Feasibility Research Report for Insuring Corn Stover, Straw and Other Crop Residues

Deliverable 2:Final Feasibility Report

Contract Number: D11PX18877

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Due Date: November 15, 2011

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SECTION I. EXECUTIVE SUMMARY

In the United States, straw and stover are the most common field residues from crops. Straw consists of the dry stalks of cereal plantsafter the grain and chaff are removed. The leaves and stalks of corn, sorghum,and soybean plants left in the field after harvest comprise the stover. The distinction between the two appears to arise because straw is often removed from the field while stover is not as frequently removed. A substantial portion of the energy captured by crop plants remains in the straw or stover after harvest; stored primarily in cellulose, hemicellulose, and lignin.Based on relatively recent technological improvements, biological and chemical processes can be used to convert a fraction of this energy to biofuels.

In this report, the Contractor assesses the feasibility of developing a federally subsidized insurance program for corn stover, straw, and other crop residues harvested as feedstocks for biorefineries. The Contractor sought to identifycrop residue data available from the United States Department of Energy (DOE), the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), USDA Risk Management Agency (RMA), USDA Economic Research Service (ERS), as well as data in the academic literature. The data collection focused on crop residues that are or can be commercially grown in the United States.

Initially, the Contractor sought to develop an understanding of relevant crop speciesand the characteristics of the agricultural sectors producing these crops. This effort included developing an understanding of the literature relevant to residue production with a focus ongathering information about crop residue biofuel feedstocks.The Contractor then reviewed the available government and private data. Finally, after a systematic analysis of the available testimonial and quantitative data, the Contractor organized a report on the feasibility of insuring crop residues under the terms of the Federal Crop Insurance Act (Act).[1]The resulting report is intended to assist RMA in determining if it is feasible and practical to proceed with development of federal crop insurance of crop residues harvested as feedstocks for biorefineries.

Corn, soybeans, wheat, sugarcane, sugarbeets, rice, sorghum, barley, oats, and rye comprise the commodities producing the largest quantities of crop residuesin the United States. Corn stover has been estimated to comprise as much as80 percent of ‗harvestable' field residues,[2] with wheat straw accounting for an additional 10 percent.[3]Although more acreage in the United Statesis planted in soybeans than wheat, it is not considered a good management practice to remove the soybean stover from the field, nor, given its finely fragmented nature following common harvest practices, is it generally practical to do so. Since the vast majority of the harvestable residue is produced by corn and wheat, the major focus of the feasibility research effort was on residues from these two crops, with the other crops considered more generally. However, the basic concepts described for insurability of corn stover and wheat straw are applicable to the remaining crops.

[1]Federal Crop Insurance Act as Amended: Title 7 U.S., Chapter 36, Subchapter 1.
[2]Kadam, K.L., and J.D. McMillan, 2003, Availability of corn stover as a sustainable feedstock for bioethanol production. Bioresource Technology 88:17-25.
[3]Nelson RG. Resource assessment and removal analysis for corn stover andwheat straw in the eastern and midwestern United States: Rainfall and winderosion methodology. *Biomass &Bioenergy* 22, 349–363 (2002).

There are basically four uses for stover, straw, and other crop residues: soil amendment, forage, feed, and biorefinery feedstock. Some straw also is used for animal bedding and as mulch. Left in place, the residues increase soil organic content, recycle minerals removed by the crop to the soil, retain moisture, and serve as a hindrance to erosion. When animals are allowed to graze on the residues, the amount of organic material returned to the acreage decreases somewhat, but the embodied minerals are returned to the soil in a more soluble form. Depending on the grazing habits of the stock usingthe residues for forage, this use of residues canadversely impact erosion control. When a portion of the residues is removed for feed or as a biofuels feedstock, the embodied minerals are removed from the field. Eventually, there are costs associated with replacing these minerals. Furthermore, depending on the structure of the soil it may be necessary to amend the soil organic content (e.g., with manure) after removing residues. Historically, the most common use of harvested residues has been for feed.[4] More recently, removal of residues as a biofuel feedstock has been an option.

While the amount of energy contained in crop residues is enormous, breeding programs have focused on increasing energy stored in the crop itself (e.g., the grain). For ―modern varieties of [the] most intensively-cultivated grain crops,"40 to 60 percent of biomass, and consequently of the captured energy, is embodied in the residue.[5]

The solicitation defines 12 criteria that must be met to establish the feasibility of insuring a crop under the Act. For crop residues, data traditionally used to establish rates and prices for insurance are sparse and collected using inconsistent protocols. Consequently, the development of a stand-alone yield-based policy using historical residue yield data is not feasible. If Adjusted Gross Revenue (AGR) or the Adjusted Gross Revenue – LITE (AGR–Lite) were to be used to manage risk for crop residue harvests, the location of most of the operations producing substantial quantities of crop residues would require the expansioninto states not currently covered under those programs. In addition, many of the operations producing stover have total gross incomes larger than the liability limits available under AGR-Lite. For many operations, the small proportion of income derived from the residues would not allow the residues to be used in calculating a diversity score. Furthermore, on most operations producing crop residues as a biofuel feedstock, the straw or stover would be the only crop not insurable using a yield-based program. Nonetheless, in states where AGR or AGR-Lite are available, straw is an insurable commodity (commodity #0940) and stover could be included under ―other crops" (commodity #0609).

However, as an alternative to AGR and AGR-Lite, an endorsement to the grain crop policies could be developed for much of the crop residue that will initially be used for biorefinery feedstock. There is substantial literature that correlates residue production to the production of the underlying crop. Therefore, the Contractor believes the grain yield data, risk data, and rating can be used as a proxy for insuring the crop residues. There are also data available for pricing residues using cost pricing, feed market pricing,market value (especially for straw in some markets),and energy pricing. If these proxy approaches are acceptable to the Federal Crop Insurance Corporation (FCIC) and RMA, the Contractor believes it is feasible, and would be relatively simple to develop an endorsement to the Coarse Grains and Small Grains Crop

[4]Smil, V. 1999. Crop Residues: Agriculture's Largest Harvest. *BioScience* 49:299-308.
[5]Hay, R.K.M., Harvest index: a review of its use in plant breeding and crop physiology, *Annals of Applied Biology* 126: 197–216.

Provisions to insure the stover and straw from corn and wheat harvested as a biofuel feedstock. To illustrate the potential of this approach, the Contractor presents an outline of the basis for developinginsurance of corn stover, straw, and other crop residues using this approach.

SECTION II. INTRODUCTION

The Statement of Work (SOW) for Project Number D11PX18877 identifies the objectives of the project as ―to obtain analysis and information, determine the feasibility and identify issues related to potentially insuring Corn Stover, Straw, and other Crop Residues as a biofuel feedstock. The contractor shall produce a research report that assesses the likelihood of successfully developing a Corn Stover, Straw and/or other Crop Residues insurance program, identifies important issues about potentially insuring these Crop Residues and recommends the most viable type of insurance plan, if any, that is feasible."[6] This document is the feasibility report in final form required by that SOW.

Crop Residues

Crop residues are generally divided into two categories: field and process residues. Field residues are biological materials normally left in a field after the crop has been harvested. These field residues include stems, roots, leaves, and elements of the fruits (husks, cobs, pods, etc.) that are not part of the harvested crop. Process residues are biological materials remaining after a crop has been converted into another form. Depending on the crop, these process residues can include pulp, peels, husks, seeds, bagasse,[7] and roots. Both field and process residues can be used as soil amendments and in animal feed. Some can be used in manufacturing (e.g., orange peels remaining after juice production can be used to manufacture orange oil, which is used as an industrial solvent).

Language on the ―period of insurance" in the Crop Insurance Act (Act) states, ―Except in the cases of tobacco, potatoes, and sweet potatoes, insurance shall not extend beyond the period during which the insured commodity is in the field. As used in the preceding sentence… the term ‗field' means the environment in which the commodity is produced."[8] This limitation explicitly precludes insurance of process residues without an act of Congress. Consequently, the focus of the remainder of this study is field residues.

Straw and stover are the most common field residues. Straw consists of the dry stalks of cereal plants (e.g., barley, oats, rice, rye and wheat) after the grain and chaff are removed. The leaves and stalks of corn, sorghum,and soybean plants left in the field after harvestcomprise stover.

Cellulosic Ethanol Production

A substantial portion of the energy captured by cropsis embodied in the straw and stover. There are a number of ways this energy can be used by producers. Field residues can be directly grazed by livestock or can be harvestedfor use as fodder. Stover, straw, and other crop residues (e.g., bagasse) can also be incorporated into the soil to increase soil organic content.In addition, field residues havepotential as a biomass feedstock for cellulosic ethanol production.

The crops themselves, as well as crop residues,are examples ofagricultural biomass. Biomass is biological material derived from living, or recently living organisms.[9] Biomass is composed of a

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[6]USDA, RMA, 2011, SOW, Project Number: D11PX18877, page 17.
[7]The fibrous matter left after sugarcane and sorghum stalks are crushed to extract the sugar-bearing juice.
[8] Federal Crop Insurance Act as Amended 7 U.S., Chapter 36, Subchapter 1, Section 1508 (a) (2)
[9]Fossil fuels also have a biological origin, but its origin is much older and the chemicals have been changed by the geological processes involved in the fossilization.

mixture of organic (carbon-based) molecules containing hydrogen and usually including oxygen. Biomass also generally includes molecules containing nitrogen and small quantities of sulfur, phosphorus, and metals. The carbon in biomass is derived from the atmosphere by plants during the process of photosynthesis. Both the carbon and the energy in the biomass cycle through the system. Some of the plantbiomass is convertedinto animal biomass when eaten. Plant material that is not eaten may be broken down by microorganisms or burned.

The U.S. Department of Energy (DOE) defines biomass as organic matter available on a recurring basis,[10] including plants, plant-derived materials, animal manure, and municipal residues. Plant biomass can be derived from agricultural crops, trees, native grasses, and aquatic plants (including single celled algae as well as more complex aquatic plants). Plant biomass is of particular interest because the organic chemicals in plants (carbohydrates, proteins, and lipids) store energy captured during photosynthesis. This energy can subsequently be used by people either by direct combustion (burning) or by conversion to solid, liquid, or gaseous fuels.

The carbohydrate components of plants include simple sugars and starches in the body of the cell, and cellulose,[11] hemicellulose,[12] and lignin[13] in the cell walls. Starches can be converted to sugars through digestion. The sugars, in turn, can be converted to alcohol by the process of fermentation. This is the principal process by which corn grain ethanol (a biofuel) is produced. The byproducts of these processes, distiller‘s dried grains and solubles, are used as animal feed.

