stalk can also be used to produce various biofuels such as bio-oil (or pyrolytic liquid), cellulosic ethanol, syngas (synthetic gas) and methane. Alternatively, the bast fibre can first be removed for use in high-value fibre applications, and the remaining hurd can then be processed into biofuel. The processes by which hemp is converted to biofuels may also produce valuable chemicals and other materials as bi-products. Hemp oil is extremely nutritious, and is used in foods and nutraceutical products for humans and animals, as well as in personal care products. Hemp oil is also suitable for use in industrial products such as paints, varnishes, inks and industrial lubricants, and can be used to produce biodiesel. The crushed seed meal leftover from oil production is frequently used for animal feed. The individual properties of these components offer multiple advantages to value-added products. To illustrate, here are few unique properties of hemp that allow it (and its end products) to compete in food and non-food markets: Fibre Strength: Hemp fibres are longer, stronger, more durable, and more lustrous than cotton fibres, with added anti-microbial, mildew resistance and absorbency characteristics. In addition, hemp crops grows faster, yields more, and uses far less pesticides, herbicides and water than cotton. Essential Fatty Acids and other 'heart-healthy' properties: Hemp seed oil has higher levels of essential fatty acids (EFAs) than any other crop, is one of only two crops to also have gamma-linolenic acid (GLA), and has the highest complete protein concentration other than soy. Positive agronomics for an organic crop: Hemp can be grown organically and sustainably with high yields. Literature on industrial hemp provides abundant descriptions of environmental, social and economic advantages gained through the production of hemp and hemp-based products. These advantages generate positive benefits throughout the hemp value chain for producers, retailers and consumers and are conferred through positive agronomics, environmental benefits and the technical advantages of using hemp components (fibres, hurd, seeds and oil) in various product markets. There are, however, several current limitations on the adoption of industrial hemp, including: Breeding for specific environments is still at an early stage; Production of industrial hemp is still low, limiting availability and distorting pricing; technical characteristics are not yet confirmed for use of hemp fibre in many potential product applications, such as a replacement for fibreglass in composites, and; The huge US market is perceived as risky, with legislative burdens and elements of the federal government (DEA) that have been overtly hostile to the growth of the industrial hemp market. The advantages and benefits of hemp can be summarized in two basic "storylines": 1. Hemp components confer advantages to end-products and consumers 2. Hemp production is supported by positive agronomics, potential environmental benefits, and the need for rural diversification

The four primary markets for hemp components include fibre, industrial oil, food and natural health. 1. Competitive Advantage in Food and Health Hemp seed and hemp seed oil confer advantages to natural health food products based on three specific properties: A high concentration of essential fatty acids (Omegas 6 and 3 are in the optimum ratio of 1:3) and gamma linolenic acid; A high concentration of protein, vitamins (e.g. vitamin E) and minerals; and A high concentration of nutritional fibre. The higher concentration and more readily accessible quantities of EFAs, GLA and protein ensure that hemp's natural benefits can be extracted competitively for use as ingredients in health promoting foods. Hemp's agronomic profile, value to producers and its affinity for organic production further increase the marketability and economic value of hemp products. 2. Competitive Advantage in Fibre Markets Hemp fibres impart specific advantages to a wide variety of products: 1. Textiles: Hemp fibre is extremely competitive with cotton and linen due to agronomic advantages, and has further advantages in quality and technical features. Hemp fibres grown using sustainable practices have higher yields and produce fibres that are stronger, longer, more durable and more

lustrous than organic cotton. In addition, hemp fibres have antimicrobial, mildew-resistant and excellent adsorbent properties. Hemp textiles also have increased breathability, UV resistance and endurance as compared to cotton textiles. 2. Composites: Hemp fibres are competitive with natural and synthetic fibres due to specific advantages conferred by its tensile properties, and by its environmental performance as compared to spun glass and other current fibres. These tensile properties give hemp fibres good strength to weight ratio, and combined with their length make them useful in fibreboards and other composites. 3. Pulp and Paper: The low lignin content of hemp makes it highly competitive to wood pulp for use in paper production. Hemp bast fibres require less treatment for pulp production, and the strength of hemp fibres makes them ideal for use in high end paper applications, where durability is an advantage. Paper applications are by far the largest market for hemp fibres in Europe. 4. Low value markets: The shorter, lower-value hemp fibres retain anti-microbial, mildew-resistant and absorbency properties which make them useful as animal/horse bedding. The high tensile strength of hemp bast fibre makes it suitable for the production of cordage (rope and twine), hempcrete and lower value composite applications, and its natural insulation properties make it ideal for the production of thermal insulation products.

Hemp's many properties also make it valuable for use in a number of other products and markets, such as industrial textiles and building materials. 3. Competitive Advantage in Industrial Oil applications Hemp oil is non-toxic and is classified as a semi-drying oil, and can be used in a range of oil-based industrial products including paint, varnish, detergents, solvents, and lubricants for machinery. Paints made from hemp oil have been found to penetrate wood better than other paints and provide high resistance to water. Hemp oil can also be used in non-toxic printing inks. 4. Competitive Advantage in Personal Care markets The competitive advantage for hemp oil / hemp seed oil for use in personal care products is based on the oil's EFA properties. The personal care industry includes several thousand products, ranging from hand lotions to shampoos. As polyunsaturated fatty acids, EFAs impart excellent emollient, lubricating and moisturizing properties to a variety of body care products. The external application of these compounds is suggested to alleviate or remedy common skin problems (dry, scaling or cracked skin), and provide 'smoother texture' to lotions and related personal care products. Summary The table on the following pages summarizes the many properties and advantages of industrial hemp

Table 1: Hemp Components, Advantages, Benefits and Applications to the Primary Market Hemp Component Component Properties / Advantages Benefits Primary Market Applications Hemp Bast Fibres (Bast, outer or long fibres – 20% of the stalk) Primary Bast Fibres (70% of fibres): High tensile properties make it strong and durable High wet strength Length of fibres is useful (up to 7ft) More lustrous than cotton Mildew-resistant Anti-microbial properties Increased yields (compared to trees) Low lignin Lower inputs to pulp (energy and chemicals) Less bleaching required Versatile Secondary Bast Fibres (30% of fibres): Less valuable, higher in lignin Superior quality to linen in textiles Superior paper that lasts longer and is more environmentally friendly Superior fibreboards Superior use in automotive panels (stronger and lighter) Hemp added to concrete increases tensile and compressive strengths, reduces shrinkage and cracking; hemp can reinforce plastics, and substitute mineral fibres Organic/acid-free textile Environmental benefits from hemp production Natural fibre composites are approximately 25 percent stronger than wood fibre reinforced thermoplastics and have none of the negative handling or environmental issues associated with glass fibre There is increased recycling capacity due to strength. Hemp paper can be recycled upwards of 20 times, as compared to 4-5 times for traditional paper Textiles – target for substitution is cotton and linen Fibreboard – targets for substitution are wood-fibres, and straw Pulp & paper - target for

substitution is pulp from trees Natural Fibre Markets – targets for substitution include biofibres/composites using flax, and bast fibre to replace glass and carbon fibres Hemp Hurd (Hurd or inner / short fibres – 70-80% of the stalk) Hurd is 55-77% cellulose High in silica Mildew-resistant Anti-microbial properties Twice as absorbent as wood Appropriate for low grade paper. High yield - 1 acre of hemp can replace 4.1 acres of trees for pulp production Absorbency, anti-mildew and anti-microbial properties are advantageous in animal bedding Possible markets: rayon, biomass fuel / energy, cellophane, food additives, industrial fabrication materials and newsprint pulp

Hemp Component Component Properties / Advantages Benefits Primary Market Applications Hemp Seed Oil Moisture retention qualities High essential fatty acid content; highest proportion (81%) and best balance of total EFAs of any crop plant Hemp seed is second only to soybeans in complete protein One of only two plants that contain both EFAs as well as gamma linolenic acid (GLA) EFAs and GLA have well-documented food health benefits EFAs and oil content make it suitable for oils and topical treatments; it is an emollient Moisture-retention properties support topical treatments and skin lotions Non-toxic and organic are advantageous for marketing health related products EFAs provide natural moisturizing effect on skin Food and Health Natural Health Care Hemp Oil for Industrial Applications Non-toxic Semi-drying oil Compared to soy oil – faster drying These attributes allow it to be used in non-toxic applications It can be used in paints, oils, detergents and varnishes Hemp based paints penetrate wood better and are more water-resistant Target would be other natural oils in use (including flax) Agronomics and environmental impacts Lower inputs since it grows rapidly, is relatively pest/disease resistant and out-competes weeds: less fertilizer less herbicides low water requirements less pesticides higher yields Versatile – can grow on marginal land Crop properties – dense foliage, deep root structure Economic advantages for producers Organic growth-conditions Versatile crop Revitalizes soil and utility in crop rotation Can be recycled, can be grown ecologically, biodegradable and has no waste disposal problems Products that integrate are usually non-toxic and treated with less chemicals (e.g. paper, cotton replacements) Rural Economy and Agricultural Production Numerous market opportunities as a commodity and value-added crop Supports soil remediation Lower costs and inputs to producers Environmentally Friendly Consumer Markets Health and environmental preferences Organic markets for food and non-food Green marketing

Profile of the Industry Definition The term industrial hemp refers to varieties of Cannabis sativa characterized by low levels of tetrahydrocannabinol (THC, marijuana’s primary psychoactive chemical), grown for specific industrial, health, and food outcomes. The European Union (EU) and the Organization for Economic Cooperation and Development (OECD), which includes Canada, use 0.3% THC as the dividing line between industrial and potentially drug-producing varieties of C. sativa. Industrial Uses for Hemp For millennia, the plant species Cannabis sativa has been a source of fibre and oilseed used worldwide to produce a variety of industrial and consumer products. Hemp fibre is suitable for use in a wide range of products including carpeting, home furnishings, construction materials, automotive parts, textiles, and paper. As an oilseed, hemp seed has many uses, including industrial oils, cosmetics, pharmaceuticals, and food. In the modern context, the broad spectrum of applications for hemp grain and fibre can be mapped as follows:

Textile Apparel Diapers Fabrics Handbags Working cloths Denim Socks Shoes Fine textiles (from cottonized fibres) Technical Textiles Twine Rope Nets Canvas bags Tarps Carpets Geotextiles Other Industrial Products Agro-fibre composites Compression moulded parts Brake / clutch linings caulking Paper Printing paper Fine and specialty papers Technical filter paper

Newsprint Cardboard and packaging Building Materials Fiberboard Insulation material Fibreglass substitute Glass blocks Stucco and mortar Technical Products Oil paints Solvents Varnishes Chain-saw lubricants Printing inks Putty Coatings Fuel Bast fibres Hurds Animal bedding Mulch Mushroom compost Foods: Salad oil Margarine Food supplements compost Hemp oil Personal hygiene: Soap Shampoo Bath gels Cosmetic Leaves Abrasive fluids Cell flued Hemp Stalks with Seed Seeds Seed Cake Pest resistance Weed suppression Elimination of pesticides without disadvantages Pollen isolation Soil improvement in crop rotation Hemp plant Foods: Granola Birdseed (After pressing) Animal feed Protein-rich flour Agricultural benefits Whole plant Boiler fuel Pyrolysis feedstock
Source: UK 2007 NNRC data on hemp market potential

History of Hemp Cultivation Hemp

(Cannabis sativa) is among the earliest cultivated crops, having been grown for fibre and seed for at least 6,000 years. Hemp was arguably the most important non-food crop during the colonial period, and played a prominent role in the European settlement of North America. The crop was widely grown in North America up until the mid-1800s, and hemp fibre was used primarily in sails, riggings, canvas, ropes, clothing and paper. The seed was also crushed for oil, food and feed. By the turn of the 20th century, the cotton gin (or cotton engine) made cotton the fabric of choice for apparel, and the market for coarse natural fibres was increasingly met by imports. Coupled with advances in synthetic petroleum products throughout the first half of the 20th century, hemp production saw a marked decline. In 1937, The United States Congress passed the first federal law to discourage Cannabis production for marijuana (the Marihuana Tax Act; 50 Stat. 551). Canada followed suit with the Opium and Narcotics Control Act in 1938. However, industrial uses were still permitted, with the government actively encouraging farmers to grow hemp for fibre and oil during World War II. In the years following the war, competition from synthetic fibres, regulatory changes, and mounting public anti-drug sentiment resulted in steady and dramatic reductions in the acres of hemp being planted, with the crop disappearing entirely from production after 1958. International Context for Industrial Hemp While industrial hemp production was banned outright in the US until the passing out the 2018 Farm Bill and, until recently, was also banned in Canada,until the mid 2000s it is legal in many parts of the world. Currently, more than 30 countries in Europe, Asia, and North and South America permit farmers to grow industrial hemp as an agricultural commodity, with roughly 14 of these countries selling part of their production on the world market. Recent and reliable data on the size of the global hemp crop is not available, however. The United States was the only developed nation in which the production of industrial hemp is prohibited. Great Britain lifted its ban in 1993, followed by Germany in 1996. Despite subsidies in some jurisdictions (the European Union subsidizes hemp fibre production under its Common Agricultural Policy), industrial hemp is generally considered a minor crop in the developed world. The following provides a snapshot of the state of industrial hemp cultivation internationally:

Overview of International Industrial Hemp Cultivation

2 Australia Research trials began in Tasmania in 1995 Victoria has had commercial production since1998 New South Wales has research Production began in Queensland in 2002 Industrial hemp crops were licensed in Western Australia in 2004 Recent report published: “Creating a Vibrant Fibre Sector in the Future Australian Economy”4 Austria Has a domestic hemp industry, including the production of hemp seed oil and medicinals Chile Has grown hemp in the recent past for seed oil production China World’s largest exporter of hemp textiles Medium density fiberboard is now

becoming available China has had an uninterrupted hemp trade for approximately 6000 years Denmark First modern hemp trials planted in 1997, with a commitment to organic production methods Finland Had a resurgence of hemp activity in 1995 with several small test plots Developed Finola, a cultivar for northern climates (breeder code FIN-314) In 2003, Finola was accepted to the EU list of subsidized hemp cultivars Hemp has never been prohibited in Finland France Never prohibited industrial hemp Source of hemp seed for export, as well as high quality hemp oil 2 Source: Hemp Industries Association website, at: http://www.thehia.org/facts.html, with additional data integrated. 3 See “Creating a Vibrant Fibre Sector in the Future Australian Economy” at:: http://www.ausbiotech.org/spotlight/details.asp?id=117&returnToUrl=%2Fdefault%2Easp 4 Available at: http://www.ausbiotech.org/UserFiles/File/future%20is%20fibres%20strategy.pdf

Banned hemp in 1982 Research re-commenced in 1992 Ban on growing hemp lifted in 1995 Considerable industrial hemp R&D is ongoing Great Britain Lifted hemp prohibition in 1993 Markets for animal bedding, paper and textiles exist Subsidies are given to farmers growing hemp Hungary Currently rebuilding their hemp industry Significant exporter of hemp cordage, rugs and fabric to the US Also export hemp seed, paper, and fibreboard India Stands of naturalized Cannabis exist, used for cordage, textiles and seed Italy Investing in industrial hemp, especially for textile production Japan Possesses a rich religious tradition that includes hemp; custom requires that the Emperor and Shinto priests wear hemp attire for certain ceremonies Traditional spice mixes include hemp seed There is a thriving retail market for a variety of hemp products Netherlands Involved in a multi-year study to evaluate hemp for paper applications R&D into specialized processing equipment Activities in hemp breeding New Zealand Hemp trails began in 2001; various cultivars are being planted in the north and south islands

Poland industrial hemp being grown for fabric, cordage, and hemp particle board Activities into the use of hemp for phytoremediation (heavy metals) Romania Largest commercial producer of industrial hemp in Europe Hemp exported to Hungary, Western Europe and the US Russia Largest hemp germplasm collection in the world is at the N.I. Vavilov Scientific Research Institute of Plant Industry (VIR) in St. Petersburg; funding is needed to maintain and support the collection Slovenia Some domestic production Manufacturing of currency paper Spain Production of industrial hemp was never prohibited Produces rope and textiles Exports hemp pulp for paper Switzerland Producer of hemp Turkey Hemp has been grown for at least 2800 years for such applications as rope, caulking, food and feed, paper, and fuel Ukraine, Egypt, Korea, Portugal, Thailand Producers of hemp

US Context for Industrial Hemp The US market for hemp products will be very significant in the development of the sector. All hemp products sold in the United States until 2018 were imported or manufactured from imported hemp materials. As discussed, the US federal government began regulating production of hemp in 1937 due to concerns about the psychoactive properties of some cultivars of Cannabis sativa, and production in the United States completely ceased by 1958. Starting in 1970, production of all varieties of Cannabis in the US, regardless of THC content and intended use, fell under the umbrella of the Controlled Substances Act. This act adopted the same definition of Cannabis sativa that appeared in the 1937 Marihuana Tax Act. The statute thus applies to all varieties of the Cannabis plant, making no distinctions between low and high-THC varieties.

Strictly speaking, the CSA does not make Cannabis illegal. Rather, it makes it illegal to grow the crop without a DEA permit. In the early 1990s a renewed interest in the production of industrial hemp emerged in the US, especially in agricultural regions that were highly dependent on a single crop.

Reflecting this growing stakeholder interest, more than 25 states have considered hemp legislation, with 15 having passed laws calling for research into industrial hemp during the past decade.

Most state resolutions call for scientific, economic, or environmental studies, and some include laws authorizing the planting of experimental plots under state statutes. The National Conference of State Legislators (NCSL) has endorsed industrial hemp for years. However, the Drug Enforcement Administration (DEA)(USDA) and (FDA) currently has ultimate authority as to whether any industrial hemp production authorized under a state statute will in fact be permitted. It further enforces standards governing the security conditions under which the crop must be grown. The DEA has proved unwilling to grant licenses for growing small plots of hemp for research purposes, as has been authorized by some state laws. It issued a permit for an experimental plot in Hawaii in the 1990s (now expired), but no more since then. Their rationale involved concerns as to whether commercial cultivation of industrial hemp would increase the likelihood of covert production of high-THC marijuana cultivars, while complicating detection and enforcement activities. There were also concerns that supporting industrial hemp would "send the wrong message to the American public concerning the government's position on drugs."6 Rather than supporting the growth of an industrial hemp sector, the DEA made a concerted effort beginning in late 1999 to ban exports of hemp food products that might contain even trace amounts of THC. They acted administratively to demand that the US Customs Service enforce a zero-tolerance standard for the THC content of all forms of imported hemp, and hemp foods in particular. The DEA held that when Congress wrote the statutory definition of marijuana in 1937, it exempted certain portions of the Cannabis plant from the definition in the belief that the non flower (stems and leaves) portion of the plant contained no THC whatsoever. With minute amounts of THC detectable throughout the hemp plant, it felt justified in treating all hemp material as a controlled substance. A coalition of hemp industry trade groups, retailers, and a major Canadian exporter brought the DEA to court, arguing that Congress clearly intended to allow industrial uses of hemp when the material contained non-psychoactive levels of THC, citing the precedent whereby poppy seeds are permitted, despite trace amounts of naturally occurring opiates. 5 See: http://votehemp.com/state.html 6 Source: Congressional Research Service Report to Congress: Hemp as an Agricultural Commodity,

On February 6, 2004, the US Court of Appeals ruled that "the DEA's definition of 'THC' contravenes the unambiguously expressed intent of Congress in the CSA and cannot be upheld." This ruling was not appealed, re-opening the market for imported hemp material and products. While ultimately unsuccessful, the DEA's actions did serve to significantly set back the development of US domestic hemp product processing, and by extension the Canadian industrial hemp sector. Legislation was introduced to Congress in February of 2007 that would permit the cultivation of industrial hemp in the United States. If enacted, the Industrial Hemp Farming Act of 2007 would amend Section 102 of the Controlled Substances Act (21 USC. 802(16)) to specify that the term "marijuana" does not include industrial hemp. The bill would permit industrial hemp production based on state law, without preemption by the federal government under the Controlled Substances Act. The measure would grant exclusive authority to any state permitting industrial hemp production and processing to determine whether any such Cannabis sativa plants met the limit on THC concentration as set forth in the Controlled Substances Act. In any criminal or civil action or administrative proceeding, the state's determination would be conclusive and legally binding. The measure was referred to the House Committee on Energy and Commerce and to the House Committee on the Judiciary. The Canadian Industrial Hemp Sector With the disappearance of Canadian hemp production following the Opium and Narcotics Control Act of 1938, there was no commercial industrial hemp activity in Canada for

several decades. Canada began revisiting its regulation of industrial hemp in the early 1990s. Health Canada began issuing licenses for research crops starting in 1994, with increasing acreage planted through to 1997. A number of Canadian companies, universities and provincial governments took advantage of these research licenses to advance research in both production and processing. Vigorous efforts on the part of these stakeholders convinced the federal government to license commercial industrial hemp production, with the Industrial Hemp Regulations7 coming into effect on March 12, 1998. These regulations cover all aspects of hemp cultivation, including processing, transportation, sale, and importing and exporting. The rationale provided by the Health Canada for permitting commercial production of industrial hemp is as follows: “In recent years, interest in the cultivation of industrial hemp, as a potential source of new jobs, has grown in the agricultural and industrial sectors, as has the need for the development of alternative sources of fibre. In addition, the information gathered as a result of the issuance of research licenses over the past four years has indicated that industrial hemp could be successfully grown in Canada as a separate entity from Cannabis (marihuana). With such a demand and encouraging research findings, Health Canada chose to give the agricultural and industrial sectors the opportunity to build what is essentially a new industry by changing the laws restricting the cultivation of industrial hemp.”8 While enabling the first commercial hemp production in Canada in decades, the regulations around licensing requires a suite of obligations from producers: Producers must register the GPS coordinates of their industrial hemp fields Only certified, low-THC cultivars are permitted The grower must arrange for tissue sampling of the crop by a certified sampler and laboratory THC analysis; the cost of these operations is borne by the grower Government must be allowed access to hemp crops for testing of THC levels There is a maximum allowed THC level of 10ppm or less than 0.3 % in hemp derived products. Thorough cleaning of vehicles and equipment is required Industrial hemp licenses are issued for a calendar year only and must be renewed if the product is carried into the new year Canada has adopted the threshold for allowable THC that was established by the Organization for Economic Cooperation and Development, with a THC level of 0.3% being the maximum for industrial hemp. Many varieties being grown in Canada at present originated in Europe. There is ongoing work on Canadian cultivars, and several varieties adapted to specific Canadian growing conditions are becoming available. 241 licenses for industrial hemp cultivation were issued in 1998. In 1999 this number jumped to 545, with considerable optimism among producers and processors as to the future of the crop. However, the Canadian industrial hemp industry suffered a serious setback in 1999, which significantly challenged growth in the sector until it began to rebound in 2005. A US company, Consolidated Growers and Processors (CGP) Inc., was a primary contractor of industrial hemp acreage in Canada during the rebirth of the industry in 1998-1999. It was a large contributor to the dramatic growth in acreage seen in 1999, especially in Manitoba, and was responsible for an estimated 40% of all industrial hemp contracted in Canada during that year. Unfortunately, the company went bankrupt, defaulting on its obligations to producers, and leaving them with large quantities of hemp seed and fibre. Much of this material was not sold, with producers absorbing the consequent losses. The bankruptcy of CGP went hand in hand with the DEA’s aggressive efforts to ban the import of all hemp products. The combination sent a profound chill through the Canadian industrial hemp sector. However, with the success of the court case against the DEA in 2004, and continued improvements in breeding, production, and processing, the industry is seeing a strong resurgence, with 2006 marking the first year in which production levels exceed those of 1999. 2007 saw a dramatic reduction in hemp acreage planted, but this is being seen more as a correction of the overproduction in 2006, rather than an indication of a second sustained downturn. Another significant factor in the 2007 downturn was the increasingly positive economics of growing other crops.

8 Source: Health Canada website, at:
http://www.hc-sc.gc.ca/dhpmps/pubs/precurs/factsheet_fiche_e.html
With the imminent commercialization of made-in-Canada bast fibre processing technologies, the research and development work under the Biofibres Initiative, and the continued strength and growth of the food and health markets, there is renewed optimism amongst stakeholders from all stages in the industrial hemp value chain as to the future growth of the sector. Currently, the prairie provinces are the primary hemp producers, as seen in the examination of acreages in Canada which follows later in this section. Manitoba has historically had the largest crops, followed by Saskatchewan and Alberta. Ontario, Quebec and British Columbia have more modest hemp production, although there are strengths in hemp processing, especially in Ontario. Due to strong demand for organic hempseed, roughly one third of the current Canadian hemp crop is certified organic.

9 Production As proven through its cultivation over a large percentage of the planet's arable land, industrial hemp is a hardy, fast growing, resilient and high yield crop. It is an annual broadleaf plant, featuring a taproot. The female flowers and seed set are indeterminate,

10 with both ripe and immature seeds on the same plant during harvest. The typical height of an industrial hemp crop is between 2 to 4.5 metres. Some cultivars that have been optimized for seed grow shorter and stockier, while cultivars optimized for fibre can be taller. Under ideal growing conditions, industrial hemp is capable of very rapid growth. Industrial hemp is well adapted to temperate regions. In Canada, industrial hemp has shown good potential as an alternative to be included in rotation with other, more traditional crops. Used in rotation, industrial hemp has the potential to disrupt traditional crop disease cycles, while delivering attractive profit margins. Most cultivars of hemp are photoperiodic, taking their cue to flower (seed) from the shortening days and increasingly red cast of the late summer sun. The period from seeding to harvest is between 70 to 140 days, depending on the cultivar, with most varieties taking somewhere between 85 and 120 days. This relatively short growing season, coupled with its tolerance for a wide variety of growing conditions, makes it a potentially viable crop for many regions in Canada. Hemp grown for fibre-only applications can be harvested during pollination, 60 to 90 days after seeding. Industrial hemp has a long history of breeding and genetic selection, with a great variety of cultivars in existence. Work on optimizing hemp for specific regions in Canada is well underway, with steady improvements in both genetics and production methodology being realized. Canadian hemp seed breeders have been developing unique cultivars targeting such properties as essential fatty acid profiles, seed yield, short stature (more favourable for combining and more energy into seeds), fibre quality, fibre yield, and low THC levels. Dual purpose cultivars, with favourable seed and fibre properties, are also common. 9 Source: Don Lotter. (2001) Hemp Heaven and Hell… a story in two parts. Newfarm.Org, at: http://www.newfarm.org/international/canada_don/manitoba/index.shtml 10 The seeds continue to develop and mature over an extended period of time.

Health Canada in its infancy approved 27 cultivars of industrial hemp for use in Canada. These cultivars have a proven THC content of under 0.3%, with many of them containing much lower concentrations than this. Health Canada has recently begun exempting certain cultivars of hemp from the full regime of inspection and analysis, due to a solid track record of very low THC. Finola was the most widely planted breed of hemp in 2007, at 5224 acres, followed by USO 14 at 4486 acres and Crag at 1168 acres. In Ontario, hemp yields average 1250 lbs/acre of grain using the Anka cultivar, and yields as high as 1800 lbs/acre have been achieved on occasion growing Crag.11 Arthur Hanks of the Canadian Hemp Trade Alliance advises farmers to prepare for a low average of 500-700

lbs/acre, and points out that if production costs can be kept to $300/acre, they can make money on that. However, experienced farmers quite often average 1100-1200 lbs/acre. The top yields that Arthur Hanks has heard of are 2000 lbs, for Finola under irrigation, and he has noticed that experienced hemp farmers tend to average much better yields. 12 Manitoba's Management Plus Program lists hemp variety yields as follows:13 Table 3: Manitoba Hemp Variety Yields Yield per acre Year Variety Acres (pounds) # of Producers 2004 FINOLA (FIN 314) 380 551 4 USO 14 2,559.00 295 19 USO 31 1,359.00 128 5 2005 FELINA 34 208 183 3 FINOLA (FIN 314) 1,116.00 163 8 USO 14 6,841.00 346 40 USO 31 1,376.00 212 7 2006 ALYSSA 535 406 6 CRAG 487 476 6 FINOLA (FIN 314) 2,843.00 639 21 USO 14 23,338.00 560 83 USO 31 2,508.00 445 14 When interpreting the chart above, it must be kept in mind that these yields include both conventional and organic farming, and as is discussed further on, inexperienced organic farmers tend to average yields of 50% of what conventional farming would produce. 11 Correspondence with Shep Shepenko 12 Correspondence with Arthur Hanks, The Canadian Hemp Trade Alliance. www.hemptrade.ca 13 http://www.mmpp.com/Home_Page.htm

Agronomics If hemp is planted at the proper time it reportedly suppresses most weeds. However, some growers feel weed control is still necessary for optimum yield.14 Insect and disease problems must be managed like any other crop. However: "its rapid growth and vigorous nature allow it to overcome the attack of most diseases and pests."15 Hemp has been found to require approximately the same fertility as a high-yielding crop of wheat, with up to 110 kg / ha of nitrogen, depending on soil fertility and past cropping, as well as phosphorus. Roughly 40% of the mass of industrial hemp crops are left in the field in the form of roots, leaves and tops, and this material contains over half of the nutrients applied to the crop. Many of the nutrients will be available to future crops. The OMAFRA factsheet Growing Industrial Hemp in Ontario provides a detailed overview of the agronomics and best practices for hemp cultivation in Ontario, available at: http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm. Similar data is available for Manitoba at: http://www.gov.mb.ca/agriculture/crops/hemp/bko05s00.html. Saskatchewan Agriculture and Food has published a document entitled Hemp Production in Saskatchewan, available at: http://www.votehemp.com/PDF/Hemp_Production_SK-2006.pdf. Alberta Agriculture and Rural Development provides extensive information at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex126?opendocument. The British Columbia Ministry of Agriculture and Food has published an Industrial Hemp Factsheet, available at: http://www.agf.gov.bc.ca/speccrop/publications/documents/hempinfo.pdf. Other provinces may have similar material available. As the United States should also adopt 1 central hub of the data driven documentation ,

Acreage under Cultivation The following table lists the acres under cultivation since commercial cultivation began in 1998: 14 Source: Don Lotter. (2001) Hemp Heaven and Hell… a story in two parts. Newfarm.Org, at: http://www.newfarm.org/international/canada_don/manitoba/index.shtml 15 OMAFRA Factsheet: Growing Industrial Hemp in Ontario, at: http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm 21 Table 4: Hectares of Hemp under cultivation 1998-2007 Canada BC AB SK MB ON QC NB NS 1998 2400 72 38 263 606 1164 24 214 19 1999 14205 225 754 3093 8887 1023 86 4 126 2000 5485 291 306 1426 2906 217 239 0 102 2001 1312 96 113 392 472 209 30 0 0 2002 1530 200 123 449 597 142 19 0 0 2003 2733 7 153 672 1468 397 13 4 18 2004 3531 18 639 1004 1655 183 10 4 18 2005 9725 0 916 3429 5018 251 74 19 18 2006 19458 111 2103 6154 11726 346 88 8 18 2007 4684 43 605 2078 1728 53 173 4 0 Source: Health Canada, as found at: Alberta Agriculture and Food. (August 2007)

Industrial Hemp Production in Canada, @
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/econ9631

As can be seen, Canadian hemp production is concentrated in Saskatchewan, Manitoba, Alberta and Ontario. In 2007, for the first time Saskatchewan overtook Manitoba as the largest producer of hemp, followed by Alberta, Quebec, Ontario, British Columbia, and finally New Brunswick. As hemp is a new crop in Canada, no production statistics are currently being collected by Statistics Canada. In 2007 there were 179 licenses issued by the Industrial Hemp Section of Health Canada's Office of Controlled Substances, with 149 licenses for cultivation, and 30 licenses for breeding

Economics of Production Producers tend to be clustered in networks and co-operatives, and / or are located in relatively close proximity to processing facilities in order to minimize transportation costs. A primary challenge for hemp growers is to find a buyer who will contract for the purchase of their harvest. Currently, the only other market for industrial hemp, aside from contracts with known processors, is the supply of local cottage industries.

Costs of production are tied to a number of interrelated variables. Factors such as small acreage, low yields, the age and cost of equipment, the cost of land, and opportunity cost (as determined by competing uses for this agricultural land) will negatively impact the economics of production. In addition to the typical expenses associated with agricultural production in Canada, growing industrial hemp will entail some additional expenses, including police security checks, considerable regulatory paperwork, GPS requirements, and THC sampling and testing. 22 Assuming markets for both fibre and grain (hempseed), dual purpose crops currently have an advantage in costs of production against revenue generated. However, the market for fibre remains underdeveloped. As the hemp sector continues to grow and as new technologies are applied to the production, processing and manufacturing of components using hemp fibres, more commercial possibilities will become feasible and market demand will grow, strengthening the farm gate value delivered to farmers. Fibre The value of unprocessed hemp fibre (straw) is influenced by such factors as fibre length, fineness, colour and the market demand for a given quality of fibre. The quality of the fibre will be influenced by the maturity of the plants, conditions during field retting (if employed), and issues of storage. Prices paid to producers range considerably, and are hard to pin down due to the absence of reliable price or quality indicators. The North American market for hemp fibre remains underdeveloped, due to the lack of commercial bast fibre processing capacity and specific market pull from end-use companies? Grain Grain markets for hemp have been more robust, with prices noted between $0.45-$0.55 per pound.16 The Canadian Hemp Trade Alliance reported a market price of $0.50 to $0.60 cents per pound for conventional hemp seed, with an $0.85-cent/pound market price for certified organic seed in winter 2003-2004. Producers in Manitoba in 2007 reportedly received $0.40 per pound for conventional hemp seed, and $0.80 per pound for organic hemp seed.17

The demand for hemp seed is currently the primary driver of the Canadian industrial hemp industry. Organics Producer experience in Manitoba indicates that industrial hemp grown organically initially yields approximately 50% of what would be seen using conventional techniques, primarily due to the inability to get enough nutrients to the crop, and especially nitrogen. However, it has also been noted that, if judged by the experience with organic production in other crops, this yield is expected to catch up to within 10% of conventional techniques after some years of "agronomic fine-tuning".18 It is interesting to note that the reported price for organic hemp seed exactly tracks the reduction in yield

that is being seen. Markets As pointed out by Small and Marcus**, it typically takes between 10 to 15 years for the industry associated with a new agricultural crop to mature.** While it is true that foreign imports have been the basis for hemp products in North America for upwards of two decades, production is barely a decade old in Canada. The industrial hemp industry is still in its infancy, and as such, is likely to "continue experiencing the risks inherent in a small niche market for some time." However, Small and Marcus further express that "hemp ... has such a diversity of possible uses, promoted by extremely enthusiastic market developers, and attracts so much attention" that it is likely to carve out a much larger share of the North American marketplace."19 An update in 2007 of a December 2003 report from Agriculture and Agri-Food Canada draws an even more positive conclusion, based on its reading of consumer interest. After listing hemp's "remarkable advantages", including its superior agronomic characteristics, its substantial yield of fibre per acre, and the many developing market niches, the report notes that "these advantages are in tune with the environmental and health preferences of today's North American public." AAFC concludes by stating that "the growing curiosity of consumers, the interest shown by farmers and processors, and Canada's excellent growing conditions for industrial hemp allow optimistic views for its future." 20 Fibre and food uses for industrial hemp are growing rapidly and have increased over 300 percent in just the past few years. Hemp Seed Much of the growth in hemp production is a result of the increased sales of hemp food products. Between 2005/2006 and 2006/2007, the value of Canadian hemp seed products exported more than doubled, and the quantity of exports increased fourfold (see table page 25). As pointed out by the Canadian Hemp Trade Alliance, the harvesting, shelling, and processing technologies for conventional oilseed crops in Canada are suitable for handling hemp seed. This has enabled acreage to expand as soon as markets are found. Most of the hemp currently grown in Canada is for **hemp seed for processing into oils and meal**. Hemp Fibre The Canadian hemp fibre industry is not currently as developed as the grain market, with biomass engineering issues still needing to be optimized, including harvesting and processing, as well as transportation, handling and storage. The Canadian Hemp Trade Alliance has stated that: "The current economic reality of hemp [fibre] is that it cannot compete with waste products (wood, straw, stover, etc.) on price.... Hemp is valued between 4-10 times that of waste fibres, so it must find its way to the right products and markets." However, these markets are beginning to emerge. The bast fibre processing platform being commercialized by **Naturally Advanced Technologies** is specifically targeting hemp for advanced textile applications, with the potential to supply superior quality fibre of the correct specifications to a great variety of other applications, including composites. It should be noted that in these early days of the development of markets for hemp fibre, the available supply of fibre is a bi-product of hemp seed crops. Another competitive pressure on the price for Canadian hemp fibre is international supply, particularly from China. The world hemp fibre market continues to be dominated by low cost producers, with China, South Korea, and the Former Soviet Union producing roughly 70% of the world supply. 19 Small, Ernest and Marcus, David. (2002). Hemp: A New Crop with New Uses for North America. Pp. 284–326. In: J. Janick and A. Whipkey. (Eds.) Trends in New Crops and New Uses. ASHS Press, Alexandria, VA., p. 321 20 Agriculture and Agri-Food Canada, Profile: Canada's Industrial Hemp Industry,
http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1174595656066&lang=e

16 Source: OMAFRA Industrial Hemp Factsheet, at:
http://www.omafra.gov.on.ca/english/crops/facts/00- 067.htm 17 Source: Don Lotter. (2001) Hemp Heaven and Hell… a story in two parts. Newfarm.Org, at:

http://www.newfarm.org/international/canada_don/manitoba/index.shtml

18 Ibid. and correspondence with Arthur Hanks, Canadian Hemp Trade Alliance

To be competitive with low cost, low-quality fibre from China, Europe and Canadian The US processors must produce superior fibre, with advantageous characteristics as compared to imported fibre. The substantial transportation costs associated with the trans-continental shipping of biomass further work in favour of a domestic industry. Market data for hemp fibre is spotty at best. Estimates for the current US fibre markets for yarn and fabrics are in excess of $14 million, with the retail clothing market estimated in excess of $80 million. The industrial fibre market is expected to see double digit gains in sales in North America over the next several years.

Imports and Exports Approximately 90% of hemp materials and products globally are currently exported to the US with some additional exports to Romania and Trinidad-Tobago. Exports are being driven by the rapidly expanding grain market. However, the only industrial trade data collected by Statistics Canada was on hemp fibre until January 1, 2006, when new Harmonized System (HS) export codes for hemp oil and hemp seed (grain) came into effect. During 2006/2007, the value of Canadian hemp seed / oil exports to the US was $1,986,668. The USDA trade database shows that the **value of Canada's exports of hemp seed to the United States grew from $0 in 2004 to $1.2 million in 2006,** after the legal dispute over US imports of hemp products ended favourably for Canadian hemp exporters in late 2004. Canadian industrial hemp fibre exports have been highly variable over the past decade. From the start of commercial production through to 2005, exports ranged from a low of zero tonnes to a high of 389 tonnes. After peaking at 389 tonnes in 2000, exports decreased 46% in 2001 to 212 tonnes and declined further to 88 tonnes in 2004. However, industrial hemp fibre exports did improve by 41% reaching 124 tonnes in 2005, representing a monetary value of $188,940.22 Recently, there has been dramatic growth in Canadian industrial hemp exports. Hemp seed exports increased 300% from 2006 to 2007. Hemp oil exports were also impressive, increasing 85%. Hemp fibre exports increased 65%.23 21 Source: Industrial Hemp Profile, from the Agricultural Marketing Resource Centre (last updated December 2006), at: http://www.agmrc.org/agmrc/commodity/biomass/industrialhemp/industrialhempprofile.htm 22 Canadian Industrial Hemp Exports and Imports (2005), at: http://www4.agr.gc.ca/resources/prod/doc/prod/psc-lcs/pdf/hemp-chanvre_e.pdf 23 These figures were calculated by comparing the figures from January to June 2006 to the same period in 2007. AAFC and Statistics Canada figures, as quoted at:

http://alternativeapproaches.com/pnuke1/Article3570.html

Global imports and exports of hemp seeds The following countries are listed by the FAOSTAT, the statistical branch of the Food and Agriculture Organization of the United Nations, as being importers of hemp seeds: 26 Table 7: Hemp Seed Import Quantities by Country (2005)24 Country 1000s of tonnes Country 1000s of tonnes Austria 0.47 Luxembourg 0 Bahrain 0.02 Malta 0.01 Barbados 0.01 Netherlands 4.61 Belgium 4.42 Niger 0 Cyprus 0 Philippines 0.01 Czech Republic 0.04 Poland 0.4 Denmark 0.85 Portugal 0.13 Faroe Islands 0 Qatar 0.19 France 0.33 Romania 0.01 Germany 1.63 Serbia and Montenegro 0.02 Greece 0.46 Slovakia 0 Ireland 0.02 Slovenia 0.02 Italy 0.82 Spain 1.39 Japan 1.24 Sweden 0.71 Latvia 0.04 United Kingdom 1.96 Lebanon 0.11 Venezuela, Republic of Bolivar 0.08 Lithuania 0 Note that both Canada and the US are not included in the UN statistics, reflecting the relatively undeveloped state of data collection on the North American industrial hemp

industry. Supplying this global market for hemp seeds are the following countries: 24 FAOSTAT website, @ http://faostat.fao.org/site/535/DesktopDefault.aspx?PageID=535

Hemp Seed Export Quantities by Country (1000 tonnes)25 Country 1000s of tonnes Country 1000s of tonnes Austria 0.03 Netherlands 1.38 Belgium 1.17 Poland 0.01 China 12.42 Portugal 0 Czech Republic 0 Romania 0 Denmark 0 Slovenia 0 Egypt 0.01 Spain 0.48 France 4.99 Sweden 0.02 Germany 0.24 United Arab Emirates 0 Greece 0 United Kingdom 0.02 Italy 0.01 Unspecified 0.1 Lack of data It must be noted that overall there is a lack of data on Canadian and North American markets for hemp products, as evidenced by the exclusion from the FAOSTAT figures. Statistics on hemp production are in the early stages of development in North America, and hemp products fall under a great many product categories, with no consistent means of identifying them as having a hemp component. For example, the USDA trade database shows that the value of US imports under categories actually labeled “hemp” amounted to $6.3 million in 2006 and $6.7 million in 2005. However, this is widely acknowledged to significantly under-represent the aggregated size of the domestic industrial hemp product market. 25 FAOSTAT website, @ http://faostat.fao.org/site/535/DesktopDefault.aspx?PageID=535

Objectives

If the National Industrial Hemp Strategy program is implemented to accomplish its objective of helping streamline value chains and aligning resources and actions in the US hemp sector, the industry must define both a clear vision and set of goals, as well as provide a roadmap of concrete actions towards these goals by implementing the guidelines that have made presidence in the further advanced marketplaces such as the EU and Canada. This section outlines the central elements of the National Industrial Hemp Strategy.

It presents a vision and goal for the sector, and provides a framework for examining strategic initiatives and concrete actions towards realizing the desired outcomes. This framework categorizes the industrial hemp sector in terms of its primary sub-sectors: food and health (including personal care products), and industrial fibres and oils, with breeding and production providing a foundation for both. Collectively, these categories form the three pillars of the National Industrial Hemp Strategy. After examining the vision and goal of the Strategy, and outlining the three central pillars, attention will be turned to elements of the Strategy that are common to all pillars. This section concludes with a high level overview of the specific strategies and actions that have been identified for the individual pillars, with special attention to the areas of commonality and overlap. This high level overview is expanded upon in subsequent sections, with detailed examinations of the strategic considerations involved in each pillar. Vision and Goal for the American Industrial Hemp Sector should research
- Vision Canada as a global leader with respect to total hemp crop utilization offering solutions along the entire value chain. Goal To create an economically sustainable Canadian hemp industry, benefiting all stakeholders along the value chain and enhancing the nation’s health and natural environment. Framework for Action In the process of developing this National Industrial Hemp Strategy, the following framework was adopted for defining discrete market niches, with associated strategic considerations: I Health and Food (including Personal Care Products) II Fibre and Industrial Oil And underpinning these two sub-sectors is: III Breeding and production Each of these three pillars is addressed as a discrete unit in the sections that follow :

In the development of the National Industrial Hemp Strategy, there were three elements that underpinned and informed the development of all three pillar-specific strategies:

Whole Crop Utilization
The strategies that have been developed incorporated an integrated co-products approach that derives maximum value from the hemp feedstock. For dual-purpose and seed-only hemp cultivars, this philosophy envisions harvesting and utilizing both seeds and stems. For fibre-only crops, there will be no seed production, as harvesting is done prior to seed production occurs. Pursuing a whole-crop utilization strategy will both maximize the farm gate value of industrial hemp, and will distinguish this crop from most conventional crops that focus on only one element of the entire plant. Specific Industry Outcomes The strategies developed under each pillar are tailored to the unique parameters at play in these discrete markets. The focus for the three pillars, both separately and collectively, is on pursuing industry-specific goals, involving the elimination of barriers to value chain development and the maximization of value for each stage in these value chains. Environmental Sustainability Industrial hemp is an alternative crop with a significant role in the growth of America's bioeconomy. The tremendous potential of this crop will be squandered if value chain development is pursued without attention to the sustainability of the system. The National Industrial Hemp Strategy will incorporate an acknowledgment of the importance of sustainability throughout.

Summary of Key Strategic Areas for Action In order to capitalize on identified opportunities for the growth of the American hemp sector, the following strategic areas for action were identified through extensive stakeholder engagement undertaken in developing the National Industrial Hemp Strategy.

Some of these strategic areas for action are common to all of the industrial hemp sub-sectors, while others are specific to a particular industrial hemp commodity. Common to all Platforms Access to capital Capital is required for product development and commercialization of emerging processing technologies and products. Risk capital is not naturally attracted to emerging industries with the uncertainties that still characterize the industrial hemp sector, and the turmoil of 1999 – 2000 is a further challenge in these efforts. Concerted efforts must be made to both educate sources of capital as to the advantages and potential markets for hemp products, and to ensure that commercial hemp ventures are seen to succeed, building a track record of profitability for the sector. Because of the immaturity of the sector, government support will be essential in securing the necessary capital to move technologies and product platforms from development into commercial operation. A clearly defined value proposition, a strong, unified industry voice, and a sophisticated and knowledgeable approach to government relations will be necessary to ensure that the Canadian hemp sector delivers the significant triple bottom line benefits to Canada, and specifically to Canadian agricultural value chains, that are promised. Develop more detailed understandings of domestic and export hemp markets Knowledge of Canadian and export hemp markets is not readily available, forming a significant barrier to attracting commercial interest in the crop, and to telling the industrial hemp "story" with maximum impact. Generally, research on the economics of the sector has been lacking. Key information includes the current and potential size of various domestic and international markets, the state of global competition, insights as to what various potential industry stakeholders are looking for from hemp biomass and how it could best be provided to them, and an analysis of niche industrial hemp markets where as stakeholders – commercial, research, and policy – can build a world-leading competitive position. Continue to work with research organizations around the country optimizing the regulatory regime The ideal situation would provide with confidence that no psychoactive cultivars are being grown by licensed producers, while minimizing the costs to producers (time and money).

Ongoing work is required to increase the comfort level around the cultivation of industrial hemp, with a steady normalization of the industry. Similarly, the regulatory process for researchers should be reviewed and streamlined, to encourage long-term research on issues of importance to the industrial hemp industry. Support efforts to incorporate green credentials and tax breaks into policy. Policies to begin incorporating environmental performance into regulatory or tax-based systems will serve to provide a distinct competitive advantage for industrial hemp products as compared to equivalent fossil-fuel based products. Two such mechanisms are a cap and trade system (with a domestic market for carbon credits), and a carbon tax. British Columbia has already implemented a carbon tax, and the common perception is that it is only a matter of time until some sort of policy is implemented at the federal level. The industrial hemp industry should work in concert to promote such measures. Work to maintain access to the foriegn markets . Despite the fact that a coalition that included a processor defeated this market closure in court, the fact remains that powerful elements within the US federal government (the DEA) are hostile to the industrial hemp industry. Areas for strategic action include maintaining a close watching brief on the proposed bill and legislation situations, the forging of alliances with key industry stakeholders and other industrial hemp proponents, continued work on low THC breeding, and broad-based education campaigns as to the benefits and safety of industrial hemp.

Develop multiple value propositions that make hemp attractive versus competing crops The fewer viable markets for hemp crops, the more fragile and vulnerable the hemp sector will be. Producers need multiple opportunities to sell their crops, including markets for all components of the crop. Build a national industrial hemp network In order to build the capacity to capitalize on many of the opportunities and to undertake the strategic initiatives outlined here, a strong and unified industry voice will be necessary. This national industrial hemp network requires strong leadership and a strong cohesive well funded network consortium bringing together stakeholders from all along the value chain to address common problems and barriers. Researchers and industry need to be brought together around solving the barriers to effective commercialization of hemp processing technologies and products. A national voice for the industrial hemp industry is further needed to ensure that industrial hemp has a voice at relevant regulatory forums, establishing the stability and presence to be recognized as a key stakeholder in policy development. This national voice will also have a key role in networking with allied industries and initiatives to advance mutual interests. An obvious target for consortia building would be the growing natural fibres sector. Establish a degree of market stability If the industrial hemp industry is to gain mainstream acceptance among producers and other key links in the value chain, it must fully overcome its turbulent first decade, promoting confidence in producers, processors, and end markets. A degree of market stability will be necessary to catalyze action along the value chain. Achieving such market stability will involve strong relationships between processors and producers. Consumer Acceptance A concerted campaign is called for in order to establish consumer acceptance of hemp products, involving marketing, promotion and ongoing public awareness effort, ensuring that the many benefits of hemp are widely understood, and cementing the message that industrial hemp is not a potential source of illegal drugs. Acceptance from potential end users Related to this effort is the need to educate potential downstream links in industrial hemp value chains as to the value proposition offered by hemp substitutes. Access to Highly Qualified People (HQP) Many industry stakeholders are already encountering challenges in securing personnel with the required skill sets, such as experience in operating and maintaining specialized hemp processing machinery. Industry stakeholders must identify the skill sets that they will require to execute their growth strategies, and should work with colleges and universities to proactively design programs to meet these market needs. Infrastructure If the industrial hemp industry is to expand dramatically, it will

rapidly encounter infrastructure issues, such as storage issues, availability of harvesting equipment, and preprocessing (densification) for transportation over longer distances. A concerted effort amongst all involved stakeholders, including strong government involvement, will be necessary to ensure that infrastructure issues are not a limiting factor on the growth of the industry. Another infrastructure issue identified frequently in stakeholder consultations was the need for demonstration and **R&D facilities, with access to hemp cultivation and processing for research and proof-of-concept purposes.** I - **Health and Food Approval for use in food and feed** Canadian Food Inspection Agency (CFIA) approval has not been granted to incorporate hemp nutrients into animal feed and treats. Research into health benefits There are many gaps in research around the health benefits of hemp. Credible evidence of health benefits will be needed to maintain and expand the market for hemp food and health products over the long term. Widespread market acceptance can be greatly accelerated by comprehensive (and successful) clinical trials.

II - Fibre and Industrial Oil Development of commercial bast fibre processing capacity in Canada Fibre processing is still in the development stage in Canada. As seen in the section addressing fibre and industrial oil applications, the lack of commercial scale bast fibre processing is a primary barrier to growth in this sector. Production of sufficient (commercial) quantities of high quality bast fibre and hurd is required to enable the development of downstream applications. Identification of end-user interest in utilizing hemp as a component of their products While the broad spectrum of potential industrial hemp products are increasingly understood, there is considerably less understanding of the potential industry receptor capacity interested in commercializing these products. Furthermore, concrete commitments by a number of end-market users is lacking as this sector does not fully understand what hemp products or ingredients are available for incorporation into existing and potential product lines. While there is a fairly good idea of the parameters of the food and health markets for industrial hemp in North America, a similar understanding has not been developed for fiber and oil applications.

Industry testing of hemp fiber for specific product applications Similar to the above, industry adoption of hemp biomass for specific product applications will be predicated on extensive testing and validation of the characteristics of this material. As commercial hemp processing technologies and facilities come online, it will be essential to have representative samples analyzed by prospective industry consumers. Favorable industry testing can become powerful marketing tools, as evidenced by Naturally Advanced Technologies, a Canadian company close to commercializing a bast fiber processing platform. It currently has a market capitalization in the neighborhood of $40M, with gross revenues of approximately $2M in 2007 from sales of hemp clothing in the company’s apparel division. This market valuation is in part based on industry interest driven by extremely positive initial test results. Development of technologies and methodologies for an increasing variety of market applications Once commercial processing of hemp fiber comes readily available a variety of product applications will become feasible.

Ongoing R&D efforts to commercialize the broad spectrum of fiber and industrial oil applications are necessary to drive market pull for the output of these processing facilities. During the stakeholder consultations undertaken in developing this strategy, a strong opinion was expressed that there will be a huge demand for industrial research once commercial fiber processing is available. Additionally, there is a strong transportation industry pull to develop natural fiber mats to replace fibreglass mats. Continued work in this area is key, with commercial business manufacturing representing 60% of the

total North American market. Developing industry standard fibre grading standards Industry grading standards are an important component in providing hemp product manufacturers with the stability of supply and quality assurance that they require, and in expanding the downstream users of hemp fiber. Develop a cost-effective oil profiling system Similar to the above, cost-effective oil profiling de-risks the use of hemp oil for downstream links in the value chain. Development of markets and applications for co-products While much of the attention is focused on hemp oil and bast fibers, it is imperative that valuable markets be developed for all co-products of hemp processing, including short fibers and hurd, hurd only, fines and dust, and seed meal (left after oil extraction). If industrial hemp is going to be a viable crop that supports profitable value chains, maximum value must be derived from every unit of hemp biomass.

- Breeding and Production-The areas for strategic action in breeding and production are all oriented towards realizing increased yields per acre of hemp crops, optimized for desired applications. Advances realized through efforts in breeding and production are essential if the industrial hemp industry is to be competitive against other hemp producing nations, particularly China.

Bioresource Engineering Hemp crops exhibit relatively tough stems, and grow to many meters tall given optimum growing conditions. While functional hemp seed and fiber harvesting equipment is currently being employed by hemp producers, there are still many avenues for optimization. In many cases, producers have made the necessary equipment modifications at the farm level to overcome obstacles that are encountered. The ongoing efforts to optimize these systems must be supported and expanded.

Seed Supply The industry must ensure that sufficient supplies of hemp seeds are available for a variety of cultivars, covering the full range of growing conditions.

Optimize and Develop Cultivars for Specific Growing Conditions This area for strategic action is both obvious and self-explanatory. As well as optimizing for regional growing conditions, there is tremendous potential for the breeding of desired characteristics. Longer-term goals include the engineering of specific industrial traits such as precisely defined oil or fiber characteristics for specific industrial applications. It is anticipated that there will be ongoing interest in breeding down THC content for the foreseeable future.

Continued Development of Best Management Practices around Hemp Cultivation Aspects of hemp cultivation that will benefit from continued development of best management practices include: **Response of hemp to fertilization Seeding rate Row spacing Harvest management / improved practices** Retting International Promotion of EU and Canadian-bred Cultivars Given Canada's proven strength in the breeding of northern climate agricultural crops, it should be expected that Canadian breeders produce superior cultivars. There is the potential to promote these cultivars on the world stage, helping carve a distinct niche in the global industrial hemp industry. This discussion has examined the many strategic areas for action that were identified in the extensive stakeholder consultations undertaken in developing this strategy. The following sections examine each of the industrial hemp sub-sectors in more detail, starting with health and food (including personal care products), fiber and industrial oil, and then production and breeding. The market opportunities for each category are examined, along with the short and medium to long term actions that are needed to capitalize on identified opportunities and to meet existing and potential threats and challenges.

Health and Food (including personal care products) Overview Demographic and societal trends have led to increased interest in natural health products (NHP, or dietary supplements) and healthier for you foods (“functional foods”).

There are a number of key factors driving this growth in demand, as well as changes in the supply chain. These factors include: Aging populations, particularly the large baby-boom generation; increasing interest in ‘healthy living’; Increasing affluence and education among world populations; Increasing understanding of the link between nutrition and health; Emphasis on preventative measures to control health care costs; Increased acceptance and utilization of ‘alternative’ treatments; General consumer dissatisfaction with conventional treatments, therapies and drugs; Rising acceptance among doctors, pharmacists and other health professionals; Expanding body of scientific and clinical research to validate effectiveness and safety; Expanding press coverage of such research; Increased marketing and advertising activities by suppliers and, Evolving public policy and regulatory environments. **There are many different bioactive ingredients in hemp seed that have shown promise in disease prevention and reduction**. However, clinical research specifically on hemp seed and oil is lacking. Research on hemp seed and oil is critically needed for industry marketing, for regulators, and for health professionals – all groups require data supporting efficacy to ensure consumer confidence in this exciting functional food and natural health product. Definitions For the purposes of this report, the definition of functional foods as proposed will be used, that being, a portion of functional food is “… similar in appearance to conventional food, consumed as part of the usual diet, with demonstrated physiological benefits, and/or to reduce the risk of chronic disease beyond basic nutritional functions." This definition also includes “healthier for you” foods which generally are those foods marketed for their intrinsic health value.

Standardized regulations became effective on January 1, 2004. The regulations apply to all NHPs including homeopathic preparations, substances used in traditional medicine, a mineral or trace element, a vitamin, an amino acid, an essential fatty acid or other botanical, animal or microorganism-derived substance. These products are generally sold in a medicinal or “dosage” form.

Standards of Evidence for Evaluating Foods with Health Claims – Fact Sheet.

http://www.hc-sc.gc.ca/food-aliment/ns-sc/ne-en/health_claims-allegations_sante/ e_soe _fact_sheet.htm

Part 2. June 2003. http://canadagazette.gc.ca/partII/2003/20030618/html/sor196-e.html.

Nutritional Properties of Hemp Seed Hemp (Cannabis sativa) is one of the oldest crops cultivated by man. It has been grown for fiber and seed for the last 5,000 years. Today, hemp seed and oil are very popular in food and health products and are found in snacks, nutrition bars, hummus, non dairy milk, bread, cereals, prepared foods, and numerous other applications.

The oil is available in capsules or bottles. Because of its medicinal benefits, hemp oil is also used as a topical ingredient in natural body care and cosmetic products. Hemp Oil Hemp oil is produced by pressing the hemp seed. Hemp has the highest level of the essential fatty acids (EFAs) which are required in the diet as they can not be synthesized by humans (see chart below). The EFAs play critical roles in the reduction of several diseases and chronic conditions and a must for good health.

The two foundations EFAs are called linoleic acid (omega 6, LA) and alpha-linolenic acid (omega 3, ALA). Young animals deprived of dietary LA and ALA rapidly display negative health effects, including diminished growth, liver and kidney damage, and dermatitis; these eventually result in death. LA and ALA are so important because they are components of cell membranes. The proper functioning of all body cells depends upon healthy membranes as they act as “gate-keepers” for substances moving in and out. In the skin and the layer around the nerves, EFAs provide a moisture barrier and an insulating layer.

Hemp oil is also unique in that it is a rare plant source of a vital omega-6 EFA called gamma-linolenic acid or GLA. Modern-day diets and sluggish enzyme activity in our bodies often impair the synthesis of GLA which may cause deficiency. Hemp oil is also very low in saturated fats which are very detrimental to the heart and circulatory system. Fatty acids (%) and Diet play an enormous role in the onset of disease. The World Health Organization has found that chronic diseases contribute to approximately 60% of all deaths worldwide and 50% of the total burden of disease. Almost half of these deaths are from cardiovascular diseases,hypertension, obesity and diabetes and is estimated that these chronic diseases will account for 70% of all deaths worldwide by 2020.
(CVD), World Health Organization. Diet, Nutrition and the Prevention of Chronic Disease, series 916. 2003

Hemp Oil Aids Circulation EFAs in particular GLA and ALA, have been shown to reduce the risk of CVD and hypertension by lowering blood cholesterol and blood pressure and reducing blood platelet clotting. 29 Several studies have reported the beneficial effects of ALA on reducing the risk of heart disease. One in particular, which began in 1986 and included 51,529 health professionals, demonstrated that a 1% increase in dietary ALA intake was associated with a 40% reduction in the risk of non-fatal heart disease. 30 In the Nurses Health Study, which involved a 10-year follow-up of 76,283 women with no previously diagnosed CVD, a higher intake of ALA was associated with a lower relative risk of both fatal and non-fatal myocardial infarction. ALA can reduce ventricular fibrillation (rapid and irregular heartbeat) and help normalize heart beats. GLA can also reduce the risk of CVD by lowering levels of total and LDL-cholesterol. Hemp benefits the circulatory system through its

effects on blood fats. One study has examined the effects of hemp oil in humans and showed significant reductions in total cholesterol and more favorable cholesterol ratios in the blood. 34 Recent animal data has also shown that the fatty acids in hemp oil reduce platelet aggregation or clotting. Dr. Grant Pierce and his colleagues at the St Boniface Hospital Research Centre in Winnipeg, Canada supplemented the diets of rats with hemp seed for 12 weeks and found a 35% decrease in the blood's tendency to clot. 35 Blood clots can cause a heart attack if they occur in the arteries leading to the heart, or a stroke if they occur in the brain. Hemp Oil May Reduce Inflammation Inflammation is a controlled, ordered process whereby the body responds to infection or injury. Symptoms include redness, swelling, heat and pain. Chronic inflammation is linked with age-related diseases such as CVD, obesity, diabetes and cancer. ALA can reduce the most damaging inflammatory compound called C reactive protein or CRP as much as 75% when compared to a 'traditional Western-style' diet. 36 GLA has been studied for decades for its efficacy in arthritis and other inflammatory disorders. In randomized, placebo-controlled clinical trials significant and progressive improvement in patients with active rheumatoid arthritis treated with amounts of GLA from 500 mg to 2.8 g/day have been reported37 and included reductions in swollen and tender joints, duration of morning stiffness and patient's assessment of pain.

Lanzmann-Petithory, D. 2001. Alpha-Linolenic Acid and Cardiovascular Diseases. Journal of Nutrition, Health, and Aging. 5(3): 79-183. 30 Ascherio A, Rimm EB, Giovannucci EL, et al. 1996. Dietary fat and risk of coronary heart disease in men: Cohort follow up study in the United States. Br. Med. J; 313: 84-90. 31 Hu FB, Stampfer MJ, Manson JE, et al. 1999. Dietary intake of -linolenic acid and risk of fatal ischemic heart disease among women. Am. J. Clin. Nutr. 69:890-897. 32 Vos E, Cunnane SC. 2003. -Linolenic acid, linoleic acid, coronary artery disease, and overall mortality (letter). Am. J. Clin. Nutr; 77: 521-522. 33 Laidlaw M, Holub BJ. 2003. Effects of supplementation with fish oil-derived n-3 fatty acids and gamma-linolenic acid on circulating plasma lipids and fatty acid profiles in women. Am J Clin Nutr. 77:37-42. 34 Schwab US, Callaway JC, Erkkilä AT, Gynther J, Uusitupa MI, Järvinen T. 2006. Effects of hemp seed and flaxseed oils on the profile of serum lipids, serum total, and lipoprotein lipid concentrations and hemostatic factors. Eur J Nutr. 45(8):470-7. 35 Richard MN, Ganguly R, Steigerwald SN, Al-Khalifa A, Pierce GN. Dietary hempseed reduces platelet aggregation. 2007. J Thromb Haemost. 5: 424–5. 36 Zhao, G., Etherton, T.D., Martin, K.R., et al. 2004. Dietary alpha-linolenic acid reduces inflammatory and lipid cardiovascular risk factors in hypercholesterolemic men and women. J. Nutr. 134: 2991-299

Hemp Oil GLA May Reduce Diabetes

Diabetes is a disease in which the body does not properly produce or use insulin. It can lead to neuropathy, a condition where nerves degenerate. Symptoms of pain and numbness follow leading to skin ulceration, amputation and impotence. In over 400 patients, 480 mg/day of GLA continued to improve established diabetic neuropathy symptoms throughout a 3 to 12 month period. The positive effects of GLA may be due to a restoration of normal nerve function through improvements in cell membrane function. Hemp GLA May Aid in Weight Control GLA supplementation may impede weight regain following major weight loss. Fifty formerly obese humans were randomized into a double-blind study and given either 890 mg/d of GLA or 5 g/d olive oil (control). Following one year, weight regain was significantly lower in the GLA group, and continued to be until the conclusion of the study at 50 weeks. The Importance of EFA Balance The ratio of the amounts of omega-6 to omega-3 EFAs in vegetable oils is a hotly debated topic among nutritionists. Omega-6 and omega-3 EFAs work synergistically at the cellular level to ensure effective metabolism. An excess of either can cause an

imbalance in cell function. Leading experts such as the Scientific Review Committee of Health Canada and the World Health Organization have recommended that the ratio of intake of omega-6 EFAs to omega-3 EFAs should range from 4:1 to 10:1. Hemp oil has a 3:1 ratio – the oil closest to an ideal omega 6:omega 3 range. Put simply, hemp oil contains three omega-6 EFAs for each omega-3 EFA. So what does this mean for daily intakes? Nutritionists generally recommend that, for EFAs to provide optimal cell function and contribute to overall health, daily requirements should range from 7 to 11 g of LA and from 1.5 to 3.0 g of ALA. 40 This can be obtained from one tablespoon of hemp oil. People who consume a diet high in saturated fats or trans fatty acids, those who are overweight or under a great deal of stress will require more EFAs. 37 Zurier, R.B., DeLuca, P. and Rothman, D. 1996. Gamma-linolenic acid, inflammation, immune responses, and rheumatoid arthritis. In: Gamma-linolenic acid: Metabolism and its roles in nutrition and medicine. Huang, Y-S. and Mills, D.E., Eds., AOCS Press, Champaign, Ill. pp. 129-136 38 Horrobin, D.F. 1997. Essential fatty acids in the management of impaired nerve function in diabetes. Diabetes. 46(2S): S90. 39 Schirmer, MA, and Phinney, SD. 2007. Gamma Linolenate Reduces Weight Regain in Formerly Obese Humans. J. Nutr. 137: 1430–1435. 40 Albert CM, Oh K, Whang W, et al. 2005. Dietary α-linolenic acid intake and risk of sudden cardiac death and coronary heart disease. Circulation 112: 3232-3238.

Antioxidants

Hemp oil contains a number of antioxidants including natural Vitamin E, at higher levels than other oils. Vitamin E helps to reduce the damage to body cells caused by the constant assault of free radicals which are produced as a result of normal metabolic processes in living systems. Pollution, second-hand smoke, many dietary constituents and aging contribute to the production of free radicals often exceeding the protective antioxidant capacity of our bodies leading to oxidative stress. Antioxidants in hemp oil “neutralize” free radicals and offer protection against oxidative damage. Phytosterols are found in high levels in hemp oil. Like humans who produce cholesterol for various metabolic functions, plants produce phytosterols. These compounds have a similar structure to cholesterol. Phytosterols act to lower cholesterol by competing for absorption in the gastrointestinal tract decreasing the overall amount of cholesterol absorbed and available to the bloodstream. Hemp Protein - Proteins are essential to life and participate in every process within cells. Protein is necessary for the diet since the essential amino acids which make up their structures can not be synthesized in the body and must be obtained from food.

Hemp is an exceptionally high-quality plant protein in terms of amino acid composition. Only soybeans are higher in total protein, but absorption is much more limited than hemp. Hemp protein contains all 21 amino acids, including the 8 essential amino acids in a ratio that resembles “complete” protein sources such as meat, milk, and eggs. Dr. Jim House of the Department of Human Nutritional Sciences, University of Manitoba found that the protein digestibility of hemp nuts was over 0.6 closely followed by hemp seeds and hemp protein flour. The standard against which protein digestibility and amino acid quality is assessed is casein which measures 1.0. Most importantly, hemp protein is highly digestible, with >90% digestibility for hemp nuts. Hemp protein is also a valuable source of other nonessential amino acids including arginine which can help to lower blood pressure. Gluten-free Proteins in Hemp Gluten is a general name given to the storage proteins found in wheat, rye, barley, and oats. Celiac disease occurs when consuming gluten proteins triggers an autoimmune response that damages the lining of the small intestine, which can reduce nutrient absorption and contribute to other ailments of the body and immune system. About one in 133 people or more than 2.5 Antioxidants Hemp oil contains a number of antioxidants including natural Vitamin E, at higher levels

than other oils. Vitamin E helps to reduce the damage to body cells caused by the constant assault of free radicals which are produced as a result of normal metabolic processes in living systems. Pollution, second hand smoke, many dietary constituents and aging contribute to the production of free radicals often exceeding the protective antioxidant capacity of our bodies leading to oxidative stress. Antioxidants in hemp oil “neutralize” free radicals and offer protection against oxidative damage. Phytosterols Phytosterols are found in high levels in hemp oil. Like humans who produce cholesterol for various metabolic functions, plants produce phytosterols. These compounds have a similar structure to cholesterol. Phytosterols act to lower cholesterol by competing for absorption in the gastrointestinal tract decreasing the overall amount of cholesterol absorbed and available to the bloodstream. 41 Hemp Protein Proteins are essential to life and participate in every process within cells. Protein is necessary for the diet since the essential amino acids which make up their structures can not be synthesized in the body and must be obtained from food. Hemp is an exceptionally high-quality plant protein in terms of amino acid composition. Only soybeans are higher in total protein, but absorption is much more limited than hemp. Hemp protein contains all 21 amino acids, including the 8 essential amino acids in a ratio that resembles “complete” protein sources such as meat, milk, and eggs. Dr. Jim House of the Department of Human Nutritional Sciences, University of Manitoba found that the protein digestibility of hemp nuts was over 0.6 closely followed by hemp seeds and hemp protein flour. 42 The standard against which protein digestibility and amino acid quality are assessed is casein which measures 1.0. Most importantly, hemp protein is highly digestible, with >90% digestibility for hemp nuts. Hemp protein is also a valuable source of other nonessential amino acids including arginine which can help to lower blood pressure. Gluten-free Proteins in Hemp Gluten is a general name given to the storage proteins found in wheat, rye, barley, and oats. Celiac disease occurs when consuming gluten proteins triggers an autoimmune response that damages the lining of the small intestine, which can reduce nutrient absorption and contribute to other ailments of the body and immune system. About one in 133 people or more than 2.5 million people in the US suffer from celiac disease and the disease is also increasing in Canada. 43 Hemp Seed and protein contain no detectable gluten proteins

Lees, A.M., Mok, H.Y., Lees, R.S., McCluskey, M.A. and Grundy, S.M. 1977. Plant sterols as cholesterol-lowering agents: Clinical trials in patients with hypercholesterolemia and studies of sterol balance. Atherosclerosis. 28:325-338. 42 House, J. 2007. Characterization of Hemp Seeds, Hulled Seeds and Protein Flour for Macronutrients, Protein Composition and Digestibility. Report for the Canadian Hemp Trade Association. Unpublished results.

Hemp Protein Powders

Hemp Seed protein powder is produced by cold pressing whole hemp seeds to expel the oil, resulting in a dry cake. The cake is then milled at low temperatures to remove a portion of the fiber and produce a concentrated form of protein. The resulting protein powder contains on average 50% protein. Typically, a standard 30g serving of hemp protein powder supplies about 15g of protein. There are differences between hemp protein and its major competitor, soy protein. Hemp protein does not contain anti-nutritional factors that reduce the absorption of soy protein. Unlike hemp protein powder, many soy isolate powders that are not labeled organic are processed with hexane, a petroleum solvent. The resulting hexane-processed soy is utilized in many soy protein powders, cereals, and bars. In addition, non-organic soybeans used in many soy products are often derived from genetically modified soybeans. Hemp is never genetically modified. Dietary Fibre Soluble and insoluble fiber account for about 30% of the weight of full-fat hemp seeds. Soluble fibers delay transit

through the stomach, trapping fat and sugar which aids in the maintenance of blood glucose and cholesterol. Insoluble fibers promote laxation and provide relief from constipation. Recommended levels of fiber for women is 25 grams and for men is 38 grams per day. However, usual intakes for most people average only 14 to 15 g/day. 44 Hemp Seeds are an important source of healthy fibers. Vitamins **Hemp Seed is a very good source of the important vitamin B complex including Vitamins B1 (thiamine), B2 (riboflavin) and B6 (pyridoxine).**

The B vitamins play a role in metabolism, enhancing the immune and nervous systems, and supporting cell growth and division. Vitamin B1 is involved in the regulation of carbohydrate metabolism and in the nervous system. Vitamin B2 aids in the metabolism of fats, carbohydrates, and respiratory proteins. A deficiency can result in skin lesions and light sensitivity. Vitamin B6 is involved in the absorption and metabolism of amino acids and fats. Deficiency in these vitamins may result in a smooth tongue, skin disorders, dizziness, nausea, anemia, convulsions, and kidney stones.

Hemp Seeds are also rich in folic acid which is very important for all women who may become pregnant. Adequate folate intake during the periconceptional period helps protect against a number of congenital malformations including neural tube defects which can result in malformations of the spine (spina bifida), skull, and brain.

Prevalence of Celiac Disease. 2007. http://www.celiac.com/ 44 Alaimo K, McDowell MA, Briefel RR, et al. Dietary Intake of Vitamins, Minerals and Fiber of Persons Ages 2 Months and Over in the United States: the Third National Health and Nutrition Examination Survey, Phase 1, 1988-91. Hyattsville, Md: National Center for Health Statistics; 1994. Advance data from vital and health statistics: No 258

Minerals

Hemp Seeds are rich in the minerals phosphorus, magnesium and manganese. Magnesium, the fourth most abundant mineral in the body, is required for more than 300 biochemical reactions in the body, including the maintenance of muscle and nerve function, heart rhythm and bone strength. These minerals help to regulate blood sugar levels, promote normal blood pressure, and are involved in energy metabolism and protein synthesis. Hemp Oil and Skin Care Hemp oil contains important nutritional compounds which are critical for ensuring healthy, soft and vibrant skin as well as to reduce the signs of aging. Hemp body products include shampoos, conditioner, hand & body lotions, bath and massage oil, moisturizing cream, and lip balms. Diet significantly influences the health and vitality of the skin and hair. Because of their importance in the cell membrane, EFAs protect the skin from moisture loss that can lead to premature sagging and wrinkles. GLA and ALA are preferentially stored in the skin. People who reduce dietary fat, especially EFAs, too drastically will very quickly notice dry, eczema-type skin problems. Loss of skin epidermal barrier function leading to rapid moisture loss is one of the first consequences of EFA deficiency. This is referred to as transepidermal water loss. Long term depletion of dietary EFAs will lead to erythema (abnormal skin redness) with scaling, dermatitis, skin atrophy, edema, hair loss, and itching45 . ALA and GLA have been shown to reduce skin inflammation and improve overall skin vitality, such as softer, smoother, healthier skin. The numerous antioxidants especially Vitamin E found in hemp oil can also reduce the damage that free radicals can cause to skin and hair by “quenching” their effects. EFAs and antioxidants are critical to reduce aging and preserve the health of the skin and hair.

Health and Food Market Opportunities for Hemp -

There are several Canadian functional foods and natural health product companies focusing on the development and marketing of hemp and hemp products. Many companies are more involved in exporting and direct sales to retailers, comprised of innovative, entrepreneurial companies – primarily SMEs (small and medium-size companies) that are supplying the global functional food, natural health products, and ingredients' markets. An important characteristic of these companies is their evolution, for the most part, from farm-based companies supplying the local market to global businesses. The hemp focused FFNHP industry is one that is truly rural-based – the most successful companies in the sector (e.g. Hemp Oil Canada, Mum Original) have a strong working relationship with the local producer community and in fact market hemp products with a guarantee of high quality from the seed to the package. The hemp industry has received very little government support and has made tremendous market achievements despite this fact. It is an industry that continues to be developed based on merit rather than government funding. However in order to experience further success in the global food and health markets and to continue to grow, there are several opportunities and challenges that should be addressed with both industry cash and in-kind support.

The opportunities and challenges that are described here have been identified through a comprehensive nutrition literature review (Appendix A) and a thorough market assessment (Appendix B). Observations were confirmed by several in-person industry stakeholder consultations and interviews that were held throughout this initiative

Market Opportunities –

Promoting the Goodness of Hemp As is apparent from the literature review (see Appendix A), hempseed, protein oil and nuts have an abundance of healthy constituents that need to be exploited through marketing and communications activities.

Effective information dissemination to key target groups such as the food industry, health care professionals, the medical community and consumers should be undertaken. It is recommended that the industry association, HIA plays a leading role in promoting the health benefits of hemp. At least a part item position should be devoted to this role.

Reaching health professionals with key messages about the health benefits of hemp, and how to incorporate hemp into the diet to achieve these benefits, has been identified by hemp suppliers as a key priority. The initial target for the dissemination of this information is the health care community and dietitians who are consumer's direct links to health and nutrition information. Depending upon funding availability, several marketing and promotional materials should be developed.

1. Maintenance of current research and food technology database – this unique hemp database provides overview abstracts on scientific and food-related publications and is posted on CHTA website. The CHTA should develop a 'consumer-friendly' website with helpful information on the health aspects of hemp, recipes, commonly asked questions, etc.

2. Development of nutritional and functionality information via newsletters and fact sheets for distribution and posting on the CHTA website.
3. Webcasts – Depending upon funding, at least one 'informational' webcasts should be planned. Webcast technology provides an opportunity to communicate technical information via a controlled, inter-active and focused educational message to a large targeted audience. The content is to be decided upon but potential areas of interest include technical/formulation issues, regulatory update, supporting consumer research, new products, health claims, etc. The promotion of hemp as a high quality and safe crop and product must resonate throughout all communications.

The Question of THC

In recent years, the presence of trace residual delta-9-tetrahydrocannabinol (THC), the main psychoactive ingredient of marijuana, in food products incorporating hemp seed and seed derivatives (hemp nuts, oil, flour, meal, and protein isolate) has raised concerns over THC's potentially adverse impacts on human health. It has been established over the last decade that the consumption of currently available hemp foods does not pose an unacceptable health risk due to THC.

A hazard assessment for the intake of THC via hemp foods, including the establishment of Lowest Observed Adverse Effects Level (LOAEL) and No Observed Adverse Effect Levels (NOAEL) for oral ingestion of THC, derivation of safety factors, and estimation of the corresponding acceptable daily intake (ADI) has supported this. An exposure assessment for the intake of THC via hemp foods, assuming their extensive daily consumption with trace residual THC levels achieved by Canadian suppliers in hemp seed and seed derivatives has also established that even very extreme consumption of hemp-based products would not yield near harmful levels of THC.

This message needs to be communicated responsibly and effectively to all stakeholder groups. The ultimate goal of communication and marketing efforts is to increase the awareness and usage of hemp by the domestic and international food industry and to secure the support of health associations, dieticians, medical and academic communities and other health professionals regarding the health benefits of hemp. They should establish itself as a resource for the third party, accurate, unbiased and high-quality science-based information about hemp.

Hemp Food Formulation Research

Many forms of hemp are commonly used in different types of food products. However, most of these products are being developed and marketed by small companies involved in the natural and organic segment of the food sector. Mid to larger size food companies may be interested in using hemp but

will require data establishing its health attributes and formulation characteristics. In particular, these companies require technical information about using hemp in foods especially as related to maintaining the quality and the stability of the oil fraction. In order that hemp can be more effectively utilized by the food industry, product development should occur in conjunction with clinical studies. As far as the practicalities of food fortification are concerned, manufacturers must consider their target consumer market, as well as the particular health issue it wishes to address. Hemp, as a vegetarian option, can be added to all types of foods and beverages.

Clinical Trials to assess the Health Effects of Hemp Hemp contains a heart healthy fatty acid profile, an array of lipid lowering constituents including soluble fibre, phytosterols and Vitamin E, and highly digestible, high quality protein. The health effects of these ingredients in isolation or from other products are described in the literature review.

Well-designed clinical research is needed to determine the significance of these constituents in terms of health benefits for humans, particularly in regard to cardiovascular diseases such as myocardial infarction and stroke, cardiac arrhythmia, and atherosclerosis. Inflammation is a key feature of these chronic diseases. Atherosclerosis, for example, is now recognized as an inflammatory disease, and all stages – initiation, growth and complication of the atherosclerotic plaque – are an inflammatory response to injury. Chronic, low-grade inflammation is also associated with insulin resistance, obesity and type 2 diabetes. The inflammatory cytokine tumor necrosis factor-α (TNF-α) is over expressed in obesity and contributes to insulin resistance.

Potential markers of inflammation include soluble adhesion molecules (e.g. E-selectin, P-selectin, intracellular adhesion molecule-1, vascular cell adhesion molecule-1) and acute-phase reactants (e.g. fibrinogen, serum amyloid protein, C-reactive protein). Of these, CRP is consistently shown to be a strong predictor of CVD and it is possible that at least some of the known cardiovascular risk factors may affect the risk for CVD by modulating inflammation. There has been no assessment of the effects of hemp on inflammatory compounds such as TNF-α, interleukin-1β, and major eicosanoids. No studies have measured the effects of hemp on C-reactive protein (CRP) or the soluble adhesion molecules.

No research has been conducted on the effects of hemp protein or fiber on serum lipids or on inflammatory biomarkers. Positive results from clinical research that assesses the effects of hemp on inflammatory reactions and biomarkers would produce results that could benefit millions of Canadians with chronic disease, including children, many of whom are overweight or obese and at risk of developing diabetes. A study population of healthy adults and those with one or more chronic diseases (e.g. cardiovascular symptoms, type 2 diabetes, obesity or metabolic syndrome) Five dietary interventions:

1. The control group (usual diet) 2. The group consuming usual diet + ground hemp seed 3. The group consuming usual diet + hemp oil 4. The group consuming usual diet + hemp nut 5. Group consuming usual diet + hemp protein flour A dietary intervention lasting 3-6 months, with clinical assessments made at baseline, 1 month, 3 months and/or 6 months Assessment of serum lipids, glucose and insulin, weight loss measurements (DXAE) and a range of inflammatory biomarkers: main eicosanoids, cytokines (e.g. tumor necrosis factor-α, interleukin-1β), platelet-activating factor (PAF), soluble adhesion molecules (E Selectin, P-selectin, intracellular adhesion molecule-1, vascular

cell adhesion molecule-1) and acute-phase reactants (e.g. fibrinogen, serum amyloid protein, C-reactive protein).

Other Opportunities As identified in the literature review and the market assessment, there are a number of areas that the hemp industry is currently witnessing success which have the potential to grow even further, including: Gluten free 46 Natural Personal Care Pet food Products Depending upon resources, these areas could be explored further and direction as to next steps provided by the research community and the industry.

Medium Term Opportunities

Hemp Fibre, Diabetes and the Glycemic Index (GI) Low-glycemic products target the over 20 million diabetics in the United States, in addition to consumers concerned about boosting their energy level and losing weight. GI represents a potential area for research in hemp seed and hemp seed products, due to the low percentage of non-fiber carbohydrates present. The high proportion of total carbohydrate present as dietary fiber in hemp seed warrants further research to determine if hemp products, especially those containing a significant hull fraction, would provide beneficial effects for humans in relation to the glycemic response.

The GI effects of hemp and hemp products in humans could be economically assessed by the GI Laboratory at the University of Toronto. The standard protocol requires that ten normal subjects are studied on multiple occasions (maximum 3 per week) in the morning after an overnight fast. After a fasting blood sample, subjects eat a test meal containing 50g available carbohydrates and have further blood samples at 15, 30, 45, 60, 90 and 120 minutes after starting to eat. Capillary blood is obtained by finger-prick and whole blood glucose determined with an automatic analyzer using the glucose oxidase method. Each subject conducts one trial of each test food and 3 trials of the reference food. The reference food can be anhydrous glucose or white bread. These results will provide GI numbers that can be used in marketing (in the US) as well as indications of satiety for weight control and weight loss applications. Parallel to metabolic and clinical research, there will be a need for processing research to determine economical and feasible scale-up technologies for industrial use of extracted and possibly concentrated hemp fiber for use by the dietary supplement and functional food ingredient industries.

Allergen Testing for Food allergies have become a major public health issue in many countries and government officials are becoming increasingly diligent in their monitoring of incidence. Members of the hemp industry have received questions regarding potential allergens in hemp and hemp protein products. Testing should be done to alleviate any concerns related to the presence of allergenic proteins in hemp. In the United States, it is estimated that approximately 150 individuals die each year from accidental ingestion of an allergenic food. Food allergy is estimated to be the cause of 33% of emergency visits for treatment of anaphylaxis (severe allergy), and peanuts and tree nuts are the foods most often associated with these severe reactions. Additionally, in the US, 4% of the general population has a food allergy and 1% a peanut allergy. The incidence is similar in Canada with an estimated 1.2 million Canadians affected by various food allergies.48 In the US, allergen labeling requirements cover the eight foods (egg, milk, peanut, tree nuts, fish, shellfish, soy, and wheat) that account for 90% of food allergies. In Canada, the list also includes sesame and in the EU, mustard is

part of this list as are celery, sesame, and all cereals containing gluten (i.e. wheat, barley, oats, spelt, kamut, and their hybridized varieties).

Food Allergies

A food intolerance is not an allergy - it is an adverse food-induced reaction that does not involve the immune system. Lactose intolerance is one example of food intolerance. A person with lactose intolerance lacks an enzyme that is needed to digest milk sugar. When the person eats milk products, symptoms such as gas, bloating, and abdominal pain may occur. A food allergy occurs when the body's immune system reacts to a certain food, usually a protein. The reaction may result from the ingestion and in some cases skin contact or inhalation of a food or food additive. The most common form of an immune system reaction occurs when the body creates immunoglobulin E (IgE) antibodies to the food. When these IgE antibodies react with the food, histamine and other chemicals (called mediators) cause hives, asthma, abdominal pain and diarrhea, or other symptoms of an allergic reaction.

Hypersensitivity or allergic reactions to milk and egg are often outgrown at an early age, whereas reactions to peanut, tree nuts, fish, and shellfish tend to last a lifetime. Celiac disease, which is not IgE-mediated but nevertheless results in an allergic reaction, is also a life long and requires the strict avoidance of gluten-containing grains. There is no definitive treatment for food allergies other than to avoid the offending foods, especially in cases where the reaction is quite severe. Food allergy testing in a clinical setting is not a simple study. Depending upon funding, a number of subjects allergic to common food allergens are included. Either skin sensitivity or sensitivity to consumption of hemp protein is assessed. 50 The tests determine the presence of IgE antibody directed to particular foods. Two commonly used tests are blood (IgE RAST) and skin prick tests. The blood tests require a small sample of blood to be sent to a laboratory, where the amount of IgE antibody to the specific food is measured. Skin tests are performed by exposing a tiny area of scratched skin to the food being evaluated. A positive skin test results in a mosquito-bite-looking reaction at the site of the test within minutes. IgE RAST tests measure IgE-mediated reactions to a particular food. Oral challenge tests are generally used. These tests are conducted by giving gradually increasing amounts of hemp protein while observing the subject for symptoms. This is followed by laboratory analysis of IgE. Publication in a refereed journal will be required so that the results can be used to support the "lack of allergenic potential" of hemp and hemp protein.

Food Allergy and Anaphylaxis Network. 2007. http://www.foodallergy.org
Zarkadas, M, Scott, F, Salminen, and Pong, AH. 1999. Common All

Long Term Opportunities- GRAS (Generally Recognized as Safe) Affirmation for Hemp Products In the US, functional/nutraceutical ingredients can be marketed as dietary supplements, food additives, or as generally recognized as safe (GRAS) ingredients.

The regulatory requirements to determine safety are different for each of these categories. In 1997, the Food and Drug Administration (FDA) proposed replacing the GRAS affirmation process with a notification procedure whereby any person may notify FDA of a determination that a particular use of a substance is GRAS. Under the notification procedure, the FDA evaluates whether the submitted

notice provides a sufficient basis for a GRAS determination and whether the information in the notice or otherwise available to FDA raises issues that lead the agency to question whether use of the substance is GRAS. Under this process, the FDA does not make its own determination of the GRAS status of an ingredient but relies on the opinion of an Expert Panel to review a petition and determine GRAS. A substance is GRAS if its use in food has a proven track record of safety based either on a history of use before 1958 or on published scientific evidence.

Hemp does not have GRAS status, and two companies using hemp in bread products have expressed some concerns regarding this. As hemp gains popularity and profile in the US market and as larger companies become more interested in hemp as an ingredient, the safety of hemp (i.e. GRAS) will become a great issue and one that the industry will have to address. For example, companies such as Kellogg and General Mills are very reluctant to use food ingredients that do not have official GRAS. In addition, GRAS is a prerequisite for US health claims (Nutrition Labeling Education Act – NLEA) or qualified health claims. Thus a two stage approach is recommended to deal with the issue of GRAS. Commission a consultant to assess GRAS for hemp oil and seed. A comprehensive assessment should be conducted of published literature for metabolism, toxicology, and human clinical trials that bear on the safety of ingestion of hemp products. Depending upon this assessment, undertake any safety research to address any data gaps that may be found. Once data has been collected and assessed, proceed with GRASS. The GRAS process involves drafting safety documents and convening a GRAS expert panel to review and approve the submission, and dealing with FDA throughout the process.

Gain CFIA Approval for the use of Hemp in Animal Feeds The nutritional profile of hemp appears ideal for animals. Currently, the Canadian Food Inspection Agency (CFIA) has not approved hemp or hemp products for use in animal feeds and some in the hemp industry have identified this as a problem. This would require safety testing in regard to THC in various animal models and feeding trials to establish feeding levels. This is a longer term and more costly area and may not be necessary should hemp in higher value human food products continue to gain economic success in the food markets.

Burdock GA., “Dietary supplements and lessons to be learned from GRAS” Regulatory Toxicol. Pharm. 2000, 31:68-76.

Food Product Trends

Multinationals Shift Focus to Health and Wellness The formulation of foods for health is one of the leading focuses of the food industry. Foods that deliver a well-recognized health benefit to consumers have been a significant market opportunity for many years, as supported by the fact that during the early 2000s the market for healthy foods grew by 10 - 20%.78 Surveys of top global food executives confirm an industry focus on healthier foods.The “better for you” category was the food group that offered the most potential for revenue growth, reported by 54 percent of firms (up from 42 percent in last year’s survey). Organic foods were cited by 44 percent of firms (up from 15 percent in the previous survey) and high-end/premium foods (a new category on this year’s survey) were reported by 43 percent. Health is truly is the future of foods and in fact many believe that all foods are fast becoming functional. “All Natural” The terms “all-natural” and “naturally healthy” are popular among marketers to describe a food’s health benefits. To some consumers the word “natural” is synonymous with “healthy”. The term also implies that the health benefit is intrinsic to the product and not the result of added ingredients. The reformulation of foods so that they can be described as “all natural’, and the

marketing of natural health benefits, has accelerated rapidly over the last two years and today these are the most commonly adopted strategies in the business of food and health worldwide. Of relevance to hemp, the following types of brand communications are used to identify “health” to consumers: Free-from wheat/gluten/soy/dairy/lactose Free-from artificial additives/preservatives/colors/ trans fats Organic All-natural Contains only natural ingredients No unnatural ingredients Naturally high in fibre/ antioxidants Non GMO Heart Healthy Ingredients Although obesity and related health conditions are causing concern on a global scale, many consumers are looking at dietary changes in an effort to prevent disease and obesity in the first place. According to a 2005 survey by HealthFocus International, cardiovascular disease is one of consumers’ top three health concerns--not only in the US--but also in regions from India and China to France and the U.K. to Latin America.

The Market

Looking at Canada's many years of Statistics Canada estimated the total revenue from FFNHP at $2.9 billion in 2004, of which $823 million came from firms producing functional foods, $1.6 billion from firms producing NHP and $442 million from firms producing both. For 2003, data from the Nutrition Business Journal (NBJ) indicates that the Canadian nutrition industry including supplements, personal care products, and natural/organic and functional foods was valued at US $ 4.8B, a steady increase over the last four years. While functional food sales in the US represent approximately 4.0% of total food sales, Canada’s portion of total food sales is only 2.2%. According to NBJ, the Canadian market is experiencing a respectable 7.8% overall annual growth rate surpassing the 2-3% growth rate of the traditional food Industry. Canada does not currently possess a significant portion of the international health products market. However dating as far back as 2005, Canadians spent US$36.70 per capita on fortified/functional packaged foods and beverages whereas this figure was US$68.60 in the US, US$82.80 in the UK and US$138.60 per capita in Japan. However, domestic demand is expected to increase. Research conducted by Leverus Inc revealed that a 0.5% increase in the share of total spending translates to a $500 million (20%) increase in the size of the NHP sector at the retail level. Lewis (2006) estimates that by 2020 a functional food market value will be 2.9 billion. The Global Market The global market for functional foods, dietary supplements (natural health products, NHP in Canada) and food ingredients is comprised of companies that see the industry as a growth opportunity and the ability to make higher margins. It has attracted players the size of ADM, BASF, DSM, Nestle, Cargill, Bayer, Kellogg, Quaker Oats, Pepsi-Co and Danone as well as many small and medium sized enterprises. It is in this environment that the development of “healthier for you” functional foods, ingredients and NHP (FFNHP) has become a serious focus for the industry as well as the research community internationally. The hemp industry has identified health foods and NHP has a market opportunity over the short to longer terms. From an industry point of view, FFNHP offer a way to add value to existing products and to innovate with new ones. Such products are being developed to create higher-margin; value Leverus Inc. 2005. Canada's Natural Health Products Sector in 2005: State of the Industry Report. Prepared for Canadian Health Food Association, Canadian homeopathic Pharmaceutical Association and Canadian Natural Products Association by Leverus Inc in cooperation with Inter/Sect Alliance Inc. Ferrier, G. 2005. Nutrition Business Journal. NBJ Industry Overview. Webcast. April, 2005. www.nutritionbusiness.com. 54 Leverus Inc. 2005. Canada's Natural Health Products Sector in 2005: State of the Industry Report. Prepared for Canadian Health Food Association, Canadian homeopathic Pharmaceutical Association and Canadian Natural Products Association by Leverus Inc in cooperation with Inter/Sect Alliance Inc. 55 Lewis, H. 2006. Global Market Review of Functional Foods- Forecasts to 2012. Just Food. from: http://www.just-food.com/store/product.aspx?id=44028&lk=pop. 50 added lines for manufacturers and

inevitably their customers and shareholders. Of extreme importance, FFNHP offer the opportunity to positively impact health care costs which are becoming an increasingly significant burden to governments world-wide. In 2006 world consumption of NHP (supplements), natural and organic foods, natural personal care and functional foods was approximately $ 228 billion US. This market is dominated by the functional foods sector at $85 billion US, with the primary markets being the United States, Europe, Japan and Asia. Current and projected growth rates are more than triple that of conventional foods and pharmaceuticals, at ~9% to 12% per annum. It is anticipated that, based upon past data, the industry will witness steady and continued growth to 2012 when projections of global sales for functional foods alone near $95 billion dollars. The global supplement industry reached sales of $108 billion in 2020 on growth of 5%, according to NBJ. The US market contributed one-third or $22 billion to the total, followed by Europe at 23% and $16 billion. Japan was the third largest regional market with declining sales of $11 billion in 2006. Macro Trends Several macro trends are driving the global growth of the functional food and NHP industries and the interest in the area by the research community, governments and consumers. Global macro trends include the increasing prevalence of chronic disease and rising obesity rates, the increasing cost of health care, changes in public policy and the role that science will play in the development of functional foods. Rising Disease The World Health Organization's 2003 report on diet, nutrition and the prevention of chronic disease noted that, "the burden of chronic disease is rapidly increasing worldwide.59 In 2001, chronic diseases contributed to approximately 60% of all deaths worldwide and 46% of the total burden of disease. Almost half of these deaths were from cardiovascular diseases, obesity and diabetes." The WHO estimates that chronic disease will account for 70% of all deaths worldwide by 2020 in comparison to statistics for 2000. Obesity Obesity is a problem of growing concern and according the WHO,60 it has reached epidemic proportions globally, with more than 1 billion adults overweight and at least 300 million obese. In the US approximately 129.6 million Americans, or 64% of the population, are overweight or obese.61 The latest data from the National Center for Health Statistics of the CDC show that 30 56 Nutrition Business Journal. May/June 2007. The Global Nutrition Market. www.nutritionbusiness.com. 57 Ferrier, G. 2005. Nutrition Business Journal. 2005. Functional Foods VIII. The Emergence of Healthy Foods. Vol. X. 10/11. 58 Ferrier, G. 2005. Nutrition Business Journal. 2005. Functional Foods VIII. The Emergence of Healthy Foods. Vol. X. 10/11. 59 WHO Technical Report Series #916, 2003. "Diet, Nutrition and the Prevention of Chronic Diseases". 60 World Health Organization. February 2003. Global Strategy on Diet, Physical Activity and Health. http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/ 61 Statistics. 2004. Center for Disease Control and Prevention. http://www.cdc.gov/nchs/fastats/. 51 percent of US adults 20 years of age and older—over 60 million people - are obese. The percentage of young people who are overweight has more than tripled since 1980. The CDC estimates that 400,000 American deaths in 2000 (that is 1 out of every 700) were related to poor diet and physical inactivity. Canadian obesity rates too have increased over the past 25 years, with nearly one-quarter of all Canadian adults (up from 14 per cent in 1978-79) now considered seriously overweight, according to Statistics Canada.62 Cardiovascular disease (CVD) CVD accounts for the death of more Canadians than any other disease. In 2002 (the latest year for which Statistics Canada has data), cardiovascular disease accounted for 78,942 Canadian deaths.63 35% of all male deaths in Canada in 2002 were due to heart diseases, diseases of the blood vessels and stroke. For women, 37% of all deaths in 2002 were due to CVD. The US has the highest prevalence of cardiovascular diseases among global nations.64 One in 3 adult men and women has some form of CVD which has been the primary killer in the US every year but 1918. 65 Nearly 2500 Americans die of CVD each day, an average of 1 death every 35 seconds. CVD claims more lives each year than the next 4 leading causes of death combined, which are cancer, chronic lower respiratory diseases, accidents, and diabetes mellitus. Of the over 71 million

American adults with 1 or more types of CVD, close to 28 million are estimated to be age 65 or older. Diabetes There are currently more than 246 million people with diabetes worldwide and at least 50% of all people with diabetes are unaware of their condition. By 2025, it is estimated that this number will rise to over 380 million. Diabetes is the fourth main cause of death in most developed countries and is the leading cause of blindness and visual impairment in adults.66 The number of Americans with diabetes had risen to 20.8 million in 2005 or 7% of the US population, 1.5 million new cases from 2004. Individuals with metabolic syndrome (obesity, CVD and/or diabetes symptoms) are estimated to number over 50 million.68 The prevalence of adult obesity increased 57% in the brief period between 1991 and 1999, and currently over 60% of US adults are overweight.69 These increases cannot be explained by the aging of the 62 Statistics Canada. July 2005. Canadian Community Health Survey: Obesity among children and adults 2004. http://www.statcan.ca/english/research/82-620-MIE/82-620-MIE2005001.htm. 63 Statistics Canada, Causes of Death 2002. Released 2004. 64 Heart Association Statistics Committee and Stroke Statistics Subcommittee Heart Disease and Stroke Statistics--2006 Update. A Report From the American Members of the Statistics Committee and Stroke Statistics Subcommittee. 2006. Circulation. February. http://circ.ahajournals.org 65 NHANES 1999–02. Center for Disease Control. American Heart Association. www.aha.org. 66 International Diabetes Federation. 2007 Facts and Figures. http://www.idf.org/. 67 American Diabetes Association. 2005 statistics: Total Prevalence of Diabetes & Pre-diabetes. http://www.diabetes.org/diabetes-statistics/prevalence.jsp 68 Ford, E.S., Giles, H.W., and Dietz, W.H. 2002. Prevalence of the metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey. JAMA; 287:356-9. 69 Mokdad, A.H., Serdula, M.K., Deitz, W.H., et al. 1999. The spread of the obesity epidemic in the United States, 1991-1998. JAMA; 282:1519-22. 52 population alone, as similar increases are also being seen in US children.70 Currently in Canada, over 2 million Canadians have diabetes, up from 722,491 in 1995.71 Approximately 80% of people with diabetes will die as a result of heart disease or stroke. Diabetes is a contributing factor in the deaths of approximately 41,500 Canadians each year. Aging Demographic The increase in disease burden being experienced worldwide is related not only to obesity, poor diet and lifestyle, but also to an aging population. During the 20th century, the number of Americans age 65 years and above increased 1100%. By 2010, the number of people over 50 years of age will increase by 48% from early 2000 numbers; in contrast, the group aged 13-24 years will grow by only 16%. By the year 2035, it is estimated that 70 million people will over the age of 50.72 A similar situation is occurring in Canada. According to Statistics Canada and reported by Agriculture and Agri-Food Canada, by 2016, about 44% of the Canadian population will be 45 years of age or more. 73 In North America, currently, more than 75% of individuals who are 65 years of age or older suffer at least one chronic disease, whereas 50% have at least 2, a situation that imposes a tremendous burden on the health care system. Rising Health Care Costs An increase in disease incidence leads to overall increases in the cost of health care. In the US, healthcare costs were $1.9 trillion in 2004, a 7% increase from 2003, and are projected to reach $3.1 trillion by 2012 – or 17.7% of GDP.74 Spending by private health insurance has increased 10 fold since 1987. Costs increased from $3.6 billion in 1987 to $36.5 billion on obesity-linked illnesses in 2002. Total health care spending on obesity in 1987 was 2% compared to 11.6% in 2002. Canada continues to rank among the world's top ten health spenders when compared to other countries in the Organization for Economic Co-operation and Development (OECD) and ranked eighth in per capita spending (US $3,326).75 Total health expenditure in Canada, in current dollars, was estimated at $141.2 billion in 2005, and is forecast to have reached $150.3 billion in 2006 and $160.1 billion in 2007. Chronic disease accounts for a significant portion of health care costs and this is growing. In Canada, cardiovascular diseases, diabetes and cancer combined cost the Canadian economy close to $60B annually. 76 The direct cost

of obesity to Canada's health care system is estimated to be $1.8B.77 70 American Diabetes Association. Consensus Statement. 2000. Type 2 diabetes in children and adolescents. Diabetes Care. 23:381-9. 71 Canadian Diabetes Association. 2005 statistics. The prevalence and costs of diabetes. http://www.diabetes.ca/Section_About/prevalence.asp 72 United States Census Bureau. 2005. Population Estimate. http://factfinder.census.gov/ 73 Agriculture and Agri-Food Canada. 2005. Canadian Consumer Trends. Food Value Chain Bureau. http://www.agr.gc.ca/misb/fb-ba/index_e.php?s1=cons&page=intro. 74 Health, United States. 2007 annual report on trends in health statistics. http://www.cdc.gov/nchs/fastats/ 75 Canadian Institute for health Information. 2007. National Health Expenditure Trends – 1975 – 2007. 76 Canadian Institute for health Information. 2007. National Health Expenditure Trends – 1975 – 2007. 77 http://www.medicalnewstoday.com/medicalnews.php?newsid=10170 [sourced: January 26, 2007]

Food Product Trends Multinationals Shift Focus to Health and Wellness The formulation of foods for health is one of the leading focuses of the food industry. Foods that deliver a well-recognized health benefit to consumers have been a significant market opportunity for many years, as supported by the fact that during the early 2000s the market for healthy foods grew by 10 - 20%.78 Surveys of top global food executives confirm an industry focus on healthier foods.79 The "better for you" category was the food group that offered the most potential for revenue growth, reported by 54 percent of firms (up from 42 percent in last year's survey). Organic foods were cited by 44 percent of firms (up from 15 percent in the previous survey) and high-end/premium foods (a new category on this year's survey) were reported by 43 percent. Health is truly is the future of foods and in fact many believe that all foods are fast becoming functional. "All Natural" The terms "all-natural" and "naturally healthy" are popular among marketers to describe a food's health benefits. To some consumers the word "natural" is synonymous with "healthy". The term also implies that the health benefit is intrinsic to the product and not the result of added ingredients. The reformulation of foods so that they can be described as "all natural', and the marketing of natural health benefits, has accelerated rapidly over the last two years and today these are the most commonly adopted strategies in the business of food and health worldwide. Of relevance to hemp, the following types of brand communications are used to identify "health" to consumers: Free-from wheat/gluten/soy/dairy/lactose Free-from artificial additives/preservatives/colors/ trans fats Organic All-natural Contains only natural ingredients No unnatural ingredients Naturally high in fibre/ antioxidants Non GMO Heart Healthy Ingredients Although obesity and related health conditions are causing concern on a global scale, many consumers are looking at dietary changes in an effort to prevent disease and obesity in the first place. According to a 2005 survey by HealthFocus International, cardiovascular disease is one of consumers' top three health concerns--not only in the US--but also in regions from India and China to France and the U.K. to Latin America.

In 2007, Mintel International's Global New Products Database identified close to 560 new products from around the world that referenced cardiovascular and/or heart health. 2008 information from the group's Global New Products Database reveals a massive 244 percent increase in new introductions in the heart health category - from 43 products in 2006 to 148 in 2007. In 2003, only 22 new products were launched in this category, followed by 19 in 2004 and 54 in 2005. Of relevance to hemp ingredients, the heart health trend \ is currently the most important for new product development and is projected to be so for at least the next 5 years with omega 3 fatty acids, phytosterols, fibre and whole grain being top of the list ingredients. 80 Fibre Concerns with growing incidence of diabetes and obesity have led to increasing interest by food developers, in soluble fibre and in particular the glycemic index. This is an opportunity area for hemp as it is rich in soluble fibre. Food companies are

increasingly extending brand labels and/or developing new food products containing fibre. The reasons are numerous including the acceptance by the health care community regarding the established health benefits of fibre, label regulations especially in the US that allow positive health statements related to fibre content and steadily increasing consumer awareness of fibre and recognition of its health advantages. Researcher Frost & Sullivan notes that fibre is an ingredient market worth $200 million in the US alone in 2004, predicting it will double to $400 million by 2011, a conservative figure compared to some other market estimates. Euromonitor International puts the global market for foods marketing high-fibre claims including packaged foods, baked goods, bread, biscuits and cereals at about $80 billion globally, rising to $95 billion by 2011. In the US, ACNielsen found sales with fibre label claims rose 15.5% to $1.6 billion in the year ended August 2005 compared to 11.4% in 2004, 2% in 2003 and 4% in 2002.81 Glycemic Index (GI) There is strong scientific evidence that supporting low GI diets and weight loss as well as diabetic control. 44% of the North American population is actively trying to lose weight. Almost one in four shoppers in both Canada and the US has decreased their consumption of high glycemic carbohydrates within the past two years, and one in three has decreased their consumption of carbohydrates, according to the 2005 HealthFocus Trend Report.82 At the same time, approximately one in ten are increasing their consumption of low-glycemic carbohydrates and “better-for-you” carbohydrates. In early 2007, the market research firm Packaged Facts reported that sales of low-glycemic foods and beverages reached $350 million in 2006, and predict that sales will keep increasing at a compound annual growth rate of over 45 percent from 2007 to 2011, with sales projected to reach $1.8 billion in 2011.83 In a Wall Street Journal article, it was reported that the growth in total food and beverage sales in 2005 increased by 3%.84 Low fat, reduced fat and fat-free foods increased in sales by just over 2%, low carbohydrate food sales declined by over 10%, and low glycemic foods grew 412%..

Gluten Free

The US market for gluten-free foods and beverages is currently estimated at $696 million US, and is anticipated to grow to $1.7 billion US by 2010. The same report found that since 2001, the market for gluten-free products has grown at a compound annual rate of 27%, and is anticipated to grow 25% per year until the year 2010. According to information published by SPINS, more than 3,150 products with gluten-free label claims are currently on the market in the US. An 86% increase in new product launches in the “gluten-free” category was observed in 2006.86 In 2006, 40% of gluten-free products on the market were sold in health and natural food stores, 20% through specialty food websites and catalogue purchases, and 14% via mainstream supermarkets.87 Emerging Markets for Natural Ingredients Pet Foods and Products With the “humanization” of pets, many owners are taking as much care of the health of their pets as they do their own. A recent survey conducted for Purina Pro Plan Selects indicated that 90% of respondents “always try to purchase foods with the most health benefits for themselves and 82% look for foods with the most wholesome ingredients for their pets.”88 Industry analysts have observed that trends in the pet food market not only mirror human food trends; they often do so at an accelerated rate.89 In 2005, an American Pet Products Manufacturers Association survey reported that 63% of households in the United States owned a pet, which equates to over 69 million homes.90 Consumers spent over $14 billion on pet food during 2005 in the United States alone. And pet food manufacturers released 175 new dog and cat food products during the first six months of 2006. Euromonitor predicts that the global pet food and pet care products market will increase by 15.1%, from 58.2 billion US in 2005 to 67.0 billion US in 2010.91 High quality protein remains the most important characteristic of pet food for both consumers and pet food manufacturers. The highest quality proteins are animal sources as they are both digestible and highly available.

However, there may be an opportunity for hemp protein because of its excellent amino acid profile and high digestibility. Pets are increasingly viewed as a part of the family and this has led to a recent expansion of health and wellness pet foods and products.

Natural Personal Care The natural, organic and cosmeceutical segments of the personal care market has experienced significant growth in recent years, and are expected to continue to expand in the foreseeable future as Natural Products Companies (NPC) and large consumer marketers increase their investments into this segment of the Health and Beauty Care (HBC) market. Retail sales of natural and organic personal care products, which represented over 10% of the HBC market in 2005, exceeded $5.5 billion in 2005 growing at 14.6% ($12 billion globally). In comparison, the overall US cosmetics and toiletries market grew by 3.5% in 2005.92

The Consumer Consumers are a critical driving force behind the development of healthier for you foods and NHP. As they strive to maintain good health into old age, they are attempting to take greater control over their health care needs. With the rising incidence of obesity and the significant increases in the rates of chronic disease, consumers are becoming increasingly aware of the link between diet and medical disorders. Consumers are seeking alternatives to conventional medicine which has been dominated for decades by an attitude of “treat” rather than “prevent” illness. A number of consumer surveys have indicated that increasingly consumers believe that eating healthy is a better way to manage illness than through medication. The most common reasons that appear to motivate food purchase decisions are ensuring overall good health, reducing fat intake, following a physician's advice, and to control weight and cholesterol.93 Since 1996, taste, nutrition, cost and convenience have been the key drivers of food choices for Canadians.94 It is forecast that food and supplements will continue to be seen by consumers as a solution to present and pending health problems. 95 Princeton Survey Research Associates recently reported that 76% of consumers feel that eating healthfully is a better way to manage illness than medication. The top five factors motivating food purchase decisions, according to the results of this survey, are ensuring overall good health, reducing fat intake, following a physician's advice, and to control weight and cholesterol intake.96 In 2002, the annual "Shopping for Health" study, a joint survey between the Food Marketing Institute and Prevention Magazine, noted that 68% of shoppers are more likely to treat themselves before seeing a physician, up from 31% in 1998.9

Regulatory Issues Crucial to tapping into the potential for functional foods and NHPs is establishing a market friendly regulatory framework. Japan was the first global jurisdiction to institute regulatory reforms that encourage companies to utilize health claims to develop healthier foods and to communicate such messages to consumers. Part of the reason this system developed in Japan was due to that country's concern over a rapidly aging population. Europe is another leader in functional food development, not due to favorable regulations but more so to excellent public awareness of the health benefits of foods and natural medicines as well as a significant focus upon research. The EU is moving ahead with harmonization across nations of regulations for health claims and for scientific substantiation of FF efficacy. Due in part to industry lobbying as well as consumer interest, the US established health-claim environments for both food and dietary supplement products in the mid 1990’s. In Canada, health products are either foods or drugs. A Natural Health Product (NHP), as defined by Health Canada, is “any plant or plant material, a bacterium, fungus, alga, non-human plant

material, or an extract or isolate of these materials." This includes vitamins and minerals, herbal remedies, homeopathic medicines, traditional medicines such as Traditional Chinese Medicine (TCM), probiotics and other ingredients such as amino acids and essential fatty acids. It is essentially equivalent to the US "dietary supplement" regulatory definition. The NHP regulations were implemented in January 2004 by Health Canada through its newly formed Natural Health Products Directorate (NHPD). As an addition to the scheme of the Canadian Food and Drug Act and Regulations, NHPs are considered a subset of drugs, in which health claims such as disease treatment or prevention, as well as structure/function claims, are allowed. The regulations include product licenses, labeling requirements, evidence summary reporting, safety summary reporting, quality summary reporting, clinical trial guidance and procedures, GMP and site licenses. The regulations require pre-market approval from NHPD for all NHPs that are new to the Canadian market, as well as re-approval of all existing NHPs in a six-year transition period. In addition, site licenses are required for Canadian companies that manufacture, package, label or import NHPs. In Canada, the current regulatory environment for foods with health claims, both for marketing and for product approval, is not as favorable or transparent as in other global jurisdictions. Canada has three categories of health claims and two categories of claims not considered health claims. Health claims include structure/function claims, risk-reduction claims and therapeutic claims – all are claims related to the definition of a drug by claiming uses related to the prevention or management of a disease or abnormal physical state, including their symptoms (applies to risk-reduction claims and therapeutic claims) or the modification of organic functions beyond what is considered normal and required for the maintenance of good health (applies to structure/function claims).98 Because such claims bring food under the definition of a drug, regulatory amendments are required to approve the use of these claims.