Update of:

Opportunities for Value-added Utilization of Oilseeds and Oilseed Products in Minnesota

Prepared for:

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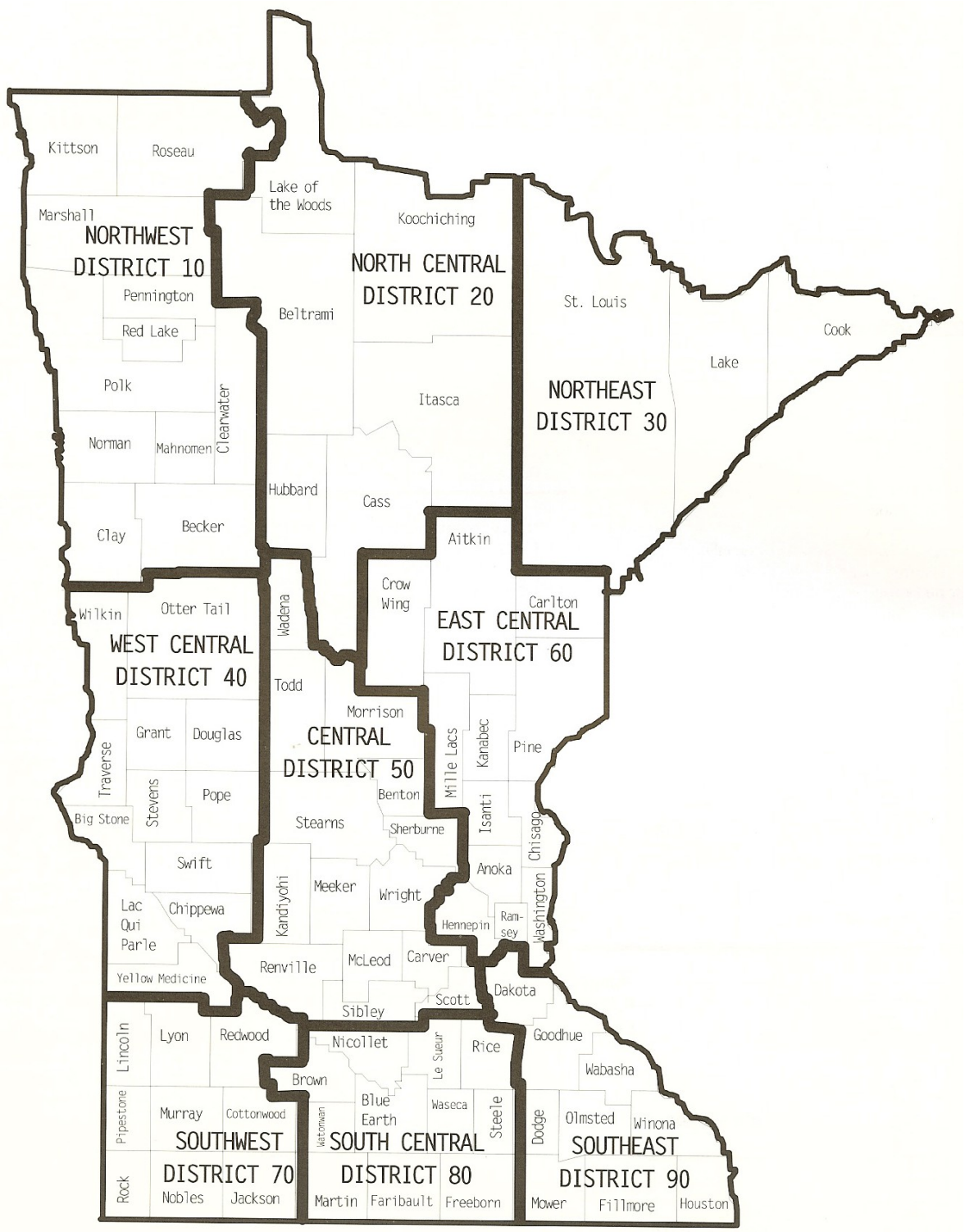
October 26, 2005

Minnesota's Agricultural Statistics Districts



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Introduction

Purpose

The purpose of this study is to update the September 15, 2000 study "Opportunities for Value-added Utilization of Oilseeds and Oilseed Products in Minnesota," to include: quality improvements regarding low linolenic acid and trans fatty acids; examination of the role and availability of used oils, fats and greases, particularly in the production of biodiesel from these raw materials, and the availability/volumes fats and oils available from border states, in addition to the concepts addressed in the previous study.

Previous study

It is assumed that those with access to this study have access to the previous study conducted in 2000. Therefore, rather than repeating much of the information contained in that study, it will be referred to at times in this study, with updated information provided in this study as appropriate.

Qualifications of Robert W. Carlson

Robert W. Carlson has been engaged in the oilseed processing industry since 1972. Experience includes:

Selected Consulting Projects & Studies

- "Assessment of Situation at Al Ghurair Foods Soybean Plant in Dubai, United Arab Emirates"
  Completed: July 2005
  Client: American Soybean Association, Istanbul, Turkey
  Contact: Chris Andrew, 90-212-258-2800, candrew@superonline.com

- "Sustainability Plan for Uganda Oilseed Producers and Processors Association"
  Completed: June 2003
  Client: ACDI/VOCA and Uganda Oilseed Producers and Processors Association
  Contact: Emmet Murphy, 256-41-343-306, emurphy-pl480@acdivocaug.org;
  Peter Otimodoch, 256-41-342-504, oilseed@spacenet.co.ug

- "Opportunities for Enhancement of Oil Revenue at Colorado Mills"
  Completed: July 2001
  Client: Colorado Mills, Lamar CO, USA
  Contact: Doug Uhland, 719-336-8452

- "Feasibility Study for Soybean Oil Processing, Refining and Esterification (SOPREP) Plant in Michigan"
  Completed: May 2001

Client: Zeeland Farm Service, Zeeland MI, USA and Michigan Soybean Association
Contact: Cliff Meeuwsen, 616-772-9042, cliffm@zfsinc.com; Keith Reinholt, 517-652-3294, reinholt@michigansoybean.org

- "Opportunities for Value-added Utilization of Oilseeds and Oilseed Products in Minnesota"
  Completed: September 2000
  Client: Agricultural Utilization Research Institute, Marshall MN, USA and Minnesota Soybean Association
  Contact: Max Norris, 507-537-7440, mnorris@auri.org; Jim Palmer, 507-388-1635, jim@mnsoybean.com

- "Feasibility Study for Missouri Value Processors"
  Completed: April 2000
  Client: Missouri Value Processors, Chillicothe MO, USA and Missouri Soybean Association
  Contact: Dale Ludwig, 507-537-7440, dludwig@mosoy.org

- "Feasibility Study for Specialty Oilseed Processing Plant in North Dakota"
  Completed: April 1997
  Client: Security State Bank of North Dakota and AgGrow Oils, Carrington ND, USA
  Contact: John Gardner, GardnerJ@missouri.edu

  "Feasibility for Sunflower Processing Plant in South Dakota"
  Completed: December 1996
  Client: Farmland Industries, Kansas City MO, USA
  Contact: No longer available

Employment History within the Oilseed Processing Industry

- February 2005–present: Independent agribusiness consultant, Minneapolis MN, USA

- April 2004–January 2005: General Manager, Cargill Trading Egypt, Cairo, Egypt; Managing Director, National Vegetable Oil Company, Borg el-Arab, Egypt
  Soybean processing plant

- November 2003–February 2004: Chief Executive Officer, Farmers Oilseed Cooperative, Claxton GA, USA
  Proposed specialty soybean and canola processing plant

- October 2002–October 2003: Independent agribusiness consultant, Minneapolis MN, USA

- September 2001–August 2002: General Manger, Crown Friendship Engineering Company, Wuhan, China
  Designer and manufacturer of oilseed processing and refining equipment

- November 1999–August 2001: Independent agribusiness consultant, Minneapolis MN, USA
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- July 1997–October 1999: Managing Director, Champion Food & Oils Group, Cairo, Egypt
  Soybean, sunflower and cottonseed processing and refining

- March 1996–June 1997: Independent agribusiness consultant, Minneapolis MN, USA

- November 1993–February 1996: Vice President-Operations, National Sun Industries, Minneapolis MN, USA
  Oilseed processing plants in North Dakota (sunflower, canola and crambe) and Kansas (soybean and sunflower)

- May 1972–January 1991: General Manager, Cargill Inc, Minneapolis MN, USA
  Oilseed processing plants in Minnesota (soybean), Iowa (soybean) and North Dakota (sunflower and flax)

Disclaimer

Robert W. Carlson has used his experience in and knowledge of the oilseed industry in preparation of this study and has reached the conclusions in an objective and unbiased manner. There is no assurance given, nor should any be inferred by AURI or anyone with whom AURI shares this study, that any projections or forecasts made by this study or implied by it will in fact be realized.

Executive Summary

The purpose of this study is to update a similar study conducted in 2000.

The oilseed industry is vast and growing worldwide enterprise. **Since 1990, worldwide production of oilseeds has increased by 74%**, to 372 million metric tons (MT). **During this same period, worldwide population has increased by only 21%.** The rapid expansion in oilseed production is reflective of a rising standard of living, with people demanding more fried foods and more meat, milk and eggs in their diets.

Soybeans are the world's dominant oilseed, **accounting for nearly 60% of production** today, up from 50% in 1990.

While the **United States** still leads the world in **oilseed production and processing**, thanks to its huge soybean crop, these **leads are shrinking** as Argentina and Brazil expand their soybean production and Argentina, Brazil and China expand their processing capacity. **Argentina has become the primary supplier of soybean oil and meal to the world, accounting for 48% of soybean oil exports and 44% of soybean meal exports in 2005.**

Minnesota is the third largest soybean producing state, after Illinois and Iowa. Production of other oilseeds in Minnesota (canola, flax, and sunflower) has diminished in importance during the past decade, to the point where **soybeans now account for over 99% of oilseed production in the state.**

In recent years expansion of **soybean acreage in the Northwest Agricultural Statistics District** has been impressive—from 492,000 acres in 1997 to 1.2 million acres in 2004.

With the start-up of two 3000 T/day (100,000 bushel/day) soybean plants in 2003 (the CHS plant at Fairmont and the Minnesota Soybean Processors plant at Brewster), **Minnesota** became **the third largest soybean processing state**. The state's five soybean processing plants (ADM at Mankato, CHS at Mankato and Fairmont, Minnesota Soybean Processors at Brewster and AGP at Dawson) have capacity to process about 60% of the annual soybean crop. This is in line with other large soybean producing states. (ADM also has a 3000 T/day sunflower and flax processing plant at Red Wing.)

At the time of the 2000 study, Minnesota had soybean meal production capacity of 2.2 million metric tons/year and calculated soybean meal consumption of 1.7 million MT. With the start-up of two new soybean processing plants at Brewster and Fairmont in the fall of 2003, Minnesota now has soybean meal production capacity of 3.5 million MT/year while calculated soybean meal consumption has increased to only 1.8 million

MY/year. Thus, **excess soybean meal production capacity has increased by 1.2 million MT and now equals 94% of calculated soybean meal consumption**.

This is a problem for the state's processors. Due to its location on the northern edge of the soybean processing area of the country, **Minnesota is at a disadvantage when it tries to ship products, especially soybean meal, out of the state**. This disadvantage is accentuated by the fact that Minnesota soybeans are typically lower in protein content (sometimes in oil content, too) than soybeans grown farther south, resulting in lower protein content in the meal produced from them. As a result of these two factors, net processing margins have been negative most of the time since the start-ups of the two new plants. Smaller than normal soybean crops in 2003 and 2004, due to unfavorable weather, exacerbated the situation.

There is no question that **Minnesota now has excessive commodity soybean processing capacity and will have for years to come**. **However, there may be opportunities for identity preserved (IP) processing and/or specialized soybean (and possibly other oilseeds) in mini-mills.**

In IP processing, the feedstock and one or both of the products are segregated in order to take advantage of special traits within the product(s). IP processing is currently being done by Consolidated Grain and Barge in Mt. Vernon, IN (non-GM soybeans for non-GM meal for Japan), Zeeland Farm Services in Zeeland, MI (LoSat™ and VISTIVE™ soybeans for low saturated fat oil and low linolenic acid oil, respectively), Thumb Oilseed Processors in Ubley, MI (organic and non-GM soybeans for organic and "natural" oils) and others. Several processors have contracted for VISITIVE™ soybeans for 2006. Other special trait soybeans are being developed by the seed companies that will need to be IP processed as they become commercialized. **Some of the commodity processors in Minnesota may be able to configure their storage space in order to IP process.**

A mini-mill also could IP process special trait soybeans or conventional soybeans (and canola) to produce "press" oil for "natural" food companies such as Hain Celestial. It also could produce bypass protein soybean meal for which some dairy farmers pay a premium of upwards of $15/T over conventional meal. **Central Minnesota Soybean Processors (CMSP), a cooperative centered in Otter Tail County, is having a feasibility study conducted to explore the possibility of building a mini-mill.**

The 2000 study recommended further study of a multiseed plant, including corn germ processing, located in west-central Minnesota. Since then the Minnesota Corn Processors plant in Marshall has been purchased by ADM. The corn germ from this plant (about 100,000 T/year) was seen as a critical feedstock to the multiseed plant. Since ADM has its own corn germ processing plants, this tonnage no longer would be available to the multiseed plant. The decline in minor oilseed acreage, mentioned previously, also is a negative for such a plant. Therefore, the **multiseed plant is no longer seen as a viable opportunity.**

Likewise, production of **NuSun™ sunflower oil**, which is a mid oleic oil that now accounts for a high percent of oil sunflower grown in the United States, **was seen as a strategy for a multiseed plant. So this is now a moot point.**

Press vegetable oil also was seen as a viable opportunity allied with either a multiseed plant or mini-mill. This **remains an opportunity worth pursuing and will be addressed in the feasibility study for the CMSP mini-mill.**

When soybean oil is refined there are by-products produced that can become feedstocks for the production of some high-value products. Primary among these is lecithin, which can be fractionated into products that are used in the pharmaceutical industry and which can be worth $100 to $300 per pound. There are about 4 ounces of lecithin in a bushel of soybeans, but this material must be reduced much further to produce the higher-value products, like phosphatidylcholine and phosphatidylserine.

Fractionation of lecithin was considered to be worthy of further investigation in the 2000 study. This was done, the **result of which is the SoyMor plant in Glenville**. The plant was started up in the spring of 2005 and is currently fine tuning its production process. It is too soon to tell if this will be a successful business.

Other by-products from refining soybean oil are **free fatty acids and deodorizer distillate**. The former is a low-value product that is used primarily in the manufacturing of soap. The latter can be processed into a form of vitamin E but that market is saturated since ADM and Cargill got into the business 8-10 years ago. **Neither of these products is considered to be worth further investigation**.

Soy concentrates (65% protein content) and soy isolates (90% protein content) are derived from soy flakes, which are soybean meal that has been desolventized in a way that gives a high protein dispensability index (PDI). This allows them to be incorporated into food products. The large soybean processors, ADM, Bunge and Cargill are heavily into the soy concentrate and isolate business to the degree that they have branded their products. This is a very competitive business in which it is advantageous to be the producer of the soy flakes that are the raw material. **CHS produces soy flakes at its processing plant in Mankato and has studied moving into the soy concentrate and/or isolate business but up to this point has decided not to.**

Soy flour is another food product that is made from soy flakes. Besides its high-protein nutritional benefit, soy flour also has functional characteristics which make it advantageous to incorporate it into some food products that also use wheat flour, such as bread. As with soy concentrates and isolates, it is advantageous for a soy flour producer to produce its own soy flakes. CHS does grind some of its soy flakes into flour. ADM, Bunge and Cargill also are soy flour producers. **With limited demand for soy flour in Minnesota, it does not appear that there is a need for additional production within the state at this time. If there were, CHS would be in the best position to provide it by expanding their existing soy flour capacity.**

Isoflavones, are compounds in soybeans that may be beneficial in relieving the symptoms of menopause and prevention of some types of cancer. ADM is the primary producer of isoflavones in the United States. Acatris, a Dutch company with its American regional office in Minneapolis, is another large producer of isoflavones. At the time of the 2000 study, Acatris (then called Schouten) was shipping soybeans from North and South America to its production plant in the Netherlands. It was suggested at that time that Acatris might consider having a production facility in Minnesota, to save considerable freight costs in shipping soybeans from the United States to Europe and the product back to the United States. Since then Acatris has changed its method of operation. Now it has soybeans degermed for it at a facility in Iowa, with only the germ being shipped to the Netherlands. So **isoflavone production by Acatris in Minnesota no longer is likely**, especially since the market for isoflavones has declined recently due to conflicting studies regarding their health benefit.

Soy-based oligosaccharides have largely been replaced by those from other sources, especially chicory root. Without any qualitative advantages over other sources of dietary fiber, of which there are many inexpensive sources, **soy-based oligosaccharides are not a viable business opportunity**, especially given that they have the disadvantage of producing intestinal gas.

Since their inception in the early 1980s, soy foods have shown impressive growth. This now appears to have peaked. The soy foods market grew by only 2.1% in 2004 and in fact four of five food categories (meat alternatives, energy bars, tofu and meal replacements) showed negative growth. Only soy milk showed modest growth. Sales of soy milk, which grew at an annual rate of 23% between 1998 and 2004, are projected to grow by only 5% annually the rest of the decade. The **decline in growth in the soy food industry** is attributed to numerous recent articles and reports that question the health benefits of soy foods and to general boredom with the category. **The soy food industry is in need of the "next big thing" to give it a needed boost. Until then, soy foods are not seen as a good investment**.

Salad dressings and sauces are produced, for the most part, near large population centers. It is cheaper to ship the ingredients (such as tank cars of refined vegetable oil) to these locations than it is to ship the packaged product long distances. This makes Minnesota an unlikely place for salad dressing and sauce production. ADM and CHS have refineries at Mankato that are capable of refining all the oil produced at their crush plants in Mankato and Fairmont. This oil largely leaves the state in tank cars destined for the dressing and sauce manufacturers in large metropolitan areas. CHS, through its Ventura Foods joint venture, does operate a margarine plant in Albert Lea, which is one of twelve plants operated by Ventura Foods across the country. **It is unlikely that a local manufacturer of salad dressings and sauces could carve out a market for itself in Minnesota.**

With the sharp rise in petroleum prices during the past year, **it appears that the time has come for biodiesel**. The start-ups of Minnesota's two largest biodiesel plants, Minnesota Soybean Processors at Brewster and SoyMor at Glenville, in August could hardly have been timed better. **However**, with announcements of plans for new biodiesel plants seemingly being made every week, **there is a risk that production capacity will run well ahead of demand. Minnesota is a case in point, where the state's three biodiesel plants can produce 60 million gallons/year, while the 2% biodiesel blend state mandate, which took effect on September 29, will require only 18 million gallons/year.**

Nationally, the National Biodiesel Board (NBB) **estimates that 25 million gallons of biodiesel were consumed in 2004 and that this will grow to 50 million gallons in 2005. NBB lists 45 currently operating biodiesel plants with capacity of 180 million gallons/year, and announced plans for another 54 plants with capacity of 390 million gallons/year, with 100 million gallons of this to be on line by May 2006.** With Minnesota the only state with a "sold at the pump" blend mandate in place at this time, one wonders where the markets will be for all this capacity, if it is all built.

If every state were to adopt Minnesota's 2% biodiesel blend mandate, there would be a market for 1 billion gallons/year. Feedstocks other than soybean oil would be needed to produce this much. **If all the soybean oil that is exported from the United States were diverted by market forces to biodiesel production, it would produce only 195 million gallons.**

ADM recently announced that it will build a 50 million gallon/year biodiesel plant at its canola processing plant in Velva, ND**. All the canola oil produced in the United States would produce 85 million gallons**, but certainly food use will continue to claim some canola oil.

Rendered fats and greases also could be a feedstock. The United States produces about 4.5 million MT/year of various fats and greases, of which **1.5 million MT are exported. If all the exported fats and greases were diverted by market forces to biodiesel production, another 400 million gallons could be produced. The 3.0 million MT/year of fats and greases that are consumed domestically (primarily by the feed industry) could produce another 800 million gallons of biodiesel.**

Waste grease also is a potential feedstock, which is difficult to quantify.

So there are enough biodiesel feedstocks to produce 1 billion gallons/year of biodiesel in the United States, if market forces are able to divert enough oils, fats and greases that are currently exported or consumed by the domestic feed industry. **But it is unlikely that additional oilseed processing plants would be built to satisfy this demand, since oilseed plants also produce meal, for which the market already is saturated and growing only at the rate of population growth—about 1% per year.**

Soybean oil is used in non-food products such as ink, paints, adhesives, waxes, solvents, cleansers and lubricants. In these applications it is seen as more environmentally friendly than petroleum-based counterparts in addition to being renewable.

Soy oil-based ink has become quite popular but has some functional characteristics that make it less desirable for some printing applications petroleum or linseed-oil based inks.

Environ Biocomposites of Mankato, the former Phenix Biocomposites, which filed for Chapter 11 bankruptcy protection shortly after the 2000 study was completed, produces a granite-like composite made from soy flour and recycled newsprint. Under its new ownership the company has continued to struggle, particularly with its namesake product, Environ®. It has produced a great deal more of a cheaper, particle-board-like product made from wheat straw called BIOFIBER™. It also has introduced and a new product called Dakota Burl™, a decorative product made from sunflower hulls.

Recently Environ Biocomposites was sold to an investor in California. Hopefully the new ownership will be able to solve the company's financial and marketing problems that have plagued it since the Mankato plant was built in 1999.

A new industrial use of soybean oil is the production of polyol, which can be used as a placement for petroleum-based polyol **in the production of polyurethane**. At this point this is **a small business but the growth potential is good**. As with other products made from soybean oil (refined oil and biodiesel), a processor should have an advantage over a manufacturer who must buy his raw material from a processor and transport it to the production site.

It is encouraging that the **United Soybean Board, seed companies and processors have teamed up to address the "Minnesota factor,"** with a target of producing soybeans in the state that grade minimum 35% protein and 19% oil content. Beans of this quality can produce 48% protein meal, which is the industry standard. If realized, this initiative will make Minnesota soybeans and soybean products more competitive.

Overview of the Oilseeds Industry

Worldwide industry

The oilseed industry is a vast, worldwide enterprise. Nearly every country in the world produces oilseeds of one kind or another and most of them have at least a rudimentary oilseed processing industry that produces two basic foods: edible oil and protein meal.

Edible oils are consumed directly in the human diet in products like cooking oil, salad oil, margarine and shortening. They also are an ingredient in many food products and industrial products.

The protein meal that remains once the oil has been extracted from the oilseed is used primarily as a feed ingredient for poultry, hogs, dairy cattle, beef cattle, lambs, fish and other animals, including pets. In essence, protein meals are used to produce animal proteins in the forms of meat, milk and eggs.

Other uses of oilseeds and their derivatives include soy foods (soy flour, soy milk, soy sauce, tofu, miso, tempeh, soy concentrates and isolates, meat analogues) as well as pharmaceuticals (isoflavones, phytosterols, tocopherols, phosphatidylcholine, phosphatidylserine) and industrial products (soy-based inks, paints, lubricants, solvents, waxes, personal care products). Vegetable oil also can be feedstock for the production of methyl esters, commonly called biodiesel, that can be used as a fuel in diesel engines.

Although the primary uses of oilseeds are related to food production, oilseed production has grown much more rapidly than the growth in world population over the past 20 years. This indicates a rising standard of living worldwide. As the standard of living rises, so does demand for a better diet featuring more vegetable oil and meat, milk and eggs. See Table 1 on the next page.

Table 1
World Oilseed Production & Population
Selected Years, 1990 – 2005
Year ending September 30
000 metric tons

Source: Oil World Annual

Year	Production of 10 oilseeds (1)	Soybeans % of all oilseeds	World population in millions
2005 (2)	371,940	57	6,455
2004	329,930	56	6,379
2003	328,250	60	6,302
2002	321,930	57	6,225
2001	311,800	57	6,148
2000	302,280	53	6,070
1995	260,560	53	5,674
1990	213,640	50	5,338
Percent increase 1990 to 2005	74%	97%	21%

NOTES:
(1) Ten oilseeds are: soybeans, cottonseed, peanuts/groundnuts, sunflowerseed, canola/rapeseed, sesameseed, palm kernel, copra, linseed & castorseed
(2) Preliminary

[NOTE: In most cases, metric tons (MT) are the unit of measurement used in this study, in order to coincide with the way that most of the world keeps statistics. A metric ton is 2204.6 pounds, or about 1.1 short tons (T). This also equals about 36.74 bushels of soybeans, which are 60-pound bushels.]

Had world *oilseed* production increased directly with world population increase, production of oilseeds in 2005 would have been 258.3 million MT rather than 371.9 million MT. Actual production exceeded this amount by 44%.

Had world *soybean* production increased directly with world population increase, production of soybeans in 2005 would have been 130 million MT rather than 212 million MT. Actual production exceeded this amount by 63%.

These data dramatically demonstrate the ever-increasing role of oilseeds in world food production, especially soybeans, due to the unique qualities of soybean meal as a protein source in animal rations.

The role of the United States

While the oilseed industry continues to expand rapidly worldwide, the role of the United States has diminished over the past 15 years in both oilseed production and processing. See Table 2.

Table 2
Oilseed Production & Processing, World & USA
1990, 1995, 2000 – 2005
Year ending September 30
000 metric tons

Source: Oil World Annual

	Oilseed Production			Oilseed Processing		
Year	World	USA	USA %	World	USA	USA %
2005 (1)	371,940	96,371	26	302,864	49,876	16
2004	329,930	76,394	23	284,896	45,613	16
2003	328,250	83,860	26	275,146	47,830	17
2002	321,930	89,637	28	271,038	50,657	19
2001	311,800	84,794	27	260,106	49,406	19
2000	302,280	82,080	27	251,329	48,060	19
1995	260,560	79,264	30	252,720	44,320	18
1990	213,640	58,826	28	209,450	na	na

NOTE:
(1) Preliminary

While oilseed crush in the rest of the world increased by 50 million MT (25%) between 2000 and 2005, oilseed crush in the United States was virtually flat during that period.

Soybeans are by far the dominant oilseed grown and processed in the United States, accounting for 88% of oilseed production during the past five years (compared with 57% worldwide).

Although the U.S. continues to lead the world in soybean production and processing, those leads are declining. The United States' share of world soybean production has declined from 50% in 1995 to 40% in 2005. The United States' share of world soybean crush has declined from 35% to 26% during the same period.

The primary shift in world soybean production has been from the United States to South America. Table 3 on the next page shows the dramatic increase in soybean production in Argentina and Brazil during the past decade.

Table 3
Soybean Production by Selected Countries
1995 and 2005
Year ending September 30
000 metric tons

Source: Oil World Annual

Country	2005	1995	% increase	% of world 2005	% of world 1995
USA	85,485	68,494	25	40	50
Brazil	50,195	26,068	93	24	19
Argentina	38,700	12,500	210	18	9
China	17,600	15,200	16	8	11
India	5,300	3,150	68	2	2
Rest of world	14,728	11,529	28	7	8
World total	212,008	136,941	55	100	100

Table 4 demonstrates the changing pattern in soybean processing worldwide.

Table 4
Soybeans Processed by Selected Countries
1995 and 2005
Year ending September 30
000 metric tons

Source: Oil World Annual

Country	2005	1995	% increase	% of world 2005	% of world 1995
United States	45,580	38,280	19	26	35
Brazil	29,870	20,190	48	17	18
China	29,700	7,800	281	17	7
Argentina	26,770	8,690	208	15	8
India	4,500	2,640	70	3	2
EU 15	14.350	14,940	- 4	8	14
Rest of world	26,180	17,610	49	15	16
Total	176,950	110,150	61	100	100

Table 4 clearly demonstrates the greatly increased share of worldwide soybean processing by China and Argentina over the past decade. However, the two countries' purposes in becoming large processors of soybean are quite different.

In the case of **China**, the increase in soybean processing is to meet the country's own rapidly growing demand for soybean meal and edible oil.

Ten years ago China processed 7.8 million MT of soybeans and used 6.4 million MT for food, feed and seed. Of the 14.2 million MT of soybeans consumed by China in 1995, all were produced domestically and China was a net exporter of 0.3 million MT of soybeans.

China produced 76% of its edible oils and fats and 103% of its protein meals in 1995, i.e. China was a net exporter of protein meals, primarily soybean meal (900,000 MT).

Five years ago China processed 16.9 million MT of soybeans (an increase of 116% during five years) and used 7.7 million MT for food, feed and seed. Of the 24.6 million MT of soybeans consumed by China in 2000, 62% were produced domestically with the remaining 38% being imported.

China produced 85% of its edible oils and fats and 99% of its protein meals in 2000. (China was a net importer of 612,000 MT of protein meals in 2000; this included 1,120,000 MT of fishmeal imports, 634,000 MT of soybean meal imports and 998,000 MT of rapeseed meal exports.)

In 2005 China will process 29.7 million MT of soybeans (an increase of 76% during five years and 281% during ten years) and use 9.4 million MT for food, feed and seed. Of the 39.1 million MT of soybeans that will be consumed by China in 2005, 45% will be produced domestically with the remaining 55% being imported.

China will produce 71% of its edible oils and fats and 100% of its **protein meals** in 2005. (China will import and export about 1.3 million MT of protein meals in 2005, with the primary imported meal being fish meal at 1.1 million MT and the primary exported meal being soybean meal at 880,000 MT.)

The situation in China is summarized in Table 5 on the next page.

Table 5
Soybean, Fats & Oils & Protein Meal Consumption in China
1995, 2000 & 2005
Year ending September 30
000 MT

Source: Oil World Annual

	2005	2000	1995
Soybeans			
Consumption	39,100	24,600	14,200
Imports	21,500	9,300	- 0.300
Percent Imported	55%	38%	na
Fats & oils consumption			
Percent produced domestically	71%	85%	76%
Protein meal consumption			
Percent produced domestically	100%	99%	103%

In the case of **Argentina**, the increase in soybean processing is related to a greatly expanded production of soybeans, the products from which have become a significant earner of foreign exchange for the country. Export duty structure favors processing beans within the country and exporting the products, i.e. the value is added within Argentina.

Ten years ago Argentina produced 12.5 million MT of soybeans, processed 8.7 million MT or 70% of the crop and used 0.5 million MT for food, feed and seed. Argentina was an exporter of 2.5 million MT of soybeans, or 20% of the crop.

Argentina exported 97% of the soybean oil that it produced in 1995 and 93% of the soybean meal.

Therefore, even ten years ago Argentina had established itself as a large soybean producer that processed most of its crop and then in turn exported most of the products. However, the size of Argentina's role in supplying the world with soybean oil and soybean meal was nowhere near the size that it has become today.

Five years ago Argentina produced 21.2 million MT of soybeans (an increase of 70% in five years), processed 16.5 million MT (78% of the crop) and used 0.8 million MT for food, feed and seed. Argentina was an exporter of 4.1 million MT of soybeans, or 19% of the crop.

Argentina exported 93% of the soybean oil that it produced in 2000 and 98% of the soybean meal.

Even with crush increasing by 77% during the five years exports of both oil and meal kept pace, i.e. Argentina continued to establish itself as a primary supplier of soybean oil and soybean meal to the world.

In 2005 Argentina produced 38.7 million MT of soybeans (an increase of 83% in five years and 210% in ten years). It will process 26.8 million MT (69% of the crop) and use 1.5 million MT for food, feed and seed. Exports will be 9.1 million MT or 24% of the crop.

Argentina will export 93% of the soybean oil that it will produce in 2005 and 97% of the soybean meal--virtually the same percentages as five years earlier even as crush increased by 68%.

The situation in Argentina is summarized in Table 6.

Table 6
Soybean Production, Usage & Product Distribution in Argentina
1995, 2000 & 2005
Year ending September 30
000 MT

Source: Oil World Annual

	2005	2000	1995
Soybeans			
Production	38,700	21,200	12,500
Domestic usage	28,300	17,300	9,200
Exports	9,100	4,100	2,500
Percent exported	24%	19%	20%
Soybean oil production			
Percent exported	93%	93%	97%
Soybean meal production			
Percent exported	97%	98%	93%

Indeed, Argentina will supply 48% of the soybean oil that will trade internationally in 2005, far outdistancing Brazil (28%) and USA (7%).

Argentina will supply 44% of the soybean meal that will trade internationally in 2005; Brazil will supply 32% and USA 12%.

It is informative to compare production and exports of beans, meal and oil among the three big soybean producers, USA, Brazil and Argentina, as summarized in Table 7.

Table 7
Production & Exports of Soybeans, Soybean Meal & Soybean Oil
Argentina, Brazil & USA
2005
Year ending September 30
000 metric tons

Source: Oil World Annual 2005

	Production	Net exports	Percent exported
Soybeans			
Argentina	38,700	9,100	24
Brazil	50,195	18.750	37
USA	85,485	29,945	35
Soybean Oil			
Argentina	5,031	4,700	93
Brazil	5,742	2,692	47
USA	8,600	635	7
Soybean Meal			
Argentina	21,168	20,600	97
Brazil	23,060	15,000	65
USA	36,190	5,680	16

What has made Argentina such a soybean oil and meal exporting powerhouse? Aside from the favorable export duty structure, the direct costs to operate a processing plant in Argentina are the lowest in the world. Huge plants of 8,000 to 10,000 T/day capacity have been built along the Rio de la Plata to take advantage of the abundant supply of raw material, low operating costs and direct loading of oil and meal from the plant to a ship at the plant's loading berth.

There is no question that Argentina has established itself as the primary supplier of soybean meal and soybean oil to the world.

The role of Minnesota

The only oilseed of which Minnesota produces a significant quantity is soybeans. Table 8 on the next page shows major oilseed production in USA and Minnesota.

Table 8
Oilseed Production in the United States & Minnesota
2004
000 metric tons

Source: National Agricultural Statistics Service

Oilseed	USA production	MN production	MN %	MN rank
Soybeans (1)	85,485	6,428	8	3
Cottonseed (2)	7,477	na	na	na
Peanuts (3)	1,933	na	na	na
Oil sunflower (4)	799	15	2	5
Canola (5)	608	22	4	2
Flax (6)	265	1	<1	4
Safflower (7)	80	na	na	na
Total	96,647	6,466	7	na

NOTES:
(1) Number 1 states are IA and IL with 16% each
(2) Number 1 state is CA with 11%
(3) Number 1 state is GA with 43%
(4) Number 1 state is ND with 39%
(5) Number 1 state is ND with 92%
(6) Number 1 state is ND with 39%
(7) Number 1 state is CA with 25%

Not included in this table is non-oil sunflower. National production in 2004 was 130,000 MT with MN producing 10,000 MT or 8% of the crop, which placed it #6 among the states. The #1 state was ND with 37% of the crop.

Soybeans are by far the #1 oilseed crop grown in Minnesota, representing over 99% of the total oilseed crop. Indeed, other oilseeds are falling more and more out of favor with Minnesota growers. The traditional growing area for sunflower, canola and flax, the Northwest Agricultural Statistics District, has seen a switch to soybeans in recent years as new varieties have been developed for extreme northern growing areas. [NOTE: See map on inside front cover of Minnesota's Agricultural Statistics Districts.]

Table 9 on the next page shows acres planted to oilseeds in the Northwest District during the past eight years.

Table 9
Area Planted to Oilseeds in Northwest Agricultural Statistics District
1997 – 2004
000 acres

Source: Minnesota Department of Agriculture

District/Crop	2004	2003	2002	2001	2000	1999	1998	1997
Northwest								
Canola	31.0	46.2	71.2	71.2	128.8	96.4	na	na
Flax	2.1	6.3	4.0	2.9	9.1	11.9	27.9	5.2
Oil SF	20.9	41.8	31.8	22.7	45.6	59.5	78.4	65.3
Soybeans	1,223.0	1,196.4	1,018.0	796.5	953.4	699.8	749.6	492.4
Rest of MN								
Soybeans	6,077.0	6,303.6	6,182.0	6,503.5	6,346.6	6,300.2	6,105.4	6,107.6

NOTE: Acreage statewide in 2005
Canola: 30,000 acres (down from 35,000 acres in 2004)
Flax: 10,000 acres (up from 7,000 acres in 2004)
Oil sunflower: 60,000 acres (up from 30,000 acres in 2004)
Soybeans: 6.8 million acres (down from 7.3 million acres in 2004)

During the 8-year period, soybean acreage increased by 148% in the Northwest District while it was virtually unchanged in the rest of the state. The Northwest District accounted for 17% of soybean acres in Minnesota in 2005 compared with 7% in 1997.

Table 10 on the next page shows the decline in the production of minor oilseeds in Minnesota over the past 20 years compared with the increase in soybean production.

Table 10
Oilseed Production in Minnesota
1985, 1990, 1995, 2000 & 2004
000 metric tons

Source: Minnesota

Oilseed	2004	2000	1995	1990	1985	Peak year
Soybeans	6,428	7,978	6,420	4,883	4,355	2002 (2)
Canola (1)	22	84	na	na	na	1998 (3)
Oil sunflower	15	35	169	52	78	1979 (4)
Flax	1	5	4	6	24	1948 (5)

NOTES:
(1) Statistics not kept until 1997
(2) Peak production was 8,406 thousand MT (309 million bushels)
(3) Peak production was 132 thousand MT
(4) Peak production was 813 thousand MT
(5) Peak production was 485 thousand MT

Projected production in 2005 (soybeans & canola per crop report October 12)

Soybeans	7,773 thousand MT @ 42 bushels/acre (286 million bushels)
Canola	20 thousand MT @ 1500 pounds/acre
Oil sunflower	39 thousand MT @ 1500 pounds/acre
Flax	5 thousand MT @ 20 bushels/acre

Thanks to the opening of two new 3000 T/day soybean processing plants in the fall of 2003 (Cenex Harvest States at Fairmont and Minnesota Soybean Processors at Brewster, to go along with ADM and CHS at Mankato and AGP at Dawson), Minnesota has become the 3rd largest soybean processing state (after Iowa and Illinois) in addition to being the 3rd largest soybean producing state.

The five soybean processing plants in Minnesota have total capacity of 14,875 MT/day, enabling Minnesota to process 60% of its soybean crop, based on operating at capacity for 310 days/year. Both Iowa and Illinois, the top two soybean producing and processing states, have crushing capacity equal to about 75% of the crop. Number 4 producing state Indiana can crush about 60% of its crop; number 5 Ohio about 50% of its crop. Total USA soybean crushing capacity equals about 65% of the crop.

[NOTE: In addition to the five soybean processing plants in Minnesota, ADM operates a 3000 MT/day multiseed plant at Red Wing which processes sunflowerseed and flax.]

Opportunities to Add Value to Oilseeds

The purpose of the 2000 study was to examine a wide range of ways to add value to oilseeds. It was not intended to be an in-depth analysis of any of the possibilities that were examined. The intent was to identify those possibilities that looked positive enough to warrant further study.

The following opportunities were examined in the 2000 study, along with the recommendations made at that time:

- Commodity soybean processing: not recommended
- Identity-preserved (IP) soybean processing: investigate further if a grower's group can be formed that is willing to commit the required time and effort
- Soybean mini-mill: investigate further
- Multiseed processing, including corn germ: investigate further
- NuSun™ sunflower oil: allied with multiseed plant
- Press vegetable oil: allied with mini-mill or multiseed plant
- Derivatives of soybean oil: investigate further
- Soy concentrates and isolates: not recommended
- Soy flour: not recommended
- Isoflavones: investigate further, perhaps with Schouten USA
- Oligosaccharides: not recommended
- Soy-based foods: not recommended, except perhaps soy milk
- Salad dressings and sauces: not recommended
- Biodiesel: not recommended, unless allied with an IP plant or mini-mill
- Industrial uses of soybeans: not recommended, unless allied with an IP plant or mini-mill

Each of these opportunities will now be revisited, including how low linolenic acid soybeans can address the growing health concern over trans fatty acids, and examination of the role and availability of rendered fats and greases and waste oils and fats in the biodiesel industry.

Commodity soybean processing

Commodity soybean processing refers to the basic industry that extracts the oil from the bean using solvent-extraction technology. Both products, the oil and the meal, are commodities, that is, there is no significant difference between one processor's products and those of another processor.

At the time of the 2000 study, both CHS and MnSP had already announced plans to build 2725 MT (3000 T or 100,000 bushel) per day plants in Fairmont and Brewster, respectively. Both were built and both started up in late 2003 (CHS in October; MSBP in December).

As pointed out in the 2000 study, this was too much additional crush capacity for Minnesota to absorb at once even though it brought total crush capacity in Minnesota into line with other large soybean producing states, as measured by the percent of the crop that can be crushed.

There are two main reasons why this is so. One is the geographic position of Minnesota within the soybean crushing industry in the United States. Being located at the northern edge of country means that Minnesota processors must go past other processors when moving products out of the state.

The only non-Minnesota market that Minnesota crushers are closer to than other crushers is north into Canada, and demand for soybean meal and oil is very limited in Canada due to the country's small population, most of which is located far to the east of Minnesota anyway.

There is not enough consumption of oil and meal in Minnesota to allow all the products to be consumed within the state. This is especially a problem with meal, which tends to be a more local market than oil.

The 2000 study pointed out that soybean meal consumption in Minnesota was nearly in balance with the existing industry's meal production capacity. At that time the number of poultry and livestock units in the state indicated soybean meal consumption of about 1.7 million MT/year, with soybean meal production capacity of about 2.2 million MT/year.

During the past five years animal units in Minnesota have changed little. Increases in hog and turkey production have been partially offset by reductions in dairy cattle. Overall soybean meal consumption has increased by only 55,000 MT/year while soybean meal production capacity has increased by 1,267,000 MT.

This means that Minnesota now has the capacity to produce nearly 3.5 million MT/year of soybean meal while consumption by livestock and poultry within the state is only 1.8 million MT/year. The surplus 1.7 million MT/year must find homes outside of the state.

Surplus meal production capacity in the state has increased from 464,000 MT (27% of meal production capacity) five years ago to 1,676,000 MT (94% of meal production capacity) today.

This situation is summarized in Table 11 on the next page.

Table 11
Calculated Soybean Meal Consumption & Soybean Meal Production Capacity in Minnesota, 1999 & 2004
000 metric tons

Source: Minnesota Department of Agriculture

	Calculated SBM consumption (1)	SBM production capacity (2)	SBM production capacity as % of SBM consumption
1999			
Hogs - 9,491,000	969		
Dairy cattle - 545,000	247		
Turkeys - 43,500,000	414		
Broilers - 44,200,000	30		
Layers - 12,240,000	67		
Total 1999	1,727	2,191	127%
2004			
Hogs - 10,143,000	1,035		
Dairy cattle - 463,000	210		
Turkeys - 46,500,000	443		
Broilers - 46,300,000	31		
Layers - 11,310,000	63		
Total 2004	1,782	3,458	194%
2004 as % of 1999	103%	158%	+67%

NOTES:
(1) Based on following:
Hogs: fall pig crop of preceding year plus spring pig crop of year @ 225 pounds/pig
Dairy cattle: average number on farms for year @ 1,000 pounds/head/year
Turkeys: number raised for year @ 21 pounds/bird raised
Broilers: number raised for year @ 1.5 pounds/bird raised
Layers: inventory on December 1 of preceding year @ 12 pounds/year
(2) Based on operating plants at rated capacity 310 days/year with 75% meal yield
1999: Three plants with combined capacity of 9,425 MT/day
2004: Five plants with combined capacity of 14,875 MT/day

The only practical way to consume a significant amount of Minnesota's soybean meal production capacity surplus within the state is more animal units on feed. But Table 11 shows that this is not happening. And even if there were economic justification for large expansion of animal units in Minnesota, it would be a battle to receive the required permits to do so.

The second reason why it is difficult for Minnesota soybean processors to compete for markets outside the state, in addition location, is the fact that Minnesota soybeans are

lower in protein content than those grown in the major soybean producing states from Nebraska to Ohio. Minnesota processors generally guarantee a protein content of 46.5% on hipro (dehulled) soybean meal while the industry standard is 47.5% to 48%.

If 47.5% protein meal can be bought for $225/T, 46.5% protein meal is worth only $220/T. This translates into a difference of about 11 cents/bushel in the margin for the processor…a very significant difference in an industry which measures its margin in cents/bushel.

[NOTE: See the Minnesota Factor section near the end of this study to see how an alliance among the United Soybean Board, seed companies and processors is attempting to address this matter.]

On the oil side, based on average USA annual soybean oil consumption of 60 pounds per capita and a population of 5 million people, Minnesota consumes 136,000 MT of soybean oil per year in the forms of cooking oil, salad oil, margarine, shortening, and food ingredients. The soybean oil production capacity within the state is about 850,000 MT/year.

While the oil side is even more disproportionate than the meal side, the two cannot be compared directly. The market for soybean meal is much more localized than that for soybean oil. Oil is often shipped long distances to the customer and Minnesota soybean oil is no different from other soybean oil, unlike the situation with the lower protein content of Minnesota soybean meal.

In addition, soybean oil must be refined before it becomes an edible product. The ADM plant at Mankato is capable of refining all its crude oil production. The CHS refinery at the Mankato crush plant can refine all the crude oil production from both the Mankato plant and the new Fairmont plant. CHS uses this large refining capacity to serve its Ventura Foods line of vegetable oil products. The MnSP plant at Brewster does not have a refinery but it started up a biodiesel plant this summer that can take up to two-thirds of its oil production. The AGP plant at Dawson has no refinery or biodiesel plant, making it the only processor in Minnesota that does not add value to its oil but must ship it to other refiners as crude oil.

In addition to the generally unfavorable situation in which to add soybean crushing capacity in Minnesota, the timing of the start-ups at Fairmont and Brewster was not good, as the soybean crop in 2003 was down considerably from the record crop of the previous year due to drought conditions during the growing season, from 8.4 million MT (309 million bushels) in 2002 to 6.5 million MT (238 million bushels) in 2003. Things did not improve in 2004, with a crop of only 6.4 million MT (236 million bushels). However, the 2005 soybean crop was forecast to be 7.8 million MT (286 million bushels) in the October 12 crop report.

One processor stated that crushing margins have been “terrible” in Minnesota the past two years due to the small crops and the need to ship soybean meal past existing

processors farther south in order to find homes for all the meal. Gross crushing margins often have been in the 30-35¢ per bushel range; full operating costs exceed this by 20¢ per bushel or more.

In conclusion, Minnesota has excess soybean processing capacity for the foreseeable future. The soybean processing industry is mature in the United States. Countries that formerly were big importers of meal and/or oil are now producing it themselves. The historical trend is that soybean crush moves to where the products are consumed (Argentina being the exception to the rule). This happened in the United States 35 years ago when considerable crushing capacity was built in the Southeast, to serve the large poultry producers there. It has happened in China over the past five years. It is taking place in the Middle East today. Europe crushes 33 million MT/year of oilseeds while producing only 20 million MT. The US has become the residual supplier of soybean oil and meal to the world, meaning that any expansion of the industry within USA must be for the purpose of supplying domestic markets for meal and oil, which also are mature, more or less growing only at the rate of population, which is only 1% per year.

Identity-preserved (IP) soybean processing

The purpose of IP processing is to segregate one or both of the products due to specific traits of the product which make it something other than a commodity. In order to do this a processor must be capable of IPing the beans as well as the desired product(s). This is not always easy to do since most soybean processing plants are configured only for commodity processing, not IP processing.

Special trait soybeans have been under development for at least the past decade. Most of these are genetically modified (GM) to give the soybean the desired trait.

The first such soybean to become commercially available was the herbicide-resistant Roundup Ready™ soybean developed by Monsanto in the mid 1990s. It rapidly gained favor with USA (and Argentine) farmers to the extend that an estimated 87% of the USA soybean crop in 2005 had the Roundup Ready™ characteristic, while 99% of the Argentine crop did. Roundup Ready™ soybeans accounted for an estimated 83% of the Minnesota soybean crop in 2005. [NOTE: Brazil has resisted the switch to Roundup Ready™ soybeans and can't seem to decide what to do about them. One estimate is that a third of the Brazilian soybean crop is now Roundup Ready™.]

Herbicide resistance is an example of an agronomic trait as opposed to a nutritional trait. Many people believe that the products (oil and meal) from GM soybeans are no different from those from non-GM soybeans. Others believe that products from GM soybeans, especially the meal (since the GM trait is detectable only in the meal) could be harmful to animal and/or human health.

The concern over health issues related to GM foods is greatest in Europe and Japan. At least one USA commodity processor, Consolidated Grain and Barge in Mount

Vernon, IN, has been offering non-GM soybean meal to Japanese customers at a premium to non-GM meal for several years. This is an example of IP processing. Although to date special trait soybeans have been predominantly agronomic ones, there also are a number of nutritional trait soybeans under development. The trait can pertain to either the oil or the meal and can be for either animal or human nutritional benefit. On the oil side special traits include low saturated fat, greater resistance to oxidation, greater heat resistance, longer shelf life and biodegradable plastic production. On the meal side they include more complete digestion (and less waste) in animal feeding, cancer and osteoporosis prevention, prevention of meat-borne diseases and reduction in off-flavor in soy-based foods.

An early example of IP processing of a soybean with a special nutritional trait was the LoSat™ (low saturated fat) soybean developed my Pioneer Hi-Bred and processed by Zeeland Farm Services (ZFS) of Zeeland, Michigan. The initial arrangement was that Pioneer Hi-Bred retained ownership of the beans and products and paid ZFS a fee to process the beans in what is known as a toll crush arrangement. However, this proved not be effective, so now LoSat™ beans are grown and processed like any other, with the grower buying the seed at a premium and selling the crop to ZFS at a premium, who processes it and markets the products, receiving a premium for the oil.

IP processing should continue to expand with the development of more and more special trait soybeans. Some existing processors already are doing this and others may follow suit. This also would be a strategy to pursue by any new processors, particularly mini-mills, which by their nature usually are better suited to IP processing than are the large commodity processing plants. See the following section on mini-mills.

A more recent example of IP processing of special nutritional trait soybeans is the low linolenic acid soybean developed by Monsanto.

Linolenic acid is one of the many fatty acids contained in soybean oil. Typically soybean oil contains about 8% linolenic acid. Monsanto has developed, through conventional breeding, a soybean that produces oil with only about 3% linolenic acid content. This gives the oil greater stability and eliminates or reduces the need to hydrogenate the oil to accomplish greater stability. Like saturated fats, hydrogenated oils contain trans fatty acids (trans fats) that can raise the level of LDL (bad) cholesterol and lower the level of HDL (good cholesterol), a major health concern to many Americans. [NOTE: Monsanto has given the name VISTIVE™ to its low linolenic acid soybean. The VISTIVE™ soybean is a Roundup Ready™ variety, so it is not a non-GM soybean, even though the low linolenic acid trait was developed through conventional breeding.]

As of January 1, 2006, listing of trans fat content will be required in nutritional labeling in the United States. The development of low linolenic acid soybean oil will be beneficial in addressing the trans fat labeling issue.

There is little doubt that trans fats have become and will continue to be a health concern. In August a judge approved an $8.5 million educational campaign by McDonald's to settle lawsuits for failing to reduce its use of partially hydrogenated cooking oil. The campaign includes a payment of $7 million to the American Heart Association to educate people about trans fats and $1.5 million to publicize that the company had not followed through on a pledge made in 2002 to switch to more healthful cooking oil.

Recently a Cleveland-area fast food chain opted to use trans fat-free canola oil in all its restaurants, no doubt as a way to promote its food as being more healthful. Others certainly will follow suit as the general public becomes more aware of the health risk posed by trans fats.

VISTIVE™ soybean acreage was small in 2005 but Monstanto expects that acreage will increase to nearly 500,000 acres in 2006. (To put this in perspective, soybean acreage in the United States was 74 million acres.)

In press releases dated August 10, September 6, September 26 and October 6, 2005, Monsanto announced that CHS will contract for up to 40,000 acres of VISTIVE™ soybeans in southern Minnesota and northern Iowa in 2006, ZFS will contract for up to 25,000 acres in Michigan, AGP will contract for up to 150,000 acres in Iowa and Cargill will contract for up to 150,000 acres in Iowa, bringing total contracted acres for 2006 to 356,000, as of this writing.. In all cases, the processor will pay a premium for contracted VISTIVE™ soybeans, and then it will crush and sell the processed soybean oil to food company customers. Presumably the processor will be able to receive a premium for low linolenic acid soybean oil; ZFS confirms that this is indeed the case.

Monsanto stated that similar agreements will be made by Monsanto with other processors in order to reach the nearly 500,000 acres that Monsanto anticipates being planted in 2006.

Pioneer Hi-Bred has been a leader in development of nutritional special trait soybeans. In addition to their LoSat™ soybeans mentioned previously, they also are ready to commercialize low linolenic acid soybeans. They anticipate 200,000 acres in 2006. Since Pioneer Hi-Bred is owned by DuPont, and DuPont is in partnership with Bunge in what they call the Bunge DuPont Biotech Alliance, their program will be different from Monsanto's. Bunge will contract for all the acres and process the soybeans, with the Alliance sharing production costs and profits. Since Bunge has no processing plants near Minnesota, their program will not be a factor here, at least not until the acreage of low linolenic acid soybeans is much larger than it is today.

Pioneer Hi-Bred is working on many other varieties of special nutritional trait soybeans. Many of these are beans in which the special trait resides in the meal, either for improved animal nutrition or nutraceuticals for humans. No doubt these soybeans will be kept under the control of the Bunge-DuPont alliance, which will

incorporate the meal (in the form of soy isolates) into their Solae™ line of soy foods and nutraceutical products.

Soybean mini-mill

This continues to be an intriguing concept. Although the United States commodity soybean processing industry is mature, there still are opportunities for small processors to fill niches for specialty processing that are not of interest to the large processors.

There are a number of operating mini-mills scattered across the country. An example is Thumb Oilseed Producers (TOP) of Ubley, Michigan. TOP is a "new generation" cooperative with a small (125 T/day) expeller plant. The members grow only organic and non-GM soybeans. From them TPO produces Soy Beginnings® brand of non-GM soy oil. The equipment in the plant (extruder/expeller and refinery) are such the oil can be physically refined, that is, it does not require the chemical treatment that is needed to refine soybean oil produced by the conventional solvent extraction process.

TOP also is a partner with Spectrum Foods of Springfield, Illinois, and InstaPro International of Des Moines, Iowa, in a venture called NexSoy, which markets NexSoy™ brand of organic soybean oil. InstaPro International makes the equipment that processes the soybeans and refines the oil; TOP is the processor/refiner and Spectrum Foods is the marketer. [NOTE: Spectrum Foods is not to be confused with Spectrum Organic Products, which recently was acquired by Hain Celestial. See page 30.]

Another expeller plant that has enjoyed considerable success for many years is West Central Soy (WSC) at Ralston, Iowa. WSC can hardly be called a mini-mill today since it has increased its capacity to 1000 T/day over the years. WCS originated as a dairy cooperative producing soybean meal with bypass protein that translates into more milk production than with normal soybean meal in the ration.

WCS's success with bypass protein soybean meal is such that it ships its meal all over the United States (and also exports some) at a premium to normal soybean meal of about $15/T. In fact, WCS's meal is so valuable that it ships none of its meal to its own feed mill next door to the soybean processing plant, but rather buys solvent extracted meal from other processors.

WCS also has been a biodiesel producer for several years. A couple years ago it installed a new biodiesel plant with capacity of 12 million gallons of biodiesel per year, capable of consuming all its soybean oil production. Until recently this was the largest biodiesel plant in the United States.

Key to the success of a mini-mill is making a specialty product that is not produced by the large commodity processors. In the case of some mini-mills this is the oil; in the case of others it is the meal. But at least one of them must be special and command a premium to commodity oil or meal, or the plant will not be able to compete, since the

cost of operating a mini-mill is greater than that to operate a large solvent extraction plant on a per unit basis. In addition, the oil yield from an expeller plant is lower, and oil is the higher-valued of the two products.

Mini-mills do have some advantages over solvent extraction plants, though. Since their capacity is smaller, they do not require as large a capital investment, environmental permitting is easier, operation is simpler and safer and expansion is simpler. Also there is new expeller technology being developed using supercritical CO_2 that has the potential to extract more oil than conventional expellers are able to as well as produce meal/flakes with a higher protein dispensability index (PDI) that is needed in producing soy foods.

Mini-mills also are well-suited to IP process specialty crops that are not produced in great enough volume to attract the large commodity processors.

There is a cooperative, Central Minnesota Soybean Processors (CMSP), centered in Otter Tail County, which is considering building a mini-mill in the Ottertail area. There should be a ready supply of soybeans for the plant, given the increase in soybean production in this part of Minnesota during the past few years.

The question remains whether or not the plant will be able to produce a specialty product and have an adequate market for such a product. There should be assurance that this will be the case before investing in this plant. There is a large market in central and west-central Minnesota for soybean meal due to the large turkey and dairy cattle populations in the region. However, a mini-mill would have a difficult time competing with the commodity processors in Enderlin and Dawson for these markets unless they can develop a premium market for their meal, as WSC has done, primarily serving the dairy industry. [NOTE: Otter Tail County is the #3 dairy county in Minnesota, with 23,800 head as of January 1, 2005. Based on consumption of 1,000 pounds/head/year, annual soybean meal consumption would be 11,900 T. The contiguous counties of Stearns, Morrison, Otter Tail and Todd rank #1, 2, 3 and 7, respectively, in dairy cattle, with total population of 130,100 as of January 1, 2005. This translates into 65,000 T/year of soybean meal consumption…enough to support a 200 T/day expeller plant.]

On the oil side, the plant could pursue a strategy either of being a supplier of “natural” oil, like TOP, or biodiesel production.

Multiseed processing, including corn germ

At the time that the 2000 study was conducted, this appeared to be worth further study. The idea was to locate the plant in west-central Minnesota to be close to the sunflower producing areas of North and South Dakota, the minor oilseed producing area of Minnesota and the Minnesota Corn Processors (MCP) plant at Marshall, which does not have a germ processing plant.

However, things have changed considerably since then. The biggest change is the fact that ADM now owns MCP. ADM has its own corn germ processing plants and would not be a supplier to a multiseed plant that would be in direct competition with its multiseed plant at Enderlin. Corn germ from MCP (up to 100,000 T/year) would have been an important feedstock for the multiseed plant.

In addition, it was assumed that canola production would increase in Minnesota, following the pattern that occurred in North Dakota, where canola acreage increased from 200,000 acres in 1996 to 1.1 million acres in 2000, But this did not happen. Minnesota canola acres declined from 140,000 in 2000 to 30,000 in 2005.

Certainly there is no room for a large new multiseed plant in Minnesota at this time.

NuSun™ sunflower oil

NuSun™ is the trade name for mid oleic acid sunflower oil. NuSun™, like low linolenic acid soybean oil discussed previously, is a non-trans fat oil. It has caught on well since its introduction five years ago or so to the point where the National Sunflower Association estimates that 85% of the oil sunflower crop in 2005 is either high oleic (70% or more oleic acid in the oil) or mid oleic (60-65% oleic acid in the oil), with most of this being mid oleic. The crushers pay a premium for NuSun™ of about 5% over regular oil sunflower.

Production of NuSun™ sunflower oil was seen as a strategy for a multiseed plant in west-central Minnesota to pursue. Since that no longer looks like a viable opportunity, production of NuSun™ sunflower oil in Minnesota has become a moot point at this time.

Press vegetable oil: allied with mini-mill or multiseed plant

Press (or expeller) vegetable oil is marketed by “natural” food companies at a significant premium to solvent extracted oil. The two major players in this market have been Spectrum Organic Products of Petaluma, California, and Hain Celestial of Melville, New York. Neither company has its own vegetable oil production plant but have their oil contract manufactured for them, mainly by expeller plants in California.

Both Spectrum and Hain indicated during discussions with them two years ago that they would entertain the idea of having some of their oil produced somewhere nearer the markets east of the Mississippi River in order to save freight costs…both freight to get the oilseeds to California to be processed and to ship the product back to the eastern half of the United States for distribution.

The 2000 study favored this strategy being pursued by a multiseed plant in west-central Minnesota since the greatest demand is for press canola oil. (The multiseed plant could have segregated its press oil from its solvent extracted oil.) As with NuSun™ sunflower oil, this is now a moot point. However, it would be a strategy for a mini-mill to pursue…either for soybean oil but also for canola oil, if the plant were configured to be a multiseed processor.

As noted previously, in order to prosper a mini-mill must produce a specialty product. This could be bypass soybean meal for the dairy industry or it could be press oil for the natural food companies. If the latter, a long term supply agreement should be reached before proceeding with construction of the plant.

[NOTE: On August 23 Hain and Spectrum announced an agreement to merge under Hain. The transaction is expected to close in November.]

If CMSP proceeds with its plan to build a mini-mill in west-central Minnesota, an alliance with Hain should be investigated. It will be important to do this prior to committing to the type of equipment to put in the plant.

Derivatives of soybean oil

This opportunity was considered to be worthy of further investigation because of the high value of the products which are used in pharmaceuticals (such as phosphatidylcholine and phosphatidylserine) which can be derived from **soy lecithin**, the ready supply of lecithin from the soybean oil refineries at Mankato and the fact that no one was already making the products in Minnesota. In fact, all high concentration (30% purity and higher) phosphatidylcholine and phosphatidylserine used in the United States is imported from Europe. [NOTE: Lecithin is one of the components of the "gums" that are removed from soybean oil during the refining process. Typically lecithin constitutes 2.0 to 2.5 percent of the oil fraction of a soybean. The oil fraction itself constitutes about 19% of a soybean. Thus, lecithin constitutes about 0.4 to 0.5 percent of a soybean—about 4-5 ounces/bushel.]

Lecithin fractionation was studied further and was eventually pursued by SoyMor, a cooperative located in south central Minnesota. Sufficient capital was raised and the plant was built in Glenville, near Albert Lea, adjacent to an already existing dry corn milling ethanol plant, Exol.

The SoyMor lecithin fractionation plant started operating early in 2005 and as of this writing is still fine-tuning the process before going into full scale production.

SoyMor's website states that the company will use only lecithin that has come from soybean oil that was extracted without the use of hexane. It also states that SoyMor will "deoil" the lecithin without using acetone (a supercritical CO_2 process will be used) so as to produce "toxic free" products that SoyMor believes will be command a premium in the market.

One reason SoyMor pursued lecithin fractionation is because the grade of lecithin derivatives it will make are not currently produced by anyone in the United States but are imported from Europe. Thus SoyMor will have a location advantage over its European competitors and will not be competing with domestic producers of the products that it will make.

The business is too new to say whether or not it is likely to succeed. It will be very interesting to follow the company's progress.

Other derivatives of soybean oil include **free fatty acids** (about 2% of the gums) and deodorizer distillate (about 0.7% of the gums). Free fatty acids have very little value and are usually sold as a by-product by the refiner to soap companies.
Deodorizer distillate can be converted to vitamin E, the market for which became (and remains) saturated after ADM and Cargill each built large vitamin E plants. So the processing of deodorizer distillate is not advocated.

Soy concentrates and isolates

Soy concentrates (about 65% protein content) and soy isolates (about 90% protein content) are used primarily as food ingredients. They are made from soy flakes, which are the same thing as soybean meal, except for being desolventized by a method that leaves the flakes with a high protein dispensability index (PDI). This makes the protein useful as a food ingredient.

There already are many producers of soy concentrates and isolates, including all of the "Big Three," ADM, Bunge and Cargill. These companies have moved away from being purely commodity processors and have moved into the area of food ingredients, even to the extend of branding their products. Among the brands are ADM's NutriSoy® line of "100% natural soy protein" and Cargill's Prolisse® soy protein, promoted "for heart health and overall nutrition," a product of Cargill Health & Food Technologies (CH&FT). Recently CH&FT was included in the "Companies to Watch" list of Nutraceuticals World. The Bunge-DuPont alliance product, Solae™ was mentioned previously.

The soy protein business is very competitive. CHS, which produces soy flakes at its processing plant in Mankato, has examined soy isolate production in the past and has decided against it. Rather, it grinds some of its flakes into soy flour and sells the rest to other producers of soy flour, concentrates and isolates.

As in the 2000 study, the soy concentrate/isolate business is not recommended.

Soy flour

As mentioned in the section above, soy flour is another food product that is made from soy flakes. Besides its high-protein nutritional benefit, soy flour also has functional characteristics which make it advantageous to incorporate it into some food products that also use wheat flour, such as bread.

As with soy concentrates and isolates, it is advantageous for a soy flour producer to produce its own soy flakes. In addition to CHS, ADM, Bunge and Cargill also are soy flour producers.

With limited demand for soy flour in Minnesota, it does not appear that there is a need for additional production within the state at this time. If there were, CHS would be in the best position to provide it by expanding their existing soy flour capacity.

Isoflavones

Isoflavones, technically called phytoestrogens, are compounds found in soybeans that have been shown to act like the female hormone, estrogen, in the human body. The primary use of isoflavones is to ease the physical effects of menopause. They also are thought to prevent cardiovascular and bone diseases, such as osteoporosis, and perhaps even some types of cancer.

ADM is the primary producer of isoflavones in the United States, at Decatur, IL. ADM markets its isoflavones under the Novasoy™ label.

Another marketer of isoflavones in the United States is Acatris, a Dutch company within the Royal Shelton Group. Acatris has its American regional sales office in Minneapolis. When the study was done in 2000 the name of the company was Schouten. At that time Schouten's method of operation was to ship soybeans to the Netherlands from the United States or South America where isoflavones were produced from the germ of the soybean and shipped from the Netherlands throughout the world. (It requires 400 units of soybeans to produce one unit of germ; the rest of the soybean can be processed into full fat soybean meal.)

At the time of the last study it was recommended that Schouten (now Acatris) be approached about the possibility of producing some of its isoflavones in Minnesota, thus saving the cost of shipping soybeans all the way to the Netherlands only to have some of the product shipped back to the United States. Schouten expressed interest in at least discussing this concept.

Things have changed since then. Acatris now ships only the soybean germ to their plant in the Netherlands rather than the entire soybean, thus saving a considerable amount of freight, due to the 1:400 ratio of germ to whole soybean mentioned above.

Acatris gets its germ in the United States from a facility in Iowa, the name and precise location of which they were not willing to disclose. However, Acatris did say that this relationship works well because another customer of the facility wants the degermed soybeans, probably for the production of soy milk.

When asked if Acatris might need another soybean degerming facility, in Minnesota, they said that it is not likely, since the growth in demand for isoflavones has slowed considerably since Acatris first got into the business in 1995. (They believe that they were the first in the world to produce soy isoflavones.) They attribute the decline in growth to a parallel decline in the growth of the soy foods industry in general (see the section on soy-based foods) and to conflicting studies as to the efficacy of soy isoflavones in mitigating the effects of menopause and disease prevention.

Acatris has recently pioneered another health product, flax lignan, from the hulls of flax. They have flax dehulled for them at a facility in North Dakota and ship the hulls to the Netherlands to be processed.

Oligosaccharides

As noted in the 2000 study, soy-based oligosaccharides, a subset of inulin, have largely been replaced by inulin derived from chicory root. Food grade inulin is a white powder with a slightly sweet taste—10% of the sweetness of sugar—that is used in fat-free foods to provide flavor and texture. [NOTE: The fat-free foods market itself has declined significantly since these foods were introduced a decade or so ago when low-fat diets were in vogue. Often people adopt low-fat diets in order to lose weight. However, most fat-free foods have at least as many calories as their "fatted" counterparts, since excessive sweeteners are incorporated to enhance flavor.]

Since oligosaccharides derived from soybeans do not contain any quality advantage, they command a low price if marketed as a dietary fiber, of which there are many inexpensive sources. Lacking unique qualities, a dietary fiber can compete only if it can be produced very inexpensively, i.e. the raw material must be very inexpensive and the extraction process must be simple and inexpensive. Oligosaccharides derived from soybeans do not meet these criteria. In addition, soy-based oligosaccharides also have the disadvantage of producing intestinal gas.

Soy-based foods

Soy-based foods have been available in one form or another for a very long time. One of the first soy-based foods was **texturized soy protein** (TSP) which is soy flakes which have been extruded to give the product a fibrous texture. TSP has been used in many forms: small chips flavored like bacon or cheese, hamburger extender, nuggets used in pet foods, patties that are flavored to taste like hamburger or sausage, soy hot dogs, etc. In these uses TSP is known generally as a meat analogue.

Meat analogues have never caught on with the general public since the flavor and "mouth feel" fall short of those of meat. Today meat analogues are used primarily by vegetarians, often in the form of "veggie burgers" that are produced by many companies and sold in venues ranging from restaurants to ball parks to grocery stores and mega-discounters.

Other forms of soy-based foods are **tofu, miso and tempeh**. These have been a mainstay of Far Eastern diets for centuries. These foods have been introduced to the Western diet but have gained a limited following, much as the case with TSP.

Soy-based dairy products and beverages, most notably soy milk, have gained greatly in popularity, especially among younger people. Not only do they appeal to vegetarians (primarily vegans, who shun all animal products, including milk) but also people with lactose intolerance.

Growth in the soy-milk market has been very impressive, from $1.5 million in retail sales in 1980, when the industry was in its infancy, to $216 million in 1998 and $745 in 2004. This represents an annual growth rate of 23% between 1998 and 2004. But growth has begun to decline, with projected sales of $1 billion by 2010. This would represent an annual growth rate of only 5% the rest of the decade.

A recently conducted study on the soy foods industry by SoyaTech of Bar Harbor, ME, entitled "*Soyfoods: The U.S. Market in 2005*," states that the robust growth that the soy foods industry had experienced since its inception appears to have peaked. Overall sales of soy foods in 2004 hit $4 billion, an increase of only 2.1% over the prior year. This followed an average annual growth rate of 11.8% the prior five years and was the slowest growth for the industry as a whole since the early 1980s. In fact, four of the five top categories of soy foods had negative sales growth in 2004. Only soy milk showed a modest increase. (The four categories that showed declining sales were meat alternatives, energy bars, tofu and meal replacements.)

The reasons cited for the decline in growth in the soy foods industry are "…numerous news articles and reports…recently questioning the health benefits of consuming soy-based food products…[and]…boredom by the consumers who regularly eat soy products." In other words, the market is in need of new products to recapture the consumer's interest.

[NOTE: A press released dated October 4, 2005, stated that sales of soy milk and non-dairy beverages (such as soy milk and fruit juice blends) was expanding by over 20% per year in Europe, with sales in 2005 projected to be 600 million euros (about $730 million). So rapid expansion continues in Europe, where the market for soy-based beverages is not as mature as it is in the United States.]

Soynuts are whole soybeans that have been roasted, like other snack nuts. Five years ago the market for soynuts was very small…a total of 6-8 million pounds/year. Most were produced in Minnesota. Dahlgren & Company of Crookston, primarily a confectionary sunflower company, was the #1 producer at 3 million pounds/year. Dahlgren does not have its own brand but produces soynuts for others with brands. Sun Valley Products of Fargo was #2 at 2 million pounds/year. American Import Company (Amport) of Minneapolis was #3 at 1 million pounds/year.

Waymouth Farms of New Hope, MN, markets soynuts under their Good Sense™ label. Their soy nuts were produced for them by Dahlgren or Sun Valley Products. Waymouth Farms stated that soynuts were a new and growing product for them in 2000 and growth has been impressive. Today they offer six choices of roasted soynuts: salted, unsalted, barbecue, hot & spicy, dry roasted and yogurt-coated.

But soynuts are a very small sliver of the roasted nut business. Snack peanut consumption is about 350 million pounds/year or 40 times that of soynuts.

All in all, the climate in the soy foods industry has cooled off substantially while the industry awaits the "next big thing" to renew consumer interest.

Salad dressings and sauces

Vegetable oil is a major ingredient in salad dressings and sauces. Due to its relatively small population, not much of this type of product is produced in Minnesota. Rather, most of it is produced near large metropolitan areas like New York, Chicago and Los Angeles. It is less expensive to ship the ingredients to the place where the finished product is made than it is to ship the finished product long distances, since the packaging also must be shipped. Imagine a railroad tank car of refined soybean oil being shipped from Minnesota to a salad dressing producer in, say, Chicago, with a small portion of the finished product being shipped back to Minnesota via truck, compared with shipping most of the bottled finished product from Minnesota to Chicago. The freight would be far greater in the latter situation.

ADM and CHS have refineries at their soybean processing plants in Mankato. The ADM refinery is sized to fit the crush plant and the CHS refinery is sized to fit the total crushing capacity of their plants in Mankato and Fairmont. This is as far in the "value chain" that ADM goes. CHS goes considerably farther due to its 50% ownership of Ventura Foods, a major producer of margarine (Saffola® and Gold-n-Soft®) shortening, cooking oil, salad dressing (Hidden Valley Original Ranch®), mayonnaise and sauces (LouAna®).

In addition to its various brands, Ventura Foods also produces private label brands for other companies. It also is a major supplier to the food service industry in the forms of large containers and portion cups.

Ventura Foods has 12 manufacturing plants, one of which is in Albert Lea, at the former Miami Margarine plant. The plant produces about one million pounds per day of margarine and shortening for the private label and food service industries.

Could a salad dressing or sauce company in Minnesota carve out a niche as a local provider? This is a question that a food industry analyst would have to answer. However, with the major brand owners already so well established it would require offering the consumer something special aside from the fact that the product was made in Minnesota.

Biodiesel

"Timing is everything…It looks like the time is now for ag-based renewable energy."
— Edgar Olson, AURI Executive Director, Ag Innovation News, Oct-Dec 2005

"For everything there is a season and a time for every matter under heaven."
— Ecclesiastes 3:1, Holy Bible, Revised Standard Version

With petroleum selling for around $65 per barrel and with Minnesota law mandating a minimum incorporation of 2% of biodiesel in all diesel fuel sold at the pump in the state, it appears that the time for biodiesel has arrived.

Biodiesel is the name given to diesel fuel made from vegetable oil or animal fats through a process called transesterification. The oil or fat is combined with methyl alcohol and a catalyst (often sodium methylate) to form biodiesel and glycerin.

Biodiesel has been used for a number of years as a lubricity agent to replace the lubricity in diesel fuel that is lost as sulfur content is reduced in order to comply with environmental laws. Biodiesel also is has a higher cetane rating than petroleum diesel (cetane is to diesel fuel as octane is to gasoline) and it produces lower levels of sulfur and particulate emissions.

For lubricity enhancement purposes, only a very low blend of biodiesel is needed—in the range of 1 part in 400-1,000. In order to play a significant role as a fuel, biodiesel will have to be blended in much higher levels than this.

A blend of 20% biodiesel, called B20, has been promoted as a means to replace significant amounts of petroleum diesel. To date B20 has been used primarily by government fleets in order to meet Alternative Fuel Vehicle requirements mandated by the Energy Policy Act of 1992 (EPAct). In order to qualify, a vehicle must use B20 or higher. [NOTE: Other alternative fuels defined by EPAct are methanol, ethanol (at a blend of 85%, or E85), compressed natural gas, propane, hydrogen, coal-derived liquid fuels, and electricity and biological materials.]

Many municipalities and school districts also use B20 (or higher) in their bus fleets, primarily to be a “good neighbor” by reducing sulfur and particulate emissions.

State mandates could become a new factor in biodiesel consumption. These mandates require that diesel fuel sold within the state contain a certain percent of biodiesel. Minnesota has led the way here. A law passed in 2002 took effect on September 29, 2005, requiring that all diesel fuel sold at the pump within Minnesota contains a minimum 2% blend of biodiesel. The start-ups in August of the Minnesota Soybean Processors (MnSP) biodiesel plant at Brewster, with capacity of 30 million gallons/year, and the SoyMor biodiesel plant at Glenville, with capacity of 25 million gallons/year, pushed Minnesota’s biodiesel production well above the 8 million gallons/year production threshold within the state that the law required in order for the mandate to become effective. (Prior to these two plants starting up, the only biodiesel producer in Minnesota was Farmers Union & Marketing Association—FUMPA—which as a 3 million gallon/year plant at Redwood Falls.)

According to the National Biodiesel Board (NBB), Minnesota is the only state that currently requires biodiesel content for all diesel fuel sold at the pump. Several other states do require state agencies to utilize biodiesel-blended fuels. For example, this summer Illinois passed a law that will require 2% biodiesel incorporation in July 2006

in vehicles operated by state and local governments, school districts, universities, community colleges and mass transit agencies. How many states will follow Minnesota's lead in mandating biodiesel blends in diesel fuel sold at the pump remains to be seen.

Even prior to the recent run-up in the price of petroleum, biodiesel had become more competitive with petroleum diesel by virtue of a federal tax credit for fuel blenders that is worth $1 for each gallon of "first use" agri-biodiesel (such as that made from soybean oil or rendered fats and greases) they blend and 50¢ for each gallon of biodiesel made from waste grease. This tax credit was originally established as part of the American JOBS Creation Act of 2004, which had an expiration date of 2006. This was extended through 2008 by the new energy bill that President Bush signed into law on August 8, 2005.

Another tax incentive for biodiesel production has been the Commodity Credit Corporation Bioenergy Program, which took effect on October 31, 2000. The CCC Bioenergy Program called for $300 million of cash payments to companies that increase their purchases of bioenergy feedstocks (such as soybeans or soybean oil for biodiesel production). However, the importance of this program has waned with diminished funding of only $25 million for the federal fiscal year which ends September 30, 2006, at which time the program is scheduled to end.

State mandates and tax credits certainly have given a boost to the infant biodiesel industry, but what will be more important to the development of the industry will be the forces of the marketplace. When the 2000 study was conducted the price of petroleum was about $35 per barrel. Today it is around $65 per barrel. This brings the price of petroleum and the price of soybean oil much closer together than they were then.

At that time soybean oil was at a very low price—only about 16¢ per pound, which equals $50 per barrel (42 gallons). Today soybean oil is worth about 22¢ per pound. This is also the average price of crude soybean oil, f.o.b. Decatur IL, over the past ten years. This equals $69 per barrel. So the price of soybean oil and petroleum are nearly identical today. What the price relationship will be in the future is anyone's guess but most observers believe that high petroleum prices will be with us indefinitely. (On the other hand, soybean oil was as high as 34¢ per pound—$107 per barrel—as recently as the spring of 2004.)

A good number of biodiesel plants either have been built or have been announced as planned. Not all of those that have been announced as planned will be built, but even if not, one has to wonder if biodiesel production capacity is running too far ahead of demand.

Minnesota is an example. There is now production capacity operating within the state of about 60 million gallons/year. The 2% biodiesel blend mandate that took effect on September 29 will require 16-18 million gallons per year or only 27-30% of active

production capacity. The amount of B20 consumption by state and local fleets will not add significantly to this amount. However, if biodiesel blends become and remain lower in price than neat petroleum diesel, demand could increase significantly. It is too soon to tell if this is likely to happen. [NOTE: If Minnesota biodiesel companies produce 18 million gallons of biodiesel from soybean oil, it would require the oil from about 12 million bushels of soybeans, or 4.2% of the 2005 crop of 286 million bushels, and it would require about 7.5% of the state's crude soybean oil production capacity.]

The original Minnesota legislation called for the mandated blend to increase to 5% at some future date but it was not included in the final version of the law. If this were to be reinstated the demand for biodiesel in Minnesota would jump to 40-45 million gallons/year—still only 75% of current capacity, but a big step toward bringing production capacity and demand into balance. With biodiesel now being price-competitive with petroleum diesel, it should be politically feasible to increase the mandated blend to 5% in the near future. Better yet, market forces themselves could be the impetus to drive biodiesel blend rates beyond the required 2%.

Of course there is nothing restricting Minnesota-produced biodiesel from being sold outside the state. However, there is plenty of biodiesel production capacity either already in place or being planned for the rest of the country.

In June Cargill announced plans to build its first biodiesel plant in the United States, a 37.5 million gallon/year plant at its soybean processing plant in Iowa Falls, IA. Also in Iowa, Western Iowa Energy has a 30 million gallon/year biodiesel plant under construction at Wall Lake. Start-up is planned for the first quarter of 2006. This plant will use soybean oil and animal fat as its feedstocks, with a 70/30 ratio anticipated (70% soybean oil). Four currently active smaller biodiesel plants in Iowa produce another 30 million gallons/year, led by West Central Soy at Ralston, IA, which opened a 12 million gallon/year plant in late 2003. With the start-up of the Cargill and WIE plants next year, Iowa will displace Minnesota as the leading biodiesel producing state in the country, with nearly 100 million gallons/year of capacity.

In April Mid-America Biofuels, a joint venture among ADM and three partners, announced plans to build a 30 million gallon/year biodiesel plant in Mexico, MO, where ADM has a soybean processing plant. While this will be ADM's first biodiesel plant in the United States, they already have an extensive biodiesel business in Europe. And on October 5 ADM announced plans to build a 50 million gallon/year biodiesel plant at its canola processing plant in Velva, ND, using canola oil as the feedstock. Will ADM now jump into the biodiesel industry in the United States in a big way?

History has shown that once ADM and Cargill get into a processing business, they expand their capacity quickly in order to achieve a dominant place in the industry. This happened in the ethanol industry and in the vitamin E industry, in the latter case to the extend that the market collapsed. It also stands to reason that a processor/biodiesel producer will have an advantage over a stand-alone biodiesel

producer similar to the advantage that the processor has over the stand alone refiner. Today almost all soybean oil is refined by the processors, with the processor/refiner (like ADM and CHS at Mankato and SDSP at Volva, SD) having replaced the stand alone refiners—companies like Procter & Gamble, Kraft and Hunt-Wesson—who no longer do their own refining, but have it done for them by the processor/refiners, while they concentrate on marketing and distribution of their branded products.

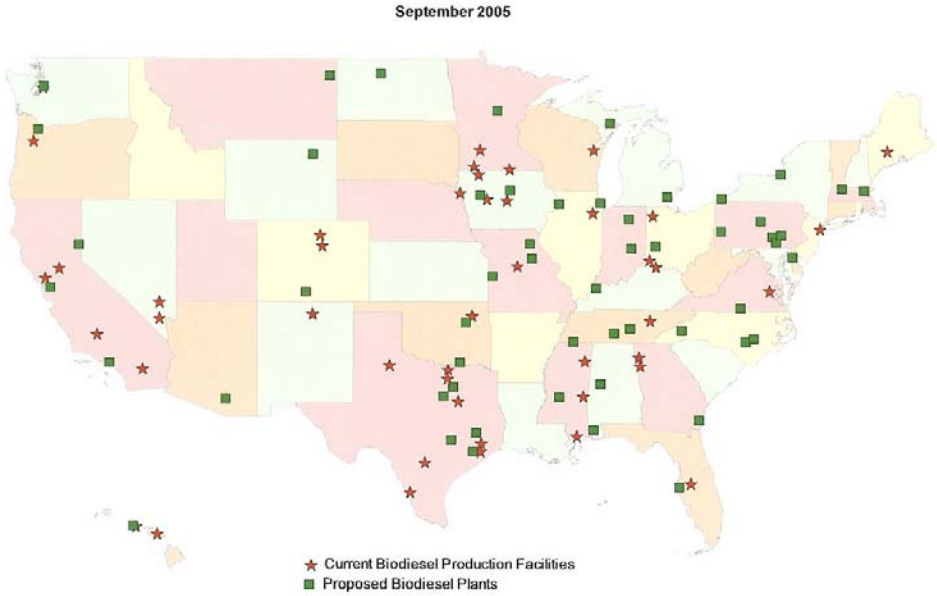
Looking at the nation as a whole, NBB lists 45 currently operating biodiesel plants and pegs current operating capacity at **dedicated biodiesel plants** (those plants that make only biodiesel) at **180 million gallons/year**. Capacity at **oleo chemical plants** (those that make products other than biodiesel alone) is pegged at **110 million gallons/year**.

NBB also lists **54 proposed dedicated** biodiesel plants that are not yet operating. These plants can be in anywhere from the equity-drive to the under-construction stage in their development. If all these plants are built (they won't be), NBB estimates that the total capacity of **dedicated** biodiesel plants (those currently operating plus the 54 proposed plants) would reach **570 million gallons/year,** not including the recently announced 50 million gallon/year ADM plant at Velva, ND.

NBB estimates that by May 2006 there will be another 100 million gallons/year of capacity on line at dedicated biodiesel plants. This would push capacity to 280 million gallons/year at dedicated plants, aside from the potential capacity at oleo chemical plants.

NBB's map and list of current and proposed biodiesel plants are shown on the following three pages.

Current and Proposed Biodiesel Production Plants



Company	City	State	Status
Alabama Biodiesel Corporation	Moundville	AL	Proposed
EarthFirst Americas	Mobile	AL	Proposed
Grecycle Arizona, LLC	Tucson	AZ	Proposed
American Bio-Fuels LLC	Bakersfield	CA	Active
Baker Commodities	Las Angeles	CA	Proposed
Bay Biodiesel, LLC	Martinez	CA	Proposed
Bio-Energy Systems, LLC	Vallejo	CA	Active
Imperial Western Products	Coachella	CA	Active
Procter and Gamble	Sacramento	CA	Active
Simple Fuels LLC	Vinton	CA	Proposed
Bio Energy of Colorado	Denver	CO	Active
Blue Sun Biodiesel	Alamosa	CO	Proposed
Rocky Mountain Biodiesel Industries	Berthoud	CO	Active
Mid-Atlantic Biodiesel	Clayton	DE	Proposed
Purada Processing, LLC	Lakeland	FL	Active
Renewable Energy System	Pinellas Park	FL	Proposed
Biomass Energy Services	Brunswick	GA	Proposed
Peach State Labs	Rome	GA	Active
US Biofuels Inc.	Rome	GA	Active
Baker Commodities	Honolulu	HI	Proposed
Pacific Biodiesel	Kahului	HI	Active
Pacific Biodiesel	Honolulu	HI	Active

Source: National Biodiesel Board

Company	City	State	Status
Ag Processing, Inc	Sergeant Bluff	IA	Active
Cargill	Iowa Falls	IA	Proposed
Clinton County BioEnergy	Clinton	IA	Proposed
Mid-States Biodiesel	Nevada	IA	Active
Soy Solutions	Milford	IA	Active
West Central	Ralston	IA	Active
Western Iowa Energy	Wall Lake	IA	Proposed
Chicago Biodiesel	Chicago	IL	Proposed
Stepan Company	Millsdale	IL	Active
Integrity Biofuels	Morristown	IN	Proposed
Louis Dreyfus	Claypool	IN	Proposed
Griffin Industries	Butler	KY	Active
Union County Biodiesel Company, LLC	Morganfield	KY	Proposed
Baker Commodities	Billerica	MA	Proposed
Northeast Biodiesel Co.	Greenfield	MA	Proposed
Bean Commercial Grease	Belgrade	ME	Active
Ag Solutions	Gladstone	MI	Proposed
Michigan Biofuels, LLC	Belleville	MI	Proposed
FUMPA BioFuels	Redwood Falls	MN	Active
Green Range Renewable Energy	Ironton	MN	Proposed
Minnesota Soybean Processors	Brewster	MN	Active
Soymor	Glenville	MN	Active
Mid America Biofuels	Mexico	MO	Proposed
Missouri Better Bean	Bunceton	MO	Active
Missouri Biofuels	Bethel	MO	Proposed
Prairie Pride	Butler	MO	Proposed
Biodiesel of Mississippi, Inc.	Nettleton	MS	Active
Channel Chemical Corporation	Gulfport	MS	Active
Earth Biofuels	Meridan	MS	Active
Earth Biofuels, Inc.	Jackson	MS	Proposed
Sustainable Systems, LLC	Culbertson	MT	Proposed
Atlantic Bioenergy LLC	Mount Olive	NC	Proposed
Blue Ridge Biofuels	Ashville	NC	Proposed
Filter Specialty Bioenergy LLC	Autryville	NC	Proposed
North Dakota Biodiesel, Inc	Minot	ND	Proposed
Earthship Biodiesel, LLC	Taos	NM	Active
Biodiesel Industries	Las Vegas	NV	Active
Biodiesel of Las Vegas	Las Vegas	NV	Active
Environmental Alternatives	Brooklyn	NY	Active
NextGen Fuel, Inc	Fulton	NY	Proposed
American Ag Fuels, LLC	Defiance	OH	Active
Jatrodiesel Inc.	Dayton	OH	Proposed
Peter Cremer (TRI-NI)	Cincinnati	OH	Active
Best Energy Solutions, LLC	Tulsa	OK	Proposed

Source: National Biodiesel Board

Company	City	State	Status
Earth Biofuels, Inc.	Durant	OK	Proposed
Green Country Biodiesel, Inc	Claremore	OK	Active
SeQuential Biofuels	Portland	OR	Proposed
SeQuential Biofuels	Salem	OR	Active
Agra Biofuels	Middletown	PA	Proposed
BioPreserve	Erie	PA	Proposed
Duff Science Co.	Howard	PA	Proposed
Keystone BioFuels, Inc.	Shiremanstown	PA	Proposed
Three Rivers Biofuels	Neville Island	PA	Proposed
United Biofuels, Inc.	York	PA	Proposed
Agri-Energy, Inc	Louisburg	TN	Proposed
AMPM Environmental Services	Moscow	TN	Proposed
Biodiesel of Mississippi	McMinnville	TN	Proposed
Blue Sky Biodiesel	Wartburg	TN	Active
Biodiesel Industries of Greater Dallas-Fort Worth	Denton	TX	Active
Central Texas Biofuels	Giddings	TX	Proposed
Corsicana Technologies, Inc.	Corsicana	TX	Active
Huish Detergents	Pasadena	TX	Active
Johann Haltermann, LTD	Houston	TX	Active
New Fuel Company	Dallas	TX	Proposed
NFE Biofuel & Energy, Inc.	Houston	TX	Proposed
Organic Fuels, LLC	Houston	TX	Proposed
Smithfield Biofuels LLC	Cleburne	TX	Proposed
SMS Envirofuels	Poteet	TX	Active
South Texas Blending	Laredo	TX	Active
Sun Cotton Biofuels	Roaring Springs	TX	Active
Texoga Technologies	Oak Ridge	TX	Active
Renroh Environmental Company	South Boston	VA	Proposed
Virginia Biodiesel Refinery	New Kent	VA	Active
Baker Commodities	Seattle	WA	Proposed
Seattle Biodiesel, LLC	Seattle	WA	Active
Renewable Alternatives	Howard	WI	Active
Energy Fuel Dynamics, LLC	Gillette	WY	Proposed

Active plants are those companies that are actively producing biodiesel.

Proposed Plants are those biodiesel companies who are in the process of raising equity, permitting or construction for their facility but are not yet actively producing biodiesel.

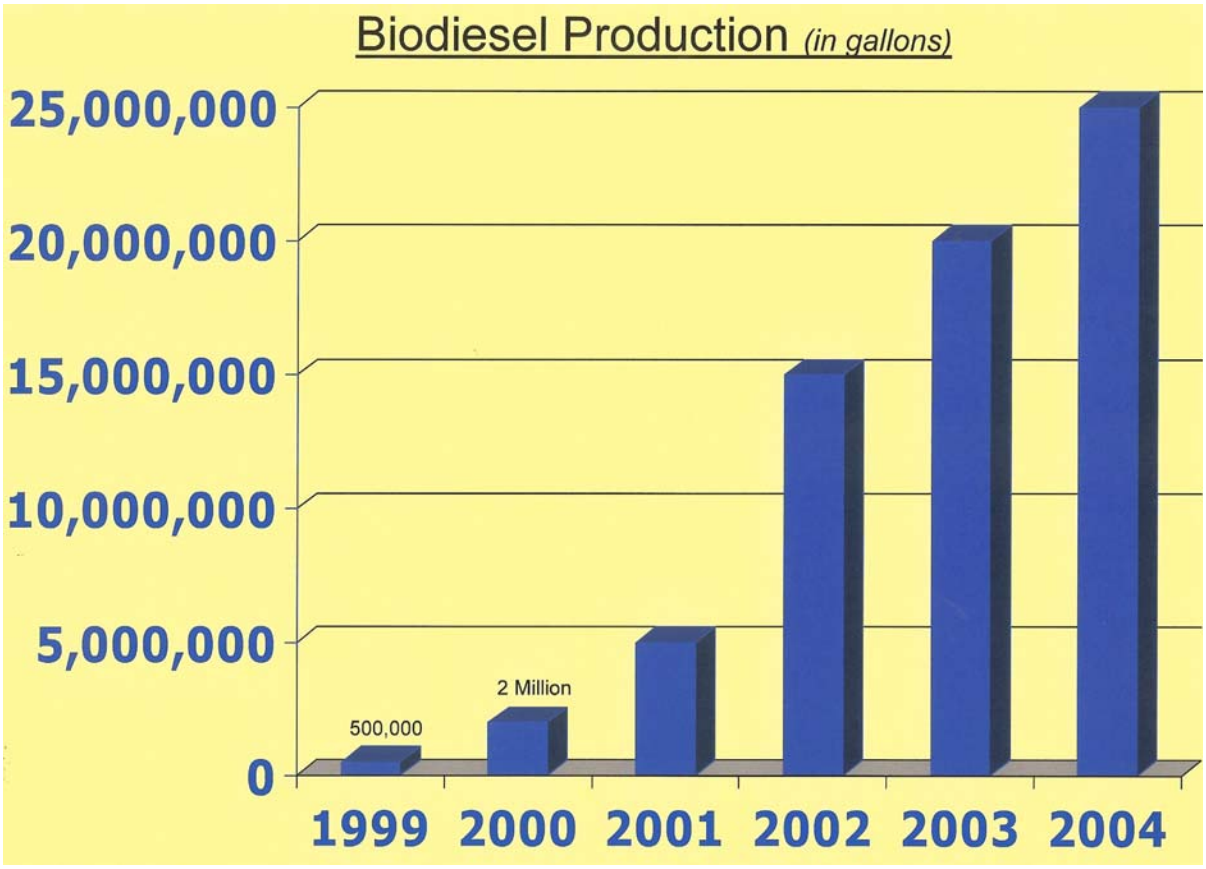
Source: National Biodiesel Board

That's the supply side of the market. What does the demand side look like? Total biodiesel consumption in 2004 was 25 million gallons. This is a 50-fold increase from five years earlier. (See the graph on the following page.) NBB projects consumption in 2005 to have doubled from 2004, to 50 million gallons. While this is impressive growth, it represents only **28% of currently active dedicated biodiesel capacity**.

That is to say, the supply/demand situation for the nation as a whole is virtually identical to that for Minnesota. [NOTE: The U.S. Department of Agriculture estimates biodiesel production in 2005 to be 124 million gallons. This is significantly different from NBB's estimated consumption figure of 50 million gallons in 2005. This could be explained, at least in part, to increases in stocks, as production exceeds consumption. There can be a difference between production and consumption in the short term.]

If biodiesel consumption were to double again in 2006, to 100 million gallons/year, this would be 36% of the dedicated production capacity that NBB projects to be on stream by May, 2006. Such great underutilization of production capacity cannot bode well for profitability within the industry.

One biodiesel producer believes that total U.S. consumption of biodiesel eventually will reach 1 billion gallons/year. This would represent about 2% of total diesel consumption in the country. But that producer believes that it will be several years before consumption reaches this point. In the meantime, it appears that biodiesel production capacity will significantly outpace consumption for at least the next few years. Eventually market forces will bring supply and demand into closer balance, but it could require some "shakeout" in the industry for this to happen if capacity continues to significantly outpace demand.



Source: National Biodiesel Board

If the market for biodiesel in the United States were to reach 1 billion gallons/year, would there be sufficient feedstock to produce it?

If one were to look only at the supply situation with soybean oil, the United States exported 650,000 MT of soybean oil in the year that ended September 30, 2005. In most cases, the export market is a residual market for U.S. soybean processors. If all this oil were redirected to biodiesel production it would produce about 195 million gallons of biodiesel…far short of the amount required.

Could more soybean processing plants be built to produce the additional soybean oil that could be used to make up this shortfall? A soybean processing plant produces four times as much meal as it does oil and the market for soybean meal in the United States is already saturated to the point where the United States exports 4-6 million MT per year (about 15% of its production) even though in most cases the export market is the residual market for soybean meal.

If enough additional soybean processing capacity were built to supply, say, an additional 250 million gallons/year of biodiesel—over and above the 195 million gallons that could be made from the oil that was exported this year, and the amount of "domestic" market oil that is already being used to produce 50 million gallons/year of biodiesel…to bring total biodiesel production from soybean oil up to 500 million gallons/year—it would require 4.5 million MT/year of additional soybean processing capacity. This equals five more crush plants the size of the new ones at Fairmont and Brewster. These plants would produce 3.4 million MT/year of soybean meal.

Where would this meal go? The export market? 3.4 million MT of meal is 60% of the amount that the United States exported in the 2004/05 crop year. More soybean meal from the United States is not needed in the world market. The peak years of U.S. soybean meal exports are behind us. We exported 8.5 million MT in 1997/98 and 5.7 million MT in 2004/05. As shown in Table 7, Argentina (20.6 million MT) and Brazil (15 million MT) have largely displaced the United States as the suppliers to the world soybean meal export/import market of 47 million/MT/year. And additional crushing capacity continues to be built overseas in countries that formerly were large importers of soybean meal.

The domestic market? The United States consumed 36.2 million MT of soybean meal in 2004/05. Consumption over the previous five years averaged 34.8 million MT. Soybean meal consumption in the United States is roughly paralleling population growth, which is about 1% per year. At this rate it would be nine years before the domestic market can absorb another 3.4 million MT of soybean meal. However, during that period it is likely that soybean meal exports from the United States will continue to decline, with this meal being re-directed to meet the slowly increasing domestic demand.

Whether additional soybean processing capacity will be built to provide oil to the biodiesel industry will depend on how fast the biodiesel industry grows. If it grows very slowly to 500 million gallons/year…and then to 1 billion gallons/year…it is possible that some additional soybean processing capacity could be built to fill some of this need. But even in this case it is not likely, due to the situation with the meal. If the biodiesel industry grows quickly, feedstock other than soybean oil will surely be needed.

What might those other feedstocks be? Soybean oil accounts for 81% of vegetable oil production in the United States. The second largest is corn oil, which accounts for 10%. It is too valuable to be used for biodiesel production. The same is true of the #3 oil, cottonseed (4%) and the #5 oil, sunflower (1%—144,000 MT). Production of canola oil (#4—280,000 MT) is too small to make a large contribution to biodiesel feedstock. Nearby Canada is a large producer of canola oil—1.4 million MT in 2005—and a net exporter of 875,000 MT, with the United States accounting for over 500,000 MT. How much of this might be diverted from food use to fuel use is hard to say.

[NOTE: The ADM biodiesel plant at Velva will need about 170,000 MT of canola oil to produce 50 million gallons of biodiesel per year, which is equal to the plant's production capacity. Therefore, ADM will have the potential to direct all of its canola oil production at Velva to biodiesel production rather than for food use.]

There will be competition from Europe for Canadian canola oil as a biodiesel feedstock. Since most Canadian canola is GM varieties, Europe has not been a destination for Canadian canola oil as a food source. However, this is not an issue when canola oil is used as a biodiesel feedstock. German-based oilseed analyst Oil World recently reported that Europe will import 75,000 MT of Canadian canola oil in the 2005/2006 marketing year, of which 50,000 MT already has been purchased and 25,000 MT shipped.

Animal fats and recycled vegetable oils and greases will play an increasingly large role if the biodiesel industry expands fairly quickly. It already has been mentioned the WIE plant in Wall Lake, IA anticipates using 30% animal fat in its feedstock mix. The FUMPA plant in Redwood Falls includes animal fats in its feedstock mix.

According to the National Renders Association, the United States produces about 3 million MT of inedible tallow and greases annually, 900,000 MT of edible tallow, 115,000 MT of lard, and 400,000 MT of poultry fat. Of these amounts, a combined 1.5 million MT, or about a third, are exported. Assuming a biodiesel yield equal to 90% of the yield from soybean oil, these exported fats and greases could produce around 400 million gallons of biodiesel. The 3.0 million MT/year of fats and greases that are consumed domestically (primarily by the feed industry) could produce another 800 million gallons of biodiesel.

So there are enough biodiesel feedstocks to produce 1 billion gallons/year of biodiesel in the United States, if market forces are able to divert enough oils, fats and greases that are currently exported or consumed by the domestic feed industry.

[NOTE: The amount of rendered products made in Minnesota is not known, but if Minnesota produced its "share" based on population, the figure would be less than 2% of the national total of 4.5 million MT, or 90,000 MT. However, the actual figure likely is less than this since the major animal slaughtering/rendering facilities are not located in the Upper Midwest.]

How much waste grease would be available for biodiesel production is anyone's guess. Domestic consumption of all fats and oils in the United States is about 14.5 million MT. Some of this is consumed in home use in the forms of butter, cooking oil, margarine, salad dressing, sauces, soaps and detergents, and cosmetics. It is unlikely that spent home-use fats and oils would be recycled. Large quantities of fats and oils are consumed as a food ingredient. This includes oil consumed as fry oil by the baking, snack food, fast food and restaurant industries. Frito Lay is the largest user of vegetable oil in the world. The fast food and restaurant industry consumes large quantities in the preparation of French fries. Spent oil from food companies and the fast food and restaurant industries goes mainly to the feed industry. As in the case of rendered fats and greases, the biodiesel industry could compete with the feed industry for this tonnage.

Current prices for rendered products range from 16¢/pound for yellow grease to 20¢/pound for tallow, with poultry fat in between. This makes rendered products about 10-20% cheaper than soybean oil but the biodiesel yield is about 10% less.

The yield on waste grease is worse yet, perhaps 20% worse than from soybean oil, and the blender's credit is only 50¢/gallon on waste grease rather than $1/gallon for first use agri-biodiesel.

One biodiesel producer stated that they cannot currently make the economics work using waste grease as the feedstock, citing high collection costs as a factor in addition to the poorer yield and lower blender's credit.

One biodiesel producer thinks that eventually 15% biodiesel incorporation is possible. Based on national diesel fuel consumption of 50 billion gallons/year, this would be 7.5 billion gallons of biodiesel. This would require 25 million MT of feedstock (at a biodiesel yield of 98.5%, and the yield is 10% or more less than this when using rendered fats and greases and waste grease as feedstocks). Total fats, oils and rendered fats and greases production in the United States is only 20 million MT/year, most of which is for food use. So it is hard to imagine where 25 million MT of feedstock would come from. This illustrates the point that although biodiesel has a role to play in the fuel industry, it is not going to make a huge dent in petroleum diesel consumption.

This is why one must be cautious when reading comments like the one below:

"By using biodiesel, we can reduce dependency on foreign oil by up to 20 percent."
—California State Senator Roy Ashburn, September 29, 2005, after Governor Arnold Schwarzenegger signed into law a proposal authored by Senator Ashburn that would allow public agencies and utilities to use vehicles that run off of biodiesel and biodiesel blends.

[NOTE: The American Trucking Associations has endorsed a biodiesel blend of up to 5% nationwide as part of a national diesel fuel standard and as a means toward decreasing dependency on foreign oil. This would require upwards of 9-10 million MT of biodiesel feedstocks. Perhaps this could be achieved if virtually all rendered products and waste grease were diverted to biodiesel production, in addition to the amount that could come from soybean and other "first use" vegetable oils.]

[NOTE: Besides its use as a motor fuel, biodiesel also is working its way into the home heating oil business in the Northeast in a 5% blend. One heating oil distributor, Devine Brothers of Norwalk, CT, states that biodiesel-blended home heating oil is now 6-8¢ per gallon cheaper than neat heating oil. Last year about 2% of Devine Brothers' customer base used "bioheat." The figure has risen to 18% this year.]

Industrial uses of soybeans

Soybean oil is used in non-food products such as ink, paints, adhesives, waxes, solvents, cleansers and lubricants. In these applications it is seen as more environmentally friendly than petroleum-based counterparts in addition to being renewable.

Linseed oil was the most common "vehicle" for paints prior to the introduction of latex paints many years ago. It continues to be used in paints and stains today but to a much lesser extent than in its hey day. This is reflected in the Minnesota flax crop being only a fraction of it what it was back then—a mere 1295 MT in 2004 compared with the record crop of 485,000 MT in 1948. (See Table 10.)

Soy oil-based ink has become quite popular. Many companies and organizations that use it make mention of the fact in their printed material to demonstrate their commitment to using a renewable, non-petroleum-based product that also is environmentally friendly and provides a more healthful work environment in print shops. Mallard Ink of St. Anthony produces a small amount of soy oil-based but points out that soy oil-based ink has some functional characteristics that make it less desirable for some printing applications than linseed oil-based ink, which accounts for most of Mallard Ink's production.

At the time of the 2000 study a promising new composite made from soy flour and recycled newsprint was being introduced by Phenix Biocomposites of Mankato. The company had been producing its granite-like composite board, called Environ®, at a

small plant in St. Peter for a few years and had recently commissioned a much larger plant in Mankato. However, the company found itself overextended with its creditors and filed for Chapter 11 bankruptcy protection not long after the 2000 study was done.

Eventually a new ownership group emerged and changed the company name to Environ Biocomposites. Under its new ownership the company has continued to struggle, particularly with its namesake product. It has produced a great deal more of a cheaper, particle-board-like product made from wheat straw called BIOFIBER™, which also had become its primary product back in 2000. Since 2000 it has introduced a new product called Dakota Burl™, a decorative product made from sunflower hulls.

Recently Environ Biocomposites was sold to an investor in California. The closing is expected to occur in November of this year. Hopefully the new ownership will be able to solve the company's financial and marketing problems that have plagued it since the Mankato plant was built in 1999.

A new industrial use of soybean oil is the production of polyol, which can be used as a placement for petroleum-based polyol in the production of polyurethane. SDSP produces polyol under the trade name SoyOl™ which goes into products as diverse as carpet backing and automobile dashboards. Dow Chemical has been a leader in the development of soy-based polyols. At this point this is a small business but the growth potential is good. As with other products made from soybean oil (refined oil and biodiesel), a processor should have an advantage over a manufacturer who must buy his raw material from a processor and transport it to the production site.

The Minnesota Factor

This topic was addressed in the previous study in some detail in an attempt to quantify the disadvantage to the crusher posed by Minnesota soybeans, which are historically lower in protein content than soybeans grown farther south. The calculation worked out to be 11¢ per bushel, which is a very significant amount to a crusher.

Since then the United Soybean Board has launched a program to improve the protein and oil content of northern soybeans. The target is 35% protein and 19% oil. The seed companies have gotten on board and are promoting their varieties that have been shown to give these yields and some of the processors will pay a premium for beans that have come from the recognized varieties.

Beans containing 35% protein, 19% oil and 13% moisture would produce hipro meal with 48.1% protein content, assuming an oil extraction rate of 95% and meal moisture of 12% moisture.

Several processors now have gone to “component pricing” whereby they pay a premium for protein and/or oil content over certain levels or pay a premium for certain varieties of soybeans which have been shown to achieve the 35% protein/19% oil target.

The following programs are known to exist:

Cenex Harvest States at Mankato and Fairmont, MN

Oil %	Premium	Protein %	Premium
19.1	1 cent	35.0	1 cent
19.3	2 cents	35.5	2 cents
19.5	3 cents	36.0	3 cents
19.7	4 cents	36.5	4 cents
19.9	5 cents	37.0	5 cents
20.1	6 cents	37.5	6 cents
20.3+	7 cents	38.0+	7 cents

NOTE: Basis 13% moisture content ; must meet minimums of 18.5 % oil **and** 34.5% protein to receive premium

Source: Cenex Harvest States website

Minnesota Soybean Processors at Brewster, MN

Oil Content %	Premium Per Bushel	Protein Content %	Premium Per Bushel
19.5	$0.05	35.0	$0.05
19.6	$0.06	35.5	$0.06
19.7	$0.07	36.0	$0.07
19.8	$0.08	36.5	$0.08
19.9	$0.09	37.0	$0.09
20.0	$0.10	37.5	$0.10

NOTE: Basis 13% moisture content; must meet minimums of 34.4% protein **and** 18.5% oil content to receive premium

Source: Minnesota Soybean Processors website

South Dakota Soybean Processors at Volga, SD

Oil Content %	Premium Per Bushel	Protein Content %	Premium Per Bushel
19.4	$0.02	34.5	$0.02
19.5	$0.03	35.0	$0.03
19.6	$0.04	35.5	$0.04
19.7	$0.05	36.0	$0.05
19.8	$0.06	36.5	$0.06
19.9	$0.07	37.0	$0.07
20.0	$0.08	37.5	$0.08

NOTE: Basis 13% moisture content; must meet minimums of 34.5% protein **and** 19.4% oil content to receive premium

Source: South Dakota Soybean Processors website

AGP at several sites, including Dawson, MN

Component Premium Schedule

Percent Oil @ As Is Moisture	Premium	Protein Premium 37% or Higher As Is Moisture
19.4 or less	None	None
19.5 to 19.8	2.0 cents	3.0 cents
19.9 to 20.1	3.0 cents	3.0 cents
20.2 to 20.4	4.0 cents	3.0 cents
20.5 to 20.7	5.0 cents	3.0 cents
20.8 to 21.0	6.0 cents	3.0 cents
21.1 and higher	7.0 cents	3.0 cents

* Minimum oil required is 19.5 to receive protein premium
* Premiums adjusted to market conditions
* As is moisture

Source: AGP website

Cargill has a program to pay a 5¢ per bushel premium for up to 5 million bushels of certain specified varieties at its plant in Sioux City, IA, with proof of seed purchase certification from the seed dealer.

The “35/19 initiative” is an example of a growers’ organization, seed companies and processors working together to improve the quality (intrinsic value) of northern soybeans to make them and the meal produced from them more competitive in the marketplace, to the benefit of all parties.

Conclusion

With the start-up of the CHS plant at Fairmont and the MnSP plant at Brewster, Minnesota now has excessive commodity soybean processing capacity and will have for years to come, even though its crush capacity as a percent of the soybean crop is similar to that of other large soybean producing states. This is because its location at the northern edge of the soybean processing area of the country and the lower protein content of the soybeans grown in the area (and the meal produced from those beans) makes it difficult to dispose of the 1.7 million MT/year of meal that cannot be consumed within the state.

Some of the commodity processors in Minnesota may be able to configure their storage space for IP processing in order to process special trait soybeans, such as low linolenic acid beans and other beans that are being developed by the seed companies that have special nutritional traits.

A mini-mill also could IP process special trait soybeans or conventional soybeans (and canola) to produce "press" oil for "natural" food companies such as Hain Celestial. It also could produce bypass protein soybean meal for which some dairy farmers pay a premium of upwards of $15/T over conventional meal. Central Minnesota Soybean Processors (CMSP), a cooperative centered in Otter Tail County, is having a feasibility study conducted to explore the possibility of building a mini-mill.

The multiseed plant that the 2000 study recommended studying further no longer is viable due to the fact that ADM now owns the Minnesota Corn Processors plant in Marshall, corn germ from which was seen as an important feedstock for the plant. Also, canola and oil sunflower production has declined sharply in Minnesota.

Likewise, production of NuSun™ sunflower oil, which was seen as a strategy for a multiseed plant, has become a moot point.

Production of high-value products like phosphatidylcholine and phosphatidylserine, which can be made from soy lecithin, has become a reality with the construction and start-up of the SoyMor lecithin fractionation plant in Glenville. It is too soon to tell if this will be a successful business.

Other by-products from refining soybean oil, free fatty acids and deodorizer distillate, can be used to produce soap stock and vitamin E, respectively. Neither of these products is considered to be worth further investigation due to the low value for soap stock and an oversupply of vitamin E.

Soy concentrates (65% protein content) and soy isolates (90% protein content), which are food and feed ingredients, are most advantageously produced by soy processors that produce soy flakes as the feedstock for these products. The large soybean

processors, ADM, Bunge and Cargill are heavily into the soy concentrate and isolate business to the degree that they have branded their products. CHS produces soy flakes at its processing plant in Mankato and has studied moving into the soy concentrate and/or isolate business but up to this point has decided not to.

Soy flour is another food product that is made from soy flakes. As with soy concentrates and isolates, it is advantageous for a soy flour producer to produce its own soy flakes. ADM, Bunge and Cargill are major soy flour producers. CHS does grind some of its soy flakes into flour. With limited demand for soy flour in Minnesota, it does not appear that there is a need for additional production within the state at this time. If there were, CHS would be in the best position to provide it by expanding its existing soy flour capacity.

Since Acatris, a major isoflavone producer in the Netherlands with its American regional sales office in Minneapolis, no longer ships whole soybeans to their plant there, but now ships only the germ, which is produced for them at a facility in Iowa, they no longer are interested in producing isoflavones in Minnesota. In addition, the market for isoflavones has declined recently due to conflicting studies regarding their health benefit.

Soy-based oligosaccharides have largely been replaced by those from other sources, especially chicory root. Without any qualitative advantage over other sources of dietary fiber, of which there are many inexpensive ones, soy-based oligosaccharides are not a viable business opportunity, especially given that they have the disadvantage of producing intestinal gas.

The rapid growth in the soy food market has peaked, with four of five food categories (meat alternatives, energy bars, tofu and meal replacements) showing negative growth in 2004. Only soy milk showed modest growth. The decline in growth in the soy food industry is attributed to numerous recent articles and reports that question the health benefits of soy foods and to general boredom with the category. The soy food industry is in need of the “next big thing” to give it a needed boost. Until then, soy foods are not seen as a good investment.

ADM and CHS have refineries at Mankato that are capable of refining all the oil produced at their crush plants in Mankato and Fairmont. This oil largely leaves the state in tank cars destined for the dressing and sauce manufacturers near large metropolitan areas, where most salad dressings and sauces are produced, due to freight advantages. This makes Minnesota an unlikely place for salad dressing and sauce production.

With the sharp rise in petroleum prices during the past year, it appears that the time has come for biodiesel. The start-ups of Minnesota’s two largest biodiesel plants, Minnesota Soybean Processors at Brewster and SoyMor at Glenville in August, could hardly have been timed better. However, with announcements of plans for new biodiesel plants seemingly being made every week, there is a risk that production

capacity will run well ahead of demand. Minnesota is a case in point, where the state's three biodiesel plants can produce 60 million gallons/year, while the 2% biodiesel blend state mandate, which took effect on September 29, will require only 18 million gallons/year.

The situation is similar nationally, where there is current demand for only about 25-30% of current production capacity, with production capacity expected to double by the end of 2006. With Minnesota the only state with a "sold at the pump" blend mandate in place at this time, one wonders what the market will be for all this capacity, if it is all built.

If every state were to adopt Minnesota's 2% biodiesel blend mandate, there would be a market for 1 billion gallons/year. Feedstocks other than soybean oil would be needed to produce this much, since all the soybean oil that is exported from the United States would produce only 195 million gallons/year of biodiesel. ADM recently announced that it will build a 50 million gallon/year biodiesel plant at its canola processing plant in Velva, ND. Rendered fats and greases that are currently exported could produce another 400 million gallons. The fats and greases that are consumed domestically (primarily by the feed industry) could produce another 800 million gallons.

So there are enough biodiesel feedstocks to produce 1 billion gallons/year of biodiesel in the United States, if market forces are able to divert enough oils, fats and greases that are currently exported or consumed by the domestic feed industry. But it is unlikely that additional oilseed processing plants would be built primarily to satisfy this demand, since oilseed plants also produce meal, for which the market already is saturated and growing only at the rate of population growth—about 1% per year.

Soy oil-based ink has become quite popular but has some functional characteristics that make it less desirable for some printing applications petroleum or linseed-oil based inks.

Environ Biocomposites of Mankato, the former Phenix Biocomposites, which filed for Chapter 11 bankruptcy protection shortly after the 2000 study was completed, produces a granite-like composite made from soy flour and recycled newsprint. Under its new ownership the company has continued to struggle, particularly with its namesake product, Environ®. It has produced a great deal more of a cheaper, particle-board-like product made from wheat straw called BIOFIBER™. It also has introduced and a new product called Dakota Burl™, a decorative product made from sunflower hulls.

Recently Environ Biocomposites was sold to an investor in California. Hopefully the new ownership will be able to solve the company's financial and marketing problems that have plagued it since the Mankato plant was built in 1999.

It is encouraging that the United Soybean Board, seed companies and processors have teamed up to address the “Minnesota factor,” with a target of producing soybeans in the state that grade minimum 35% protein and 19% oil content. Beans of this quality can produce 48% protein meal, which is the industry standard. If realized, this initiative will make Minnesota soybeans and soybean products more competitive.

People Contacted in Conducting this Study

Name	Company/organization	Area of expertise	Phone number
Laurent Leduc	Acatris	Soy isoflavones	952-920-7700
Paul Mulhollem	ADM	Commodity processing	217-362-8643
Chuck Neece	Central By-Products	Biodiesel/rendered products	507-637-2983
Pam Schubbe	CHS	Soy flour	507-625-7911
Dennis Wendland	CHS	Commodity processing	651-355-6000
Doug Debelak	Consolidated Grain & Barge	IP processing	812-833-3214
Krista McCarthy	Environ Biocomposites	Soy-based building materials	507-388-3434
Mica DeLong	Monsanto	Low linolenic acid soybeans	314-694-2992
Bob Kennedy	Pioneer Hi-Bred	Special trait soybeans	515-270-3200
Rodney Christianson	SDSP	Commodity processing	605-627-6111
Tony Prehm	SoyMor	Lecithin fractionation/biodiesel	507-448-0124
Kate Leavitt	SunOpta	Soy foods/soy milk	952-939-8106
Mark Schmidt	Syngenta	Soy protein/oil improvement	763-593-7189
JoAnn Rutkowski	Thumb Oilseed Producers	Press oil	989-658-2344
Doug Tiffany	University of MN	Biodiesel	612-625-6715
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