Field residues contain relatively little starch. The cellulose, hemicelluloses, and lignin they contain are less easily converted to biofuels than are starches. At the biorefinery, each of these three-cell wall components is extracted separately during the production of biofuels. The hemicellulose is extracted first by hydrolysis, oftenusing dilute mineral acids. The complex hemicellulose chains are broken in this extraction process, releasing simple sugars including xylose and arabinose (both five-carbon sugars), and mannose and galactose (six-carbon sugars). Cellulose is then digested, by micro-organisms or by solutions of commercial enzymes derived from micro-organisms, to produce glucose (the most common six-carbon sugar). The remaining solids, primarily lignin, are often burned at the biorefinery to produce steam, which in turn is used to the generate electricity.

The processes that produce the biomass use energy to create progressively more complicated molecules and structures. The processes that produce biofuels break down these structures and molecules to produce fuels containing a portion of the energy originally stored in the biomass. Biodiesel and ethanol are the two most common biofuels. Inasmuch as biodiesel is not generally produced from crop residues (instead being derived from extracted oils), the focus of the remaining discussion is on so called ―cellulosic" ethanol biofuels.

In the production of cellulosic ethanol biofuels, the next step is to convert the sugars to alcohols or other organic products. Alcohol production is generally accomplished by anaerobic

[10] United States Department Of Energy, 2010, Biomass Energy Data Book: Edition 3,
[11] A linear carbohydrate polymer made of glucose molecules.
[12] A carbohydrate polymer made of a mixture of simple sugars which forms an amorphous and random mass in the cell wall.
[13] A complex cross-linked polymer made of cyclical alcoholic subunits.

fermentation. Fermentation of the five-carbon sugars[14] from the hemicellulose is less efficient than fermentation of the six-carbon sugars.[15]Nonetheless, a substantial portion of the energy in the biomass is converted to energy in the alcohol produced during fermentation. The final biorefinery processes separate the marketable products from the remaining materials (primarily water, undigested macromolecules, fusel alcohols, and unfermented sugars) by distillation.While a number of fuel alcohols are being explored around the world as alternatives, particularly butanol, the vast majority of initial biorefinery activities have focused on ethanol production.Regardless of the fuel produced in the biorefinery, the insurance feasibility analysis remains the same.

Following the Energy Trail
In energy economics, a primary energy source is an energy form required by a sector to generate a supply of energy for human use. So, for example, coal (a fossil fuel) is the ―primary energy" source for coal-fired electrical generation, while the electricity generated is the ―supply of energy for human use." Just as energy from primary sources can be converted to other forms, the secondary energy can in turn be converted to tertiary energy forms (for example, the electricity can be used to produce heat).

For comparison purposes, primary energy production is converted into a common unit (most often British thermal units (BTU)). According to the United States DOE, of the 75.06 quadrillion (75,060,000,000,000,000) BTU of energy produced in the United Statesin 2010, 4.32 quadrillion BTU(5.8 percent) were from biomass(Table 1).

Table 1. 2010 UnitedState Primary Energy Production by Source (quadrillion BTU)

Fossil Fuels	58.54
Nuclear Electricity	8.44
Biomass	4.32
Hydroelectricity	2.51
Wind	0.92
Geothermal Energy	0.21
Solar/Photovoltic Electricity	0.11
Total Primary Energy Production	75.06

Source: U.S. Energy Information Administration, 2011, September 2011 Monthly Energy Review: Table 1.2: Primary Energy Production by Source, http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf, accessed September, 2011.

This represented a 10 percent increase in energy production from biomass over the previous year and a 43 percent increase over the energy produced frombiomass in 2000 (Table 2). Furthermore, the proportion of primary energy coming from biomass increased steadily from 2001 to 2010.

[14] Ferrari, M.D., E. Neirotti,.C. Albornoz, and E. Saucedo, 1992, Ethanol production from eucalyptus wood hemi-cellulose hydrolysate by *Pichia stipitis*, Biotechnology and Bioengineering 40: 753-759.
[15] Gregg, D.J. and J.N. Saddler, 1996, Factors affecting cellulose hydrolysis and the potential of enzyme recycle to enhance the efficiency of an integrated wood to ethanol process, Biotechnology and Bioengineering 51: 375-383; Sun, Y. and J. Cheng, 2002, Hydrolysis of lignocellulosic materials for ethanol production: a review, Bioresource Technology 83: 1-11.

Table 2. United State Biomass Energy Production and Total Primary Production(1975-2010)

Year	Biomass Energy Production (quadrillion BTU)	Total Primary Energy Production (quadrillion BTU)	Proportion from Biomass (percent)
1975	1.50	61.32	2.4
1976	1.71	61.56	2.8
1977	1.84	62.01	3.0
1978	2.04	63.10	3.2
1979	2.15	65.90	3.3
1980	2.48	67.18	3.7
1981	2.60	66.95	3.9
1982	2.66	66.57	4.0
1983	2.90	64.11	4.5
1984	2.97	68.84	4.3
1985	3.02	67.70	4.5
1986	2.93	67.07	4.4
1987	2.87	67.54	4.2
1988	3.02	68.92	4.4
1989	3.16	69.32	4.6
1990	2.74	70.70	3.9
1991	2.78	70.36	4.0
1992	2.93	69.96	4.2
1993	2.91	68.32	4.3
1994	3.03	70.73	4.3
1995	3.10	71.17	4.4
1996	3.16	72.49	4.4
1997	3.11	72.47	4.3
1998	2.93	72.88	4.0
1999	2.97	71.74	4.1
2000	3.01	71.33	4.2
2001	2.62	71.73	3.7
2002	2.71	70.77	3.8
2003	2.81	70.04	4.0
2004	3.00	70.19	4.3
2005	3.10	69.43	4.5
2006	3.23	70.79	4.6
2007	3.49	71.44	4.9
2008	3.87	73.11	5.3
2009	3.92	72.60	5.4
2010	4.32	75.06	5.8

Source: U.S. Energy Administration, 2011, Total Energy: Monthly Energy Review: Table 1.2: Primary Energy Production by Source, http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf, accessed September, 2011.

The DOE defines primary biomassas the biomass produced directly by photosynthesis. Primary biomass ―feedstocks" are primary biomass harvested for conversion to solid, liquid, or gaseous fuels. Primary biomass feedstocks include grains, oilseeds,crop residues (such stover, straw, orchard trimmings, and nut hulls),wood, and forestry wastes. Regardless of the source, the primary energy embodied in a dry unit weight of plant biomass is approximately the same (Table 3). Consequently, the energy industry is not so much concerned with the particular feedstock used as with a ready supply of an appropriate quantity of feedstock.

Table 3. Energy Content*of Biomass Feedstocks

Feedstock	Scientific Name	BTU/lb
Corn Stover	*Zea Mays*	7,697 to 7,967
Sugarcane Bagasse	*Gramineae Saccharum*	8,174 to 8,349
Wheat Straw	*Triticum aestivum*	7,481
Switchgrass	*Robinia pseudoacacia*	7,886 to 8,233
Woody biomass	*Populus, Platanus, Robinia, Eucalyptus*	8,354 to 8,582

* Moisture Free High Heating Value (HHV) determined using ASTM D-2015 procedures.
Source: U.S. Department of Energy, 2006, Biomass Feedstock Composition and Property Database: All Sample Types, All Heat Properties, http://www1.eere.energy.gov/biomass/feedstock_databases.html, accessed September, 2011.

In the United States, wood and wood-derived products account for the greatest use of biomass-derived energy (Table 4). Native logs, chips, pellets, compressed logs, and charcoal are alternate wood-derived energy sources. Energy embodied in waste accounts for an additional 0.4 quadrillion BTU of biomass energy used. Bioenergy is extracted from municipal solid waste, landfill gas, sludge (septic) waste, tires, and agricultural byproducts such as crop residues.[16] Heretofore, most biofuels have been generated from grain feedstocks and oils from oilseeds.

Table 4. 2008 United States Biomass Energy Utilization by Energy Sources and Energy Utilization Sector*(Quadrillion BTU)

	Residential	Commercial	Industrial	Transportation	Electrical Generation		TOTAL
					Commercial	Independent	
Biofuels		0.002	0.544	0.827			1.373
Waste		0.034	0.144		0.018	0.240	0.436
Wood and Wood-derived Fuels	0.420	0.073	1.344		0.029	0.148	2.014
TOTAL BIOMASS	0.420	0.109	2.031	0.827	0.047	0.388	3.822

*Rounding errors are evident in total biomass sums. Note the difference between utilization in this table and production in Table 2.Source: U.S. Energy Information Administration, 2010, Renewable Energy Annual 2008, http://205.254.135.24/cneaf/solar.renewables/page/rea_data/rea.pdf, accessed September, 2011.

16 U.S. Department of the Interior, 2011, The National Atlas of the United States of America, Renewable Energy Sources in the United States, http://nationalatlas.gov/articles/people/a_energy.html, accessed September, 2011.

The federal government does not quantify the biomass energy embodied in food or feed. Although food and feed do supply energy for life processes, these uses are separated from the so-called ‗energy' uses of biomass. Direct combustion is the oldest method of extraction of biomass energy.Conversion to biofuels is a more recent development.

Biofuels
Biofuels include raw biomass, liquid fuels refined from biomass, and biogases (primarily methane). The biomass refined to produce fuel is called the ‗biofuel feedstock.' The Statement of Work for the Combined Synopsis/Solicitation (Solicitation) focuses on the feasibility of insuring feedstocks derived from crop residues. As the Solicitation notes, the ―The biofuels industry could be best described as at an infant stage currently…."[17] This feasibility study is one step toward ‗improving efficiency' of biofuel production, since production of a dependable supply of feedstocks is essential to that efficiency and risk management strategies are essential for the development of a dependable supply of feedstocks.

Primary biomass energy can be converted to biodiesel and alcohol fuels.[18]Biodiesel is made by processing vegetable oils, animal fat, or recycled cooking grease/oil with alcohol and alkaline chemicals. Biodiesel can be used as an additive to fossil diesel fuel to reduce vehicle emissions or in pure form in place of traditional diesel fuel.

Ethanol is an alcohol made by fermenting biomass with high soluble carbohydrate content. The majority of ethanol produced in the United States is made from corn grain. Ethanol is used primarily as a fuel additive to increase octane and decrease carbon monoxide emissions. It can also be used to reduce greenhouse gas emissions on a life-cycle basis since the carbon in the biofuels was recently a constituent of the carbon dioxide captured by the plant during photosynthesis. A limited number of ―flex-fuel" vehicles have engines that can burn fuel with 85 percent ethanol and 15 percent fossil-derived fuels. In this later case, the biofuel becomes the principal energy source for the vehicle with the fossil fuel taking on the role of additive.

From 2005 to 2010, production of biofuels in the United Statesnearly tripled. While most biofuels feedstocks are currently starches, oils, and fats derived from the agricultural sector, whole plants and plant residues are gaining importance as feedstock for cellulosic biofuels.

The DOE Biomass Program began supporting the development of integrated biorefineries using cellulosic biomass in 2007. As of December 2010, there were 6 commercial biorefineries, 12 pilot biorefineries, 9 demonstration biorefineries, and 2 research and development biorefineries supported under this program.

Whilethere are numerous programs exploring ways to convert cellulose to ethanolefficiently, information on the cellulosic feedstocks are quite limited. According to the DOE, ―It would be desirable to include information [in the Biomass Energy Data Book] on the amount and types of crop residues and forest logging, or pulp fiber residues currently being used for energy on a state-by-state basis, but that information is not readily available. There is also no nationwide

[17] Solicitation (page 45).
[18] U.S. Department of the Interior, 2011, The National Atlas of the United States of America, Renewable Energy Sources in the United States, http://nationalatlas.gov/articles/people/a_energy.html, accessed September, 2011.

source of information on woody or herbaceous crops being used for energy since this is occurring only on a very small scale in a few isolated experimental situations."[19]

The Statement of Work states, ―The Energy Policy Act of 2005 required 7.5 billion gallons of renewable fuel to be produced annually by 2012. More recently, Congress passed the Energy Independence and Security Act of 2007 …. The bill specifies that 21 billion gallons, of the 36 billion gallon 2022 target, must be ‗advanced bio-fuels.'" Advanced biofuels must embody no more than 50 percent of the greenhouse gas emissions on a life cycle basisof the gasoline or diesel fuels the advanced biofuel replaces.

Production of cellulosic ethanol, one advanced biofuel, is projected to increase fivefold by 2022. This drastic increase is proportionally higher than that of any other biofuel.[20] Crop residue and woody biomass are the two major feedstocks for the cellulosic biofuel industry.As noted earlier, field crop residues are generally produced in proportion to the production of the underlying crop. In other words, the relationship between the residue produced and the crop produced is relatively constant over a range of yields. Consequently, due to the volume of major commodity crops grown in the United States (Table 5), the amount of stover and straw biomass available from these crops is substantial.

Table 5. 2010 Production of Major U.S. Crops

Crop	Production	Unit
Corn	12,505,675,000	bushels
Soybean	3,329,181,000	bushels
Wheat	2,206,916,000	bushels
Sugarcane	25,663,000	tons
Sugar beet	31,901,000	tons
Rice	243,104,000	hundredweight
Sorghum	345,395,000	bushels
Barley	180,268,000	bushels
Oats	81,190,000	bushels
Rye	7,431,000	bushels
TOTAL	601,465,610	tons

Source: USDA, NASS, 2011, Quickstats 2.0, http://quickstats.nass.usda.gov/, accessed October, 2011.

II.A. Research Approach

In general, the Contractor's research and analysis of the crop residue biofuel feedstock sector was guided by the approach contained in the Contractor's proposal, with a focus on the criteria for feasibility as outlined in the SOW and the language of the Act. The Contractor sought first to develop an understanding of relevant agricultural literature, current economic conditions, available government programs, and characteristics of the industry sectors, including currently available risk management tools. The Contractor then reviewed the available government and

[19] U.S. DOE, 2010, Biomass Energy Data Book: Edition 3, http://cta.ornl.gov/bedb/download.shtml, accessed August, 2011.
[20] US Dept of Energy and US Dept of Agriculture, http://www1.eere.energy.gov/biomass/pdfs/final_billionton_vision_report2.pdf, accessed March 21, 2011

private data. The Contractor gathered information concerning stakeholders' potential interest in federallysubsidized insurance products. Subsequently, the Contractor identified perils and economic risks faced by the producers who might be marketing residues as feedstock for production of biofuels, paying particular attention to stakeholders' most significant risk management concerns and expressed needs. The Contractor gathered information concerning risks associated with the identifiable, insurable perils. The Contractor also sought to understand the applicability of AGR and AGR-Lite product for industry stakeholders. The Contractor then applied RMA's criteria for feasibility to evaluate risk management through insurance of insurable perils. Finally, after a systematic analysis of the available testimonial and quantitative data, the Contractor organized a report on feasibility of insuring crop residues under the terms of the Act.

RMA's criteria for feasibility identify the requirements to establish an appropriate feasibility recommendation for crop insurance development activities in the broadest terms. Section 2.0 of the SOW states:

> *"The Contractor should ensure that the following criteria have been assessed and/or addressed within the development of the insurance program being recommended:*
>
> - *Conform to RMA's enabling legislation, regulations, and procedures that cannot be changed;*
> - *The insured's and their agents must be will to pay the appropriate price for the insurance;*
> - *The insurance product must be effective, meaningful and reflects the actual risks of the producers;*
> - *The perils affecting production must be identified and categorized as insurable and non-insurable;*
> - *Be ratable and operable in an actuarially sound manner;*
> - *Contain underwriting, rating, pricing, loss measurement, and insurance contract terms and conditions;*
> - *There must be an appropriate geographic distribution of production to ensure a sound financial insurance program;*
> - *There must be enough interest for the risk to be spread over an acceptable pool of insureds;*
> - *Customers must not be able to select insurance only when conditions are adverse;*
> - *Moral hazards must be avoidable or controllable;*
> - *There must be no change of beneficial gain; and*
> - *There must be no change in market behavior or market distortions that change the quantity supplied or shift the supply curve."*

This list by itself provides a framework for the evaluation of the feasibility of a proposed insurance product. However, the test of feasibility requires additional context. For this evaluation the additional contextual information is discussed below.

The proposed insurance coverage must conform to RMA's enabling legislation, regulations, and procedures that cannot be changed. The enabling legislation is Title 7, Chapter 36, Subchapter I of the U.S. Code, as amended.[21] Amendment of this code requires an act of Congress. The Regulations and Procedures implementing this Act are the responsibility of the FCIC Board of Directors and USDA RMA. While the Act, as amended by the 2008 Food, Conservation, and Energy Act, requiresresearch activities to ―*evaluatethe effectiveness of risk management tools for the productionof dedicated energy crops, including policies and plansof insurance that—*

> *(i) are based on market prices and yields;*
> *(ii) to the extent that insufficient data exist todevelop a policy based on market prices and yields,evaluate the policies and plans of insurance basedon the use of weather or rainfall indices to protectthe interests of crop producers; and*
> *(iii) provide protection for production or revenuelosses, or both,"*

Crop residues are not ―dedicated energy crops." There are no special elements of the Act to address these residual crops. Consequently, a feasible insurance approach for insurance of crop residues must conform to the terms of the Act or identify required legislative changes. Furthermore, a feasible approach will conform to RMA's existing procedures and regulations or identify changes required for implementation. Subsequently, Congress, the FCIC Board, and RMA would need to decide if the requisite actions were justified.

Producers or their agents must be willing to pay the appropriate price for the insurance. The willingness of producers or their agents to pay will be influenced by the coverage available and the costs associated with the insurance offer. The *prima facia* evidence of producer interest is their behavior with existing available crop insurance. Testimony gathered from stakeholders is also used in analysis of this criterion of feasibility.

The insurance product must be effective, meaningful and reflect the actual risks of the producers. If the risks are identified and appropriately categorized as to insurability (i.e., reflect the actual risks), an effective product will provide insurance that appropriately addresses the frequency and severity of potential losses. The producers' perception of the utility of the insurance and the ability of the insurance to protect the insured from financial failure affect the meaningfulness of the product.

The perils affecting production must be identified and categorized as insurable and non-insurable. The proposed insurance product must address definite causes of loss that can be observed and quantified, and that are insurable under the authorizing legislation. Measurement of the outcomes of the enterprise must be such that the uninsurable portions of reduction in productivity or production-based revenues can be identified and quantified. If this is not possible, then uninsurable losses may be indemnified to the detriment of the taxpayer and the approved insurance provider.

Insurable causes of loss for FCIC programs must meet at least two criteria. First, a cause of loss must have natural (as opposed to man-made) origins. Second, an insurable cause of loss must result in a determinable and measurable amount of loss. A cause of loss that is due to non-natural events can be easily manipulated by an unscrupulous individual (moral and/or morale

[21] See for example http://www.law.cornell.edu/uscode/7/usc_sup_01_7_10_36_20_I.html.

hazard). If the existence of the loss or the amount of the loss cannot be established, there is no manner in which an accurate and fair indemnity can be determined.

The development of crop insurance requires identification of perils, classification of those perils as insurable or non-insurable, and actuarial assessment of the risks associated with those perils. Most crop insurance addresses either production risks, price risks, or the combined outcomes in the form of revenue risks. Changes in production and revenues resulting solely from management decisions are not insurable. However, variations in production or revenue caused by natural events beyond the producer‘s control are potentially insurable, as are changes in revenues resulting from market fluctuations under some accepted approaches.

The insurance product must be ratable and operable in an actuarially sound manner. It must be possible for an actuarially-sound premium rate to be determined. This is fundamentally a question of data availability in terms of quantity of statistically valid observations (non-parametric estimation), of the ability to specify appropriate probability distributions (parametric estimation), or of the quality of non-quantifiable (judgmental) observations. It is secondarily a question of the nature of perils and the ability to associate production and/or revenue data with those perils.

The insurance product must contain underwriting, rating, pricing, loss measurement, and insurance contract terms and conditions. To develop these elements, appropriate management practices (good farming practices) must be defined and required of stakeholders. Appropriate loss controls must be available. Unless controllable losses are managed and excluded from insurance, an insurance program will not have an actuarially-sound basis and will tempt the purchaser to manipulate profits through fraud or deceptive practices.

There must be an appropriate geographic distribution of production to ensure a sound financial insurance program. An appropriate geographic distribution of insurance risk is required to address the need for insurance that is responsible to the taxpayer. This does not mean that each crop/region combination must have an expected loss ratio of 1.00 over some specific number of years. Instead, in the context of the Act, the test of soundness is program-wide. Thus, crop insurance can accept risks that may not be considered insurable under commercial insurance because adequate reinsurance is not available.

There must be enough interest for the risk to be spread over an acceptable pool of insureds. An appropriate pool size is also required to address the need for insurance that is responsible to the taxpayer, since a limited pool could face collective catastrophic loss not protected by the insurance pool funds. A sufficient number of stakeholders, who are not identically affected by perils, must be willing to buy the insurance as part of an overall farm risk management strategy. Without an appropriate pool of insured enterprises, the insurer faces the risk of catastrophic losses. Indemnities in excess of the realized premiums may occur, increasing the subsidy costs to the taxpayer.

Customers must not be able to select insurance only when conditions are adverse. At the time of enrollment the purchaser must be unable to predict the outcome. If the purchaser can predict the outcome at the time of enrollment, not only will adverse selection occur, but purchasers could —farm" the insurance to maximize profits. Only unpredictable outcomes fall into the category of appropriately insurable risks. Predictable outcomes do not include risks, but are characterized by certainty.

Moral hazards must be avoidable or controllable. There must be a clearly defined outcome or phenomenon to be insured and the outcome must be subject to random variation; the variation in outcome must be separable into that part which can or might be manipulated, and that part which cannot be controlled.

There can be no chance of beneficial gain. If an insured individual benefits unduly from participation in the program, that gain introduces the possibility that the insurance would change the status of the insured within the pool of stakeholders. Insurance should be only a vehicle to manage risk; there should be no possibility that indemnity payments will become a fundamental element of the typical income stream.

There must be no unacceptable change in market behavior or unacceptable market distortions in terms of either a change in quantity supplied or shift in the supply curve. The intent of crop insurance is not to manage the market, but to manage risks faced by individual producers. If the insurance unduly increases production, shifts production to new regions, or creates unfair advantages for individual stakeholders or particular production regions, then the market distortions will invalidate the rating developed in a neutral market. This presents a danger to stakeholders, to the market itself, and to the insuring entity. Localized interest in insurance has the potential to affect markets if the local area becomes significantly more productive because of the insurance. If the locality is a small element of the market, such broader market distortion is unlikely.

If these criteria are met, insuring a proposed crop should be feasible, appropriate underwriting should be possible, and development of the program will fulfill both the needs of the stakeholder and the requirements of being responsible to taxpayers and to the industry.

II.B. Data

The Contractor has focused efforts on obtaining available data on crop residues for any purpose, not just for energy, and on the examination of contributions such data might make to the development of insurance for crop residues harvested for energy content. The Contractor was unable to identify any source of data on the amount and types of crop residues currently being used for energy on a state-by-state basis. It appears that biofuel production from crop residues is occurring on a small scale, primarily in experimental, pilot, and demonstrationbiorefineries. The data on production are proprietary and consequently, are not widely reported or aggregated at the state level.

The DOE contracted with Oak Ridge National Laboratory to prepare a document called the Biomass Energy Data Book. Now in its third edition, the Biomass Energy Data Book incorporates DOE Energy Information Administration (EIA) estimates of biomass energy utilization and availability along with data from industry groups. The Biomass Energy Data Book states:

> *"Since most of the biomass resources currently being used for energy are residuals from industrial, agricultural or forestry activities, there is no way to systematically inventory biomass feedstock collection and use and report it in standard units. All biomass resource availability and utilization information available in the literature are estimates, not inventories of actual collection and utilization. Biomass utilization information is derived from biomass energy production data, but relies on assumptions about energy content and conversion efficiencies for each biomass type and conversion technology. Biomass availability data relies on understanding how much of a given biomass type (e.g., corn grain) is produced, alternate demands for that biomass type, economic profitability associated with each of those alternate demands, environmental impacts of collection of the biomass, and other factors such as incentives.... In all cases it should be recognized that estimates are not precise and different assumptions will change the results."*

Such estimates, while relevant to the energy analyses required by the DOE, have little relevance for a crop insurance development effort.

The Contractor also examined data available from the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), USDA Risk Management Agency (RMA), USDA Economic Research Service (ERS) and in academic literature. These agencies and services have substantial data on the production of the underlying crops, but not time-series data on crop residue production. The absence of public and private data series on crop residue production is not surprising. The residue used for forage, feed, or as a soil amendment are generally used on-farm;quantitative data on such uses are rarely collected. The Contractor has identified a variety of sources that quantify the proportion of residue to harvested production for a number of crops (Appendix A). These relationships can be used to estimate some regional patterns of residue production over time and perhaps to infer the effects of perils on residue production. However, it is important to note, these assessments will be estimates based on a steady-state assumption concerning the relationship between the crop yields to the residue production. The Contractor was not able to identify any study that specifically examined the relationship under perilous conditions, much less any study that examined crop residue yields underextremely perilous conditions. For example, the ratio of corn stover to corn grain under normal conditions might be known reasonably well, but the relationship of recoverable stover under extremely wet harvest conditions might be altogether different.In general, it is expected that the volume of recoverable biomass may be somewhat less variable than the net quantity of salable crop produced. Quality issues relevant to grain marketing, or conditions that make grain harvest difficult and reduce net grain yields, have less impact on the volume of biomass produced.

II.C. Congressionally Mandated Biofuel Biomass Feedstock Activities

The Food, Conservation, and Energy Act of 2008 (PublicLaw 110-234, also known as the 2008 Farm Bill) was a $288 billion, five-year agricultural policy bill enactedin June 2008. While the bill continues many elements of the 2002 Farm Bill, it also substantially increases support for the production of cellulosic ethanol. The 2008 Farm Bill creates and funds programs to support production of biomass crops in areas near biomass refineries. It provides matching payments to producers for harvest, transportation, and storage of biomass delivered to these refineries.

Furthermore, the bill provides for loan guarantees for commercial scale cellulosic ethanol biorefineries and funding for grants to support retrofitting existing biorefineries for production using biomass feedstocks.

The bill continues funding for the Biomass Research and Development program:

SEC. 15322. COMPREHENSIVE STUDY OF BIO-FUELS.

(a) Study- The Secretary of the Treasury, in consultation with the Secretary of Agriculture, the Secretary of Energy, and the Administrator of the Environmental Protection Agency, shall enter into an agreement with the National Academy of Sciences to produce an analysis of current scientific findings to determine--

(1) current bio-fuels production, as well as projections for future production,

(2) the maximum amount of bio-fuels production capable in United States forests and farmlands, including the current quantities and character of the feedstocks and including such information as regional forest inventories that are commercially available, used in the production of bio-fuels,

(3) the domestic effects of an increase in bio-fuels production levels, including the effects of such levels on--

(A) the price of fuel,

(B) the price of land in rural and suburban communities,

(C) crop acreage, forest acreage, and other land use,

(D) the environment, due to changes in crop acreage, fertilizer use, runoff, water use, emissions from vehicles utilizing bio-fuels, and other factors,

(E) the price of feed,

(F) the selling price of grain crops and forest products,

(G) exports and imports of grains and forest products,

(H) taxpayers, through cost or savings to commodity crop payments, and

(I) the expansion of refinery capacity,

(4) the ability to convert corn ethanol plants for other uses, such as cellulosic ethanol or bio-diesel,

(5) a comparative analysis of corn ethanol versus other bio-fuels and renewable energy sources, considering cost, energy output, and ease of implementation,

(6) the impact of the tax credit established by this subpart on the regional agricultural and silvicultural capabilities of commercially available forest inventories, and

(7) the need for additional scientific inquiry, and specific areas of interest for future research.

(b) Report- The Secretary of the Treasury shall submit an initial report of the findings of the study required under subsection (a) to Congress not later than 6 months after the date of the enactment of this Act (36 months after such date in the case of the information required by subsection (a)(6)),

and a final report not later than 12 months after such date (42 months after such date in the case of the information required by subsection (a)(6)).

Under Title XII, section 15322, the 2008 Farm Bill calls for research activities addressing federally subsidized insurance for energy crops.Section 522(c) of the Federal Crop Insurance Act (7 U.S.C.1522) is amended—

(11) ENERGY CROP INSURANCE POLICY.—

(A) DEFINITION OF DEDICATED ENERGY CROP.—In thissubsection, the term 'dedicated energy crop' means anannual or perennial crop that—

(i) is grown expressly for the purpose of producinga feedstock for renewable bio-fuel, renewable electricity,or biobased products; and

(ii) is not typically used for food, feed, or fiber.

(B) AUTHORITY.—The Corporation shall offer to enterinto 1 or more contracts with qualified entities to carryout research and development regarding a policy to insurededicated energy crops.

(C) RESEARCH AND DEVELOPMENT.—Research and development described in subparagraph (B) shall evaluatethe effectiveness of risk management tools for the productionof dedicated energy crops, including policies and plansof insurance that—

(i) are based on market prices and yields;

(ii) to the extent that insufficient data exist todevelop a policy based on market prices and yields,evaluate the policies and plans of insurance basedon the use of weather or rainfall indices to protectthe interests of crop producers; and

(iii) provide protection for production or revenuelosses, or both.

While crop residues are not ‗dedicated energy crops' as defined above, this study was initiated by the government at the same time a similar effort was established to address woody biomass grown specifically as an energy crop. The processes for generation of cellulosic ethanol from both crop residues and woody biomass are similar. However, the geographic distribution of these biomass resources and the agronomic practices used to generate the biomass are substantially and substantively different.

II.D. Reporting Requirements

The focus of the research is to provide information about crop residue biofuel feedstock.The report resulting from this researchis intended to assist RMA in determining if it is practical to proceed with development of federal crop insurance of crop residues harvested as feedstocks for biorefineries.The Solicitation requires cropdescriptions to include both the common and scientific names for acrop, its lifecycle, and the parts of the plants to be used for dedicated energy. In addition, the crop descriptions are to include the number of producers, planted acreage, and harvested acreage. In spite of extensive efforts, the Contractor found no data documenting time series for total production, value, yield, or prices of any of the crop residues. Although data are available for the crop from which the residues are derived, because of the limited markets for the residues, it is not possible to extrapolate from the data for the crop to data for the residue in terms of number of producers, planted acreage, or harvested acreage.

Price for residues can be calculated by a variety of approaches including feed value, cost value, market valueand energy pricing.[22] It is also possible to calculate the energy value of the crop residue. Isolated examples of feed value are available and could serve as a basis for establishing a contract price ceiling for the residues. As demand for residues for biofuels feedstocks increases, it is expected that prices will reflect the value of the embodied energy. Abundant data are available to establish the value of fossil fuel energy sources. These can be used as a proxy to establish a contract price ceiling for the residues. Whether the biomass is to be used for feed or biofuel feedstock, the literature tends to focus on farm-gate biomass price estimates of $50 to $60 per dry weight ton.[23]

[22] William Edwards, 2007, Estimating a Value for Corn Stover, http://www.extension.iastate.edu/agdm/crops/pdf/a1-70.pdf, accessed October, 2011.

[23] Brown, T.R., M.M. Wright, and R.C. Brown, 2010, Estimating profi tability of two biochar production scenarios:slow pyrolysis vs fast pyrolysis, Biofuels, Bioproducts and Biorefining 8:54-68, http://onlinelibrary.wiley.com/doi/10.1002/bbb.254/pdf, accessed October, 2010; Gould, K.S., Michigan State University Extension,2011, Corn stover makes excellent beef cow feed, run your numbers, http://www.cattlenetwork.com/cattle-news/Corn-stover-makes-excellent-beef-cow-feed-run-your-numbers-131348478.html, accessed October, 2011.

SECTION III. MAJOR CROP SPECIES

Only a small number ofmajor crop species producesufficientquantities of crop residue biomass for use as feedstock in biorefineries.The Contractor initially consideredthe top ten crops by production (corn, soybeans, wheat, sugarcane, sugarbeets, rice, sorghum, barley, oats, and rye) as potential crop residue sources.Each of these ten crops and the residues produced are briefly described below.

These ten crops comprise a crop grouping that produces the vast majority of crop residues in the United States. Corn accounts for approximately 80 percent of all harvestable crop residues.[24] Wheat accounts for an additional ten percent.[25]Data for most segments of crop residue production are extremely limited and sporadic. Comparison of data among reports is hampered as a result of different data collection methods and analytical procedures.

There are basically four uses for stover, straw, and other crop residues: soil amendment, forage, feed, and biorefinery feedstock. Straw also is used for animal bedding and as mulch. Left in place, the residue increases soil organic content, recycles soil minerals removed by the crop to the soil, and serves as a hindrance to erosion. When animals are allowed to graze on the residues, the amount of organic material returned to the acreage decreases somewhat, but the minerals are returned to the soil in a more soluble form.

Depending on the habits of animals grazing the residues, the use of residues as a fodder may impact erosion. When a portion of the residues are removed for feed, as a biofuels feedstock, or for other purposes, the embodied minerals are removed from the field. Eventually, there are costs associated with replacing these minerals. Furthermore, depending on the structure of the soil it may be necessary to amend the soil organic content (e.g., with manure) after removing residues. Historically, the most common use of harvested residues has been for feed.[26] More recently, removal of residues as a biofuel feedstock has been an option.

While the amount of energy contained in crop residues is enormous, breeding programs have focused on increasing energy stored in the crop itself (e.g., the grain). For ―modern varieties of [the] most intensively-cultivated grain crops,"40 to 60 percent of biomass, and consequently of the captured energy, is embodied in the residue.[27]

Zea mays (Corn or Maize)

Z. mays is an annualmonocot producing a coarse grain borne on ears (a modified branch bearing fruits) that are sheathed in a husk (made of slightly modified leaves). Cornis widely planted for its grain throughout the United States; in 2010, USDA NASS reported production in all 48 contiguous states. More than 82 percent of production took place in the top 10producing states, with 55 percent of the acreage and 62 percent of the production in Iowa, Illinois, Nebraska, Minnesota, and Indiana (Table 6). In areas with substantial production of grazing animals, corn

[24] Kadam, K.L., and J.D. McMillan, 2003, Availability of corn stover as a sustainable feedstock for bioethanol production. Bioresource Technology 88:17-25.
[25]Nelson RG. Resource assessment and removal analysis for corn stover andwheat straw in the eastern and midwestern United States: Rainfall and winderosion methodology. *Biomass &Bioenergy* 22, 349–363 (2002).
[26]Smil, V. 1999. Crop Residues: Agriculture's Largest Harvest. *BioScience* 49:299-308.
[27] Hay, R.K.M., Harvest index: a review of its use in plant breeding and crop physiology, *Annals of Applied Biology* 126: 197–216.

residues are grazed in the field or may be harvested for fodder or bedding. In areas where this is not practical, the residues have traditionally been left in the field to improve soil texture and nutrition.

Table 6. 2010 U.S. Corn Production

State	Yield (Bushels per Harvested Acre)	Acres Planted	Production (Bushels)
Iowa	165	13,400,000	2,153,250,000
Illinois	157	12,600,000	1,946,800,000
Nebraska	166	9,150,000	1,469,100,000
Minnesota	177	7,700,000	1,292,100,000
Indiana	157	5,900,000	898,040,000
Kansas	125	4,850,000	581,250,000
South Dakota	135	4,550,000	569,700,000
Wisconsin	162	3,900,000	502,200,000
Ohio	163	3,450,000	533,010,000
Missouri	123	3,150,000	369,000,000
All Other States		19,542,000	2,191,225,000
Total		88,192,000	12,505,675,000

Source: After USDA, NASS, 2011, QuickStats, http://quickstats.nass.usda.gov/, accessed October, 2011.

Corn field residues are a byproduct of the production of corn. The field residues include the stover and the root system. Both roots and stover include a range of tissues from pithy mesophyll and cortical cells with primarily cellulose and hemicellulose in the cell walls to highly lignified vascular tissues and fibers. Estimates place the proportion of dry biological mass in the corn grain at approximately 50 percent of the total biomass production.[28] Consequently, as much as350 million tons of field crop residues are produced in the United Statesduring the production of corn for grain (Table 7). However, good management practices preclude harvest of approximately 65 to 75 percent of the field residuesin corn production. These must be left in the field to assure necessary soil organic and mineral content. As a result, in the United Statesharvestable production of corn stover allowing a 25 percent harvest would be approximately 87.5 million tons.

[28]PennState, College of Agricultural Sciences, Penn State Extension, 2011, Crop residue production of different crops in rotation, http://extension.psu.edu/agronomy-guide/cm/tables/table-1-1-3, accessed October, 2011.

Table 7. 2010 U.S. Corn Field Residue Production

State	Estimated Total Field Residues (tons)	Harvestable Field Residues (tons)
Iowa	60,291,000	15,072,750
Illinois	54,510,400	13,627,600
Nebraska	41,134,800	10,283,700
Minnesota	36,178,800	9,044,700
Indiana	25,145,120	6,286,280
Kansas	16,275,000	4,068,750
South Dakota	15,951,600	3,987,900
Wisconsin	14,061,600	3,515,400
Ohio	14,924,280	3,731,070
Missouri	10,332,000	2,583,000
All Other States	61,354,300	15,338,575
Total	350,158,900	87,539,725

Source: W&A Research Department after USDA, NASS, 2011, QuickStats corn production data, assuming 50 percentof the biomass is in residueand 50 percentin the grain with 25 percent of the residue harvestable.

The Contractor was not able to identify any time series data on the total or regional production of corn stover or utilization of corn stover as a biofuels feedstock. Most of the biofuels production facilities that use crop residues are either being designed, under construction, or in the earliest stages of production.

A reasonable assumption is that crop residue utilization as a biofuels feedstock will initially be limited to production within 100 miles[29] to 200 miles[30] of the refineries, based on the high relative cost of transporting biomass long distances. Longer distances may be possible where lower cost transportation is available.

Refer to Table 8 for the current locations of cellulosic biorefinery facilities. Processor capacity is increasing as these facilities go online. If motor fuel prices remain high, it is likely successful biorefinerieswill increase their production, and consequently the utilization of feedstocks. The Contractor also expects additional facilities will be developed as the biomass biofuels technologiesare perfected and the economics of energy consumption and pricing increases the demand for biofuels. Heretofore, markets for corn stover were based on its value as an animal feed, as opposed to its value as a feedstock for biofuels production. In spite of this widespread use, the Contractor was unable to find any time-series data on production, utilization, or the value of corn stover. Instead, there is a modest literature from extension offices addressing this historic use of the crop and additional reports identifying the potential of residues used for biofuels as a cash crop.

[29] For residues transported by truck or rail.
[30] For residues transported by barge.

Table 8. DOE-funded Biomass Bioenergy Projects

State	City	Project Name	Conversion Technology
California	Emeryville	Amyris Biotechnologies Inc.	Biochemical
California	Visalia	Logos Technologies	Biochemical
Colorado	Commerce City	ClearFuels Technology	Thermo - Gasification
Florida	Vero Beach	INEOS New Planet Bioenergy LLC	Hybrid
Florida	Fort Myers	Algenol Biofuels Inc	Algae/CO_2
Georgia	Soperton	Rangefuels	Thermo - Gasification
Hawaii	Kapolei	UOP LLC	Thermo - Pyrolysis
Illinois	Decatur	Archer Daniels Midland	Biochemical
Illinois	Des Plaines	Haldor Topsoe Inc.	Thermo - Gasification
Iowa	Emmetsburg	POET	Biochemical
Kansas	Hugoton	Abengoa	Biochemical
Louisiana	Jennings	Verenium	Biochemical
Louisiana	LakeProvidence	Myriant	Biochemical
Maine	OldTown	RSA	Biochemical
Michigan	Kinross	Mascoma	Biochemical
Michigan	Alpena	American Process Inc.	Biochemical
Mississippi	Fulton	Bluefire LLC	Biochemical
Mississippi	Pontotoc	Enerkem	Thermo - Gasification
Missouri	St. Joseph	ICM Inc.	Biochemical
New Mexico	Columbus	Sapphire Energy Inc.	Algae/CO_2
Ohio	Toledo	Renewable Energy Institute International	Thermo - Gasification
Oregon	Boardman	Pacific Ethanol	Biochemical
Oregon	Boardman	ZeaChem Inc.	Hybrid
Pennsylvania	Riverside	Solazyme Inc.	Algae/Sugar
Washington	Ferndale	Lignol	Biochemical
Wisconsin	ParkFalls	Flambeau	Thermo - Gasification
Wisconsin	Wisconsin Rapids	New Page	Thermo - Gasification

Source: U.S. DOE, EEREInformationCenter, 2010, Energy Efficiency & Renewable Energy, Biomass Program, http://www1.eere.energy.gov/biomass/pdfs/ibr_portfolio_overview.pdf, accessed October, 2011.

Glycine max (Soybean)

G. max is an annual leguminous dicot producing beans (i.e., the soybeans) enclosed in pods. Soybeans are widely planted for its fruits and for the benefits to the soil arising from symbiotic nitrogen fixation that occurs in nodules formed on the roots of the plants. USDA NASS reports production in 31 states. More than 80 percent of production took place in the top 10 producing states, with 48 percent of the acreage and 53 percent of the production in Iowa, Illinois, Minnesota, Indiana,and Missouri(Table 9). In areas with substantial production of grazing animals, soybean residues can be grazed in the field. However, inasmuch as the soybeans are used in the rotation to improve soil nitrogen content, grazing of soybean residues is far less common than grazing of corn stover and grain straw. Soybean residues have traditionally been incorporatedinto the soil to improve texture and mineral nutrient content.

Table 9. 2010 U.S.Soybean Production

State	Yield (bushels per harvested acre)	Acres Planted	Production (bushels)
Iowa	51.0	9,800,000	496,230,000
Illinois	51.5	9,100,000	466,075,000
Minnesota	45.0	7,400,000	328,950,000
Indiana	48.5	5,350,000	258,505,000
Missouri	41.5	5,150,000	210,405,000
Nebraska	52.5	5,150,000	267,750,000
Ohio	48.0	4,600,000	220,320,000
Kansas	32.5	4,300,000	138,125,000
South Dakota	38.0	4,200,000	157,320,000
North Dakota	34.0	4,100,000	138,380,000
All Other States		18,254,000	647,121,000
Total		77,404,000	3,329,181,000

Source: After USDA, NASS, 2011, QuickStats, http://quickstats.nass.usda.gov/, accessed October, 2011

Soybean field residues are a byproduct of the production of soybeans and include the stover and the root system. As in corn, the residues include a range of tissues from pithy mesophyll and cortical cells to vascular tissues and fibers. Soybeans residues contain a smaller proportion of heavily lignified cells than do corn residues. Estimates place the proportion of dry biological mass in the soybeans at approximately 50 percent of the total biomass production.[31] Consequently, as much as 93 million tons of soybean field crop residues are produced in the United States (Table 10). However, good management practices generally advise against harvest of soybean field residues. These are commonly left in the field to provideappropriate soil organic materials and available mineral content. The precise benefits of this practice are not well understood.[32]Nonetheless, the Contractor believes harvestable production of soybean stover in the United Statesshould not be incentivized by development of an insurance program for soybean stover.Moreover, the process of harvesting soybeans, particularly where pre-harvest desiccants are used with common combining technology, generally renders the residue to ―loose, powdery twigs" makes residual biomass poorly suited to harvest and transport.

[31]PennState, College of Agricultural Sciences, Penn State Extension, 2011, Crop residue production of different crops in rotation, http://extension.psu.edu/agronomy-guide/cm/tables/table-1-1-3, accessed October, 2011.

[32]Schoessow, K.A., K.C. Kilian, and L.G. Bundy, 2010, Soybean Residue Management and Tillage Effects on Corn Yields and Response to Applied Nitrogen, Agronomy Journal. 102:1186–1193.

Table 10. 2010 U.S.Soybean Field Residue Production

State	Estimated Total Field Residues (tons)	Harvestable Field Residues
Iowa	14,886,900	0
Illinois	13,982,250	0
Minnesota	9,868,500	0
Indiana	7,755,150	0
Missouri	6,312,150	0
Nebraska	8,032,500	0
Ohio	6,609,600	0
Kansas	4,143,750	0
South Dakota	4,719,600	0
North Dakota	4,151,400	0
All Other States	19,413,630	0
Total	93,217,068	0

Source: W&A Research Department after USDA, NASS, 2011, QuickStats soybean production data, assuming 50 percent of the biomass is residue and50 percent seed, with none of the residue harvestable.

The Contractor was not able to identify time series data on the total or regional utilization of soybean stover as a biofuels feedstock. Heretofore, soybean stover wasused primarily as a soil amendment and occasionally for forage or feed. The Contractor was unable to find any time-series data on production, utilization, and value of soybean stover. Instead, as with corn stover, there is modest literature from extension offices addressing these historic uses of the stover crop.

Triticum **spp. (Wheat)**

Worldwide, wheat is the leading vegetable-protein resource for humans. Like corn, wheat is an annual monocot. The grains of wheat are borne in a head. Each grain isassociated with a variety of accessory structures. Most of the straw is also cut with the grain although in some areas, particularly where the field is rocky, a portion of the straw will be left standing, leaving ―stubble" between three and twenty inches tall.[33]In the harvest process the chaff and straw are separated from the grain and deposited on the field.

USDA NASS reports wheat production in 42 states. Almost 78 percent of production took place in the top 10 producing states, with 62 percent of the acreage and 54 percent of the production in North Dakota, Kansas, Texas, Montana,and Oklahoma(Table 11). In areas with substantial production of grazing animals, wheat residues can be grazed in the field or the wheat straw can be harvested for feed or bedding. In areas where this is not practical, the residues have been used to improve soil organic material and mineral nutrient content.

[33]University of Arkansas, Division of Agriculture Cooperative Extension Service, 2006, Wheat Production in Arkansas: Wheat Harvesting, http://www.aragriculture.org/crops/wheat/harvesting.htm, accessed October, 2011.

Table 11. 2010 U.S.Wheat Production

State	Yield (Bushels per Harvested Acre)	Acres Planted	Production (Bushels)
North Dakota	43.0	8,530,000	361,550,000
Kansas	45.0	8,400,000	360,000,000
Texas	34.0	5,700,000	127,500,000
Montana	41.3	5,440,000	215,360,000
Oklahoma	31.0	5,300,000	120,900,000
South Dakota	45.3	2,815,000	123,475,000
Colorado	45.5	2,478,000	108,234,000
Washington	64.7	2,330,000	147,890,000
Minnesota	54.7	1,665,000	88,070,000
Nebraska	43.0	1,600,000	64,070,000
All Other States		9,335,000	489,867,000
Total		53,593,000	2,206,916,000

Source: After USDA, NASS, 2011, QuickStats, http://quickstats.nass.usda.gov/, accessed October, 2011

Wheat field residues are a byproduct of the production of wheat, and include the straw, the chaff, and the root system. Structurally and chemically, the residues are similar to corn stover. Estimates place the proportion of dry biological mass in the wheat grain at approximately 40 percent of the total biomass.[34] Consequently, as much as 99 million tons of wheat field crop residues are produced in the United States (Table 12). Good management practices preclude harvest of approximately 75 percent of these residues. As a result, 25 million tons of wheat field residues are available for harvest.

Table 12. 2010 U.S.Wheat Field Residue Production

State	Estimated Total Field Residues (tons)	Harvestable Field Residues (tons)
North Dakota	16,269,750	4,067,438
Kansas	16,200,000	4,050,000
Texas	5,737,500	1,434,375
Montana	9,691,200	2,422,800
Oklahoma	5,440,500	1,360,125
South Dakota	5,556,375	1,389,094
Colorado	4,870,530	1,217,633
Washington	6,655,050	1,663,763
Minnesota	3,963,150	990,788
Nebraska	2,883,150	720,788
All Other States	22,044,015	5,511,004
Total	99,311,220	24,827,805

Source: W&A Research Department after USDA, NASS, 2011, QuickStats wheat production data, assuming 60 percent of the biomass is crop residue and40 percent is seed, with 25 percent of the residue harvestable.

[34]PennState, College of Agricultural Sciences, Penn State Extension, 2011, Crop residue production of different crops in rotation, http://extension.psu.edu/agronomy-guide/cm/tables/table-1-1-3, accessed October, 2011.

The Contractor was not able to identify any time series data on the total or regional utilization of wheatstraw as a biofuels feedstock. Heretofore, wheatstraw was used as a bedding, for fodder and feed, and as a soil amendment. The Contractor was unable to find only limited time-series data on production, utilization, and value of the wheat straw for these uses.[35] Instead, as with corn stover, there is modest literature from extension offices addressing these generally on-farm uses of the straw and their value to producers.

***Saccharum* spp. (Sugarcane)**

Sugarcane comprises a number of species in the genus *Saccharum*. The native sugarcanes are tall perennial grasses (a type of monocot) native to tropical and subtropical areas in Asia. The commercial sugarcane cultivars are complex hybrids of these native species.Commercial sugarcanes are cultivated in tropical and subtropical regions around the world.

The canes of *Saccharum* species are heavy, fibrous stems. Combines are used to harvest the cane. The combine cuts the cane near the ground, strips off the leaves, and chops the cane into uniform lengths. The combine blows the residues back onto the field. In the environments where sugarcane grows, these residues decompose rapidly, returning organic matter and minerals to the soil.

The harvested cane is processed rapidly as the sugar content of the stems decreases quickly following harvest. USDA NASS reports sugarcane production in Florida, Louisiana, Texas, and Hawaii (Table 13). Total cane harvests for processing amount to almost 26 million tons, just more than 0.2 percent of the biomass ofharvested corn grain.

Table 13. 2010 U.S. Sugarcane Production for Processing

State	Yield (tons per harvested acre)	Acres Planted	Production (Tons)
Florida	32.7	374,000	12,230,000
Louisiana	27.8	390,000	10,842,000
Texas	30.5	45,800	1,396,000
Hawaii	77.1	15,500	1,195,000
Total		825,300	25,663,000

Source: After USDA, NASS, 2011, QuickStats, http://quickstats.nass.usda.gov/, accessed October, 2011.

Sugarcane field residues are a byproduct of the production of sugarcane. Leaves and roots comprise the bulk of these field residues. In the areas where sugarcane residues do not decompose readily, they are burned in the fields to return embodied minerals to the soil.[36]Good management practices preclude harvest of sugarcane field residues. The Contractor was not able to identify any time series data on the total or regional utilization of sugarcanefield residues as a biofuels feedstock. The Contractor was unable to find any time-series data on production, utilization, or valuesfor the sugarcane field residues.

[35] AMS reports weekly straw price series atAlcester, South Dakota and Maurice, Iowa, at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do;jsessionid=2F71C654E0C7425B7BDC4F1B9B64713E?documentID=22155

[36] Historically, before mechanical cane harvests were the standard practice, cane fields were burned prior to harvest to eliminate vermin that threatened the harvest crews.

The processing of sugarcane in the United States produces approximately 3.6 million tons of dry bagasse.[37] This processing waste can be used in feed or used as a feedstock for biofuel production. Moreover, most bagasse is already used directly as an energy resource, as it is burned to fire boilers in sugarcane refineries. However, inasmuch as bagasse is a processing waste, it is not insurable under the Act.

***Beta vulgaris* (Sugar Beet)**

The sugarbeet is a variety of the species *Beta vulgaris*.A number of cultivars, including several incorporating genetically engineered components, are available. These are all annual dicots. The beet rootsused for the production of sugar are heavy and fibrous (i.e., they include many heavily lignified cells). Harvest involves a series of mechanical operations. The leaves and the crown of the root itself are removed by a root beater prior to harvest. After the top of the beet has healed, a harvester lifts the root and removes excess soil from the root. The lifted beets are passed into waiting trucks and removed from the field. USDA NASS reports sugar beet production in ten states (Table 14). Harvests amount to almost32 million tons.

Table 14. 2010 U.S. Sugar Beet Production

State	Yield (tons per harvested acre)	Acres Planted	Production (tons)
Minnesota	26.6	449,000	11,731,000
North Dakota	26.5	217,000	5,671,000
Idaho	31.0	171,000	5,270,000
Michigan	26.0	147,000	3,822,000
Nebraska	23.8	50,000	1,131,000
Montana	29.5	42,600	1,254,000
Wyoming	27.0	30,500	821,000
Colorado	29.5	28,900	823,000
California	40.0	25,100	1,004,000
Oregon	36.3	10,300	374,000
Total		1,171,400	31,901,000

Source: After USDA, NASS, 2011, QuickStats, http://quickstats.nass.usda.gov/, accessed October, 2011

Sugarbeet field residues are a byproduct of the production of sugar beets. The bulk of the field residuesare leaves. Generally, sugar beet field residues are left in the field, and have substantially decomposed by the time the beets themselves are harvested. The lifting and harvesting process then subsequently incorporates the remaining residue into the top layer of the soil. Beet leaves can be used as fodder for grazing animals or harvested for silage.[38]The Contractor was not able to identify any time series data on the total or regional utilization of sugar beet field residues as a biofuels feedstock. The Contractor was unable to find any time-series data on production, utilization, and value of the sugar beet field residues.

[37] W&A research Department based on a bagasse to stalk ratio of 13 percent.
[38] Cattanach, A.W., A.G. Dexter, and E.S. Oplinger, 1991, Alternative Field crop Manual: Sugarbeets, http://www.hort.purdue.edu/newcrop/afcm/sugarbeet.html, accessed October, 2011.

Following processing of sugarbeets, there is a processing residue called pulp, which is the remaining portion of the cossettes (thin slices of the beets) that entered the processing. Since water is added to the cossettes during processing, the pulp has moisture content between 75 and 95 percent (much higher than that of most field crop residues). The pulp can be pressed to expel some of the water, dried, and sold as animal feed. It can also be used as a soil amendment to return minerals to the soil. Inasmuch as pulp is a processing waste, it is not insurable under the Act.

Oryza sativa **(Rice), Sorghum bicolor (Sorghum),** ***Hordeum vulgare*** **(Barley),** ***Avena sativa*** **(Oats), and** ***Secale cereale*** **(Rye)**

O. *sativa*, *S. bicolor*, *H. vulgare*, *A. sativa*, and *S. cereale*are annual cereal grain crops grown in the United States. USDA NASS Quick Stats reports rice production in 6 states, sorghum production in 14 states, barley production in 23 states, oatsproduction in 32 states, and rye production in 4 states. Total production of these 5 grains amounts to 114 million tons (Table 15). Collectively these minor grain crops have the potential to produce 41 million tons of harvestable biomass.

Table 15. 2010 Small Grains Production (tons)

State	Production	Estimated Total Field Residues	Harvestable Field Residues
S. bicolor (Sorghum)	96,710,600	145,065,900	36,266,475
O. *sativa* (Rice)	12,155,200	12,155,200	3,038,800
H. vulgare (Barley)	4,326,432	6,489,648	1,622,412
A. sativa (Oats)	1,299,040	1,299,040	324,760
S. cereale (Rye)	208,068	312,102	78,026
Total	114,699,340	165,321,890	41,330,473

Source: W&A Research Department after USDA, NASS, 2011, QuickStats production data, assuming 60 percent of the crop biomass is residue and 40 percent is grain for sorghum, barley, and rye and 50 percent is residue and 50 percent grain for oats and rye, with 25 percent of the residue harvestable.

Small grain field residues are a byproduct of the production of the grains, and include the straw, chaff, and the root system. Structurally and chemically, the residues are similar to those for corn stover and wheat straw. Estimates place the proportion of dry biological mass in the grain at approximately 40 to 50 percent of the total biomass.[39] Consequently, as much as 165 million tons of field crop residues from these small grains collectively are produced in the United States. Good management practices preclude harvest of approximately 75 percent of these residues. As a result, approximately 41 million tons of field residues are available for harvest.

The Contractor was not able to identify any time series data on the total or regional utilization of small grain straw as a biofuels feedstock. This straw has been used as bedding, for fodder and feed, and as a soil amendment. Except for limited and sporadic reports, the Contractor was unable to find data on production, utilization, and value of the straw.

[39]PennState, College of Agricultural Sciences, Penn State Extension, 2011, Crop residue production of different crops in rotation, http://extension.psu.edu/agronomy-guide/cm/tables/table-1-1-3, accessed October, 2011.

Other Considerations Affecting Potential Quantity of Residues for Biofuel Feedstocks
Having addressed the potential for harvest of crop residues as biofuels feedstocks in general terms, it is important to note that total quantity of production *per se*(i.e., the potential for production) and available production for harvest as feedstock for a biorefinery are not the same thing. Feedstock transportation costs need to be kept low (i.e., transported over short distances) so cellulosic ethanol production can be economically feasible. In addition, the goal is to produce an advanced biofuel rather than to embody more greenhouse gas emissions on a life cycle basis than the energy represented by the ethanol produced. While the U.S. Department of Energy (DOE) has funded biorefinery development projects in 19 states, only projects in Georgia, Iowa, Kansas, Michigan, Mississippi, and Wisconsin are on a commercial scale;[40] the others are smaller pilot or demonstration projects. Consequently, the current potential market for biomass as a biofuels feedstock is quite limited. The Contractor has not identified any similar biorefinery projects funded solely with private capital. To date, privately capitalized biorefineries are grain-based rather than residue-based facilities.

In addition, recovery of the residues requires additional expense over and above the cost of harvesting the crop. The residues are quite bulky. Recovery most likely would be a secondary operation after the harvest of the crop is complete (assembling straw into bales, for example). This added expense must be evaluated in light of the probable return from sale of the residues.

In summary, corn production generates the vast majority of harvestable field residues. Although more soybean acreage is harvested than wheat acreage, it is not considered a good management practice to remove the soybean stover from the field. Due to the relatively small amounts of residues available from other crops, the focus of the remainder of feasibility study addresses the feasibility of insuring corn stover and wheat straw. The Contractor believes the mechanisms for insuring these two residue crops can be expanded to include additional crop residueswhen harvest and utilization of these lesser field residues as biofuel feedstocks justify.

[40] Commercial biorefinery projects process at least 770 tons of dry biomass per day with an average production capacity of approximately 17 million gallons of biofuels per year.

SECTION IV. PROGRAMSSUPPORTINGMAJOR CROP PRODUCTION

Producers can avail themselves of a variety of support programs from the federal, state, and private sectors. Some of these programs specifically address risk, while others assist in risk management by providing information that allows the producer to make informed decisions. Inasmuch as crop residues for use as biofuels refinery feedstocks will de derived primarily from major crops, programs generally available to operationsinvolved in major crop production are described herein. Purchased risk managementprograms supporting individual operations are also addressed in this section of the report.

Federal Programs

Federal programs supporting biofuels feedstock producers are offered primarily by agencies and services of the USDA. Agencies within the USDA serving producersare listed alphabetically, followed by support available from the DOE.Producers of major commodity crops are eligible for marketing loans, price supports, or direct payments.These payments have not been tied to the crop residues remaining after harvest of the commodity crops.

USDA Agricultural Marketing Service (AMS)

Major commodity crops producers benefit from general services of AMS. AMS Research and Promotion programs and Marketing and EconomicResearch programs occasionally address issues related to harvest and utilization of crop residues. While the majority of the AMS biofuels papers focus on grain ethanol and/or biodiesel, there are some resources available to assist producers interested in production of cellulosic ethanol biorefinery feedstocks.

USDA Animal and Plant Health Inspection Service (APHIS)

APHIS is responsible for protecting and promoting U.S. agricultural health. APHIS has been tasked with the responsibility of enforcing the obligations of the United States under phytosanitary rules such as the *Codex Alimentarius,*responding to animal and plant health import requirements of other countries, and assisting in negotiating science-based trade restrictions. While APHIS programs are relevant to the production of the major crop, they are generally not relevant to the production of biorefinery feedstocks.

USDA National Institute of Food and Agriculture (NIFA, formerly CooperativeState Research, Education, and Extension Service (CSREES))

The NIFA is the federal administrative authority that offers programs in research, extension, and education to provide important educational and consultancy resources for producers in all crop sectors. The extension services have played an active role in providing information about crop residues. Extension publications on the costs and benefits of crop residue harvest are readily available. Only recently have any these reports focused on the use of residues as biorefinery feedstocks.

Economic Research Service (ERS)

ERS provides data and analysis on crop product supply and demand, as well as information on industry structure, pricing, trade, production policies, production systems, and processing. ERS reports of particular interest focus on biofuels, biorefinery activities, and crop residues in general.

USDA Farm Service Agency (FSA)

The Farm Service Agency (FSA) Biomass Crop Assistance Program (BCAP) includes a collection, harvest, storage and transportation (CHST) subsidy program authorized by Title IX of the Farm Security and Rural Investment Act of 2002, and amended by Title IX of the 2008 Farm Bill. The BCAP-CHST program provides matching payments on a dollar-for-dollar basis for amounts paid for collection, harvest, storage and transportation of eligible material by qualified CHST-biorefineries.These payments are limited to a maximum of $45 per dry ton and 2-year payment duration. BCAP is scheduled to provide short-term (5 year eligibility window) support for eligible annual crops (including crop residues) and non-woody perennial crops, and a longer term (15 years) window for production of woody perennial crops.This program is intended to incentivize production and marketing rather than to serve as a risk management tool for production losses.

FSA also provides financial assistance to producers facing losses from natural disaster (i.e., drought, flood, fire, freeze, tornadoes, pest infestation, and other ―calamities"). FSA's Noninsured Crop Disaster Assistance Program (NAP) provides payments to producers of non-insurable crops when low yields, loss of inventory, or prevented planting occur due to a natural disaster. Inasmuch as major commodity crops are insurable in most areas, NAP is generally not relevant to this study, except to the extent that FSA recognizes crop residues as an uninsurable crop.The inclusion of crop residues in the BCAP-CHST subsidy program provides *a priori* evidence the residue can be considered a crop. The Contractor was unable to identify any use of the NAP program to indemnify againstlossesof residue as biorefinery feedstock. This is not surprising considering the relatively recent incorporation of residues as biorefinery feedstock into producers' cash crop portfolios. Furthermore, the structure of FSA NAP records provided to the Contractor does not identify the market to which noninsured crops would have been sold.

FSA's Supplemental Revenue Assistance Payments (SURE) Program provides benefits to producers for 2008 through 2011 crop year farm revenue losses due to natural disasters. It is the successor to earlier *ad hoc* crop disaster programs. For 2009 and subsequent crop years, producers or legal entities whose average non-farm income exceeds $500,000 are not eligible. A ―farm" is eligible for a SURE payment when a portion of the farm is located in a county covered by a qualifying natural disaster declaration (USDA Secretarial Declarations only) or a contiguous county, orthe actual production is less than 50 percent of the normal production. Producers must have obtained available purchased risk management instruments for **all** crops through either the Federal Crop Insurance Act (Act) or NAP as a condition of eligibility for SURE. The farm's SURE guarantee cannot exceed 90 percent of the expected revenue for the farm (i.e., there is a10percent deductible). Producers must suffer a ten percent production loss to at least one crop of economic significance on the farm in order to be eligible for a SURE payment. A qualifying loss must be caused by a natural disaster. A crop of economic significance contributes at least five percent of the expected revenue for a producer's farm. A limit of $100,000 applies to the combination of payments from SURE and the livestock disaster programs. The Contractor found no evidence of government payments for field residues.

USDA Food Safety and Inspection Service (FSIS)

FSIS employees identify, assess, and define emerging and standing issues affecting procedures, policies, activities, or resources. They are responsible for identifying food safety concerns associated with production, transportation, and marketing. FSIS personnel are also responsible for outreach and liaison activities to develop and sustain risk reduction strategies in agricultural production. Although FSIS programs are relevant to the underlying crop from which crop residues are derived, they are not relevant to the residues themselves.

USDA Foreign Agricultural Service (FAS)

FAS maintains links to resources for producers focusing on sites that identify production practices and data, including the UN FAO import and export data. Although FSA programs are relevant to the underlying crop from which crop residues are derived, they are not relevant to the residues themselves.

USDA National Agricultural Statistics Service (NASS)

NASS is the primary data collection and statistical estimating service of the USDA. Its data series are widely used by producers, businesses, and researchers. Major commodity crop data are collected both annually and as an element of the Census of Agriculture.The Contractor was not able to identify any NASS production or pricing data dealing with crop residues. Occasional regional reports on residues (particularly on stover and straw for bedding and feed) are available to producers.

USDA Risk Management Agency (RMA)

The Federal Crop Insurance Corporation (FCIC) was founded in 1938 to provide purchased risk management instruments (insurance) for agricultural producers. RMA was created as a separate agency in 1996 to operate and manage the FCIC insurance programs and other risk management tools including, but not limited to, options and futures. The FCIC insurance is structured tohelp manage producers‘productionrisks. Over the years, insurance has been made available for an increasing number of crops. Crop residues are not named specifically or generically as an insured crop. However, the major commodity crops can be insured for their primary production and in many locations the whole-enterprise revenue can be insured under two availableadjusted gross revenue products.One crop co-product that is incidental to primary commodity production is currently insurable under RMA programs; cottonseed is insured under a popular pilot program implemented for the 2011 crop year. RMA continually strives to provide an appropriate portfolio of risk management instruments for agricultural producers. This report on the feasibility of insuring a second co-product is being developed under a contract initiated by RMA.

USDA Rural Development (RD, formerly Rural Business–Cooperative Service (RBS))

RD is a small agency with limited funding and staff whose purpose is to finance and facilitate development of small and emerging private business enterprises, and promote sustainable economic development in rural communities. The Contractor was not able to identify RBS programs likely relevant to crop residue production or risk management.

DOE Energy Efficiency and Conservation Block Grant Program (EECBG)

The Energy Efficiency and Conservation Block Grant (EECBG) Programauthorized in Title V, Subtitle E of the Energy Independence and Security Act (EISA) and funded by the American Recovery and Reinvestment Act (Recovery Act) of 2009is modeled after the Department of Housing and Urban Development (HUD) Community Development Block Grant program.EECBG is intended to assist cities, counties, states, territories, and Indian tribes to develop, promote, implement, and manage energy projects and programs designed to reduce energy use and fossil fuel emissions. EECBG is also an energy jobs program.

DOEState Energy Program (SEP)
The DOE State Energy Program (SEP) provides assistance to states to develop state strategies and goals to address their energy ―priorities." Competitive SEP grants support renewable energy products (like biofuels) and technologies (like those used in biorefineries). States are expected to provide matchingfunds equivalent to 20 percent or more of the total project costs.

Tribal Energy Program (TEP)
The Tribal Energy Program (TEP) promotes tribal energy independence and fosters economic development and employment on tribal lands through the use and creation of renewable energy and energy efficiency technologies. TEP provides financial and technical assistance to tribesseeking to evaluate and develop renewable energy resource.

State Government Programs
State programs and regulations generally affect crop production and production risk management indirectly. They regulate transportation of biofuels feedstocks and may regulate emissions from biorefineries. Regulations associated with aspects of biofuels outside ―crop" production are beyond the scope of this project. As noted previously, states are expected to participate financially in the DOE SEP. This program provides incentives for production and processing of biofuel feedstocks.

Private Insurance Inventory
Private insurance companies offer coverage to agricultural operations; available coverage is described below. These products do not mirror the structure of any existing FCIC insurance.

<u>Rain and Hail Insurance Coverage</u>
The Rain and Hail Insurance Company and most other Approved Insurance Providers, offer a number of companion insurance products[41] and stand alone insurance that indemnify elements of risks not covered by FCIC insurance products. These include rain and hail coverage for the deductible portion of FCIC yield and revenue insurance, stand-alone rain insurance, and a range of replant and fire products. None of these is directed at crop residues, although certain types of coverage are offered for corn, wheat, and soybean production.

<u>Weather Insurance Coverage</u>
Private weather insurance is available from a number of traditional and online insurance companies. These products are often reinsured by major reinsurance companies (e.g., Munich Re, Swiss Re, Renaissance Re, etc.). The policies are generally ―one off" contracts, customized to reflect specific named perils identified by the insured. This insurance can be structured to cover any oneweather event (e.g., excessive rainfall) or combinations of weather events the producer chooses from available options. These policies have relatively high premiums and provide payment only if the specific event or events covered by the policy occur. There may or may not be an actual loss if the covered event(s) do occur. These products might provide a risk

[41] The term ―companion" denotes an insurance product that is sold as supplemental coverage to a Federal crop insurance policy; the term ―stand-alone" denotes a complete insurance product sold independently of any other coverage.

management tool for some of the risks associated with storage of crop residues prior to delivery. However, as noted earlier, post-production losses are not insurable under the Act, except for specific named crops. Therefore, these private weather products, if used to manage risks to the stored crop, would supplement rather than compete with any federally-subsidized production insurance available to producers.

Loss of Income Coverage

Loss of income coverage is available to businesses from the private insurance industry. Loss of income insurance coverslosses resulting from damage to structures and equipment. Due to the small role of buildings in production agriculture and the ability to manage risk to equipment through back-up systems, producer interest in this insurance is limited.

Basic Business Liability Insurance

Basic liability insurance is available.However, its utility for providing compensation for production losses is nil. It potentially would be viable as a risk management tool to cover responsibility for payments to others that might arise due to the handling or transportation of residues.

Employers Contingent Liability Insurance

Employers Contingent Liability is available with the ability to add employees as insureds.

SECTION V. AGRICULTURAL RISK

Generally, sources of risk in agriculture include production, price (market), financial, institutional, and human (personal) risk. However, the fundamental question addressed in this report is whether it is feasible to provide federally-subsidized crop insurance under the terms of the Act as an element in a crop residue producer‘s risk management tool portfolio.

Production Risk

Insurable crop residue production risks include adverse weather, disease and insect damage if control mechanisms either are not available or fail, earthquake, wildfire, volcano, and failure of irrigation supply if caused by any of the above named causes of loss. These are, in fact, precisely the risks that affect production of the underlying major crop.Risks resulting from human actions (e.g., fires caused by human activities, pollution, agricultural chemical spills, etc.) are not insurable perils under the Act.

Production risk can be systemic or idiosyncratic. Systemic risks, such as wide temperature excursions, affect all operations in a region. Other elements of production risk for commodity crop production (and consequently for production of the crop residues) are idiosyncratic, affecting individual growers. Examples of idiosyncratic production risk include an isolated disease outbreak, localized predation, or a wind-driven drying of a crop at a particular production location.

Weather-related production risk in production agriculture is caused by events such as high and low temperatures, excess precipitation, lack of precipitation, and wind either singly or in combination. Weather affects the production of a relatively large number of individual producers every year.

Crop diseases are caused by bacteria, fungi, protozoa, andviruses that result in chronic disease losses and catastrophic diseases. Chronic diseases slowly erode production and consequently affect profits. Catastrophic losses can lead to the ruin of entire industry sectors. Decreased resistance to disease may result from physical stress characterizing high density mono-culture. Consequently, good management practices are essential to limiting disease in agricultural crops, and producers typically use appropriate practices to manage these risks.

Price Risk

The prices of most crops are subject to market forces. However, there are very limited crop residue price series data. Consequently, it is not possible to assess the specific price risks associated with field residues as a crop. Inputs for productionagriculture, including fertilizers, fuel, and chemicals (e.g., pesticides),are often substantial. Substantial increases in input costs substantially affect the producer‘s margins and thus the producer‘s net revenues. Additional inputs are required as biomass is removed from the field. Additional fuel is required for the harvest of the biomass. Additional fertilizers are required to replace the minerals removed from the field in the biomass. To date, input price risks have not been insured under FCIC insurance programs, except to the extent they are an element of the AGR and AGR-Lite calculations.It is anticipated that any crop residue insurance program would be based on yield risk and that insurance prices would be fixed at either contract price levels or at a price election based on available data prior to the sales closing date.

Financial Risk

An agricultural producer‘s primary source of financial risk stems from capital and labor investment. Another financial risk is the potential need to borrow funds to manage cash flow. Although producers often comment about the relationship between crop insurance and access to operating loans, it is important to note financial risk is not an insurable risk under the Act.

Institutional Risk

Any regulatory action that interferes with the normal course of business has the potential to cause loss of revenues and markets. However, such risks are not insurable under the Act.

Human or Personal Risk

Production agricultural operations must manage human risk in compliance with the Occupational Safety and Health (OSH) Act and the Fair Labor Standards Act (FLSA). Potential risks to personnel include cuts and abrasions, infection (e.g., tetanus infections), mechanical injury from equipment, hearing loss due to excessive noise, and death. In addition, key personnel may retire, die, or divorce, with effects on the operational structure or activities. These risks fall outside the purview of federal crop insurance.Human and personal risks are not insurable risks under the Act.

SECTION VI. CROP RESIDUE AGRICULTURAL PRACTICES

As noted earlier, crop residues are a co-product of the production of crops. Each major commodity crop has unique management practices. These management practices, which are often distinct by region, were developed to optimize a sustainable harvest of the crop. Good management practices include procedures to maintain soil quality, limit diseases, and control insects and wildlife. There are no recommendations in crop management practices designed to increase residue production at the expense of the primary crop. Since the primary crop will have the dominant value in the market, the residues will always be the co-product and incidental in the management for the primary crop.

Several management practices in the harvest of the primary crop can be used, however, to reduce the cost and improve the yield of subsequent biomass harvest. In particular ―straw choppers/spreaders" installed at the back of most combine harvesters are generally removed when subsequent harvest of straw or stover is anticipated. This results in larger individual component pieces, which are more easily collected into bales and more efficiently removed from the fields.

The management practices associated with crop residue productiongenerally focus on the amount of residue that is appropriately removed from the field. Depending on the definition of residue (i.e., does it include the subsoil plant structures), the soil makeup, and erosion risks, the recommendations for limits on removal vary from 0 to 70 percent.[42]However, in most production regions, soil quality is damaged or substantial costs are incurred if more than 25 percent of the residues are removed.

Harvest Activities

For harvest, stover and straw must be cut, raked, and baled. These residuesare often cut with a rotary hay cutter and raked with a double rake. Alternatively, a combination flail chopper/windrower or swathercan be used. A third approach is to cut the stover during the grain harvest, with the chaff spreader on the combine removed. By using the combine to windrow the residues of appropriately dried standing grains, baling may follow the grain harvest without the need for additional cutting of the residue.However, windrows produced by the combine often require additional drying time and are consequently more susceptible to wet weather lossesdue to subsequent rain or snow.

Residues that are chopped and spread in the field by the combine dry faster than residues that are immediately windrowed.Flail shredding increasesthe rate of drying by chopping the residue,so a larger surface area is exposed to the air and sun. Some flail shredders can also form a windrow, reducing the number of passages over the residue crop. If the crop is dampened by rain, it must be raked to spread it so it dries before baling.

[42]Nielsen, R.L., 1995, Questions Relative to Harvesting & Storing Corn Stover, http://www.agry.purdue.edu/ext/corn/pubs/agry9509.htm, accessed October, 2011; Wilhelm, W.W., J.M.F. Johnson, J.L. Hatfield, W.B. Voorhees, and D.R. Linden, 2004,Crop and soil productivity response to corn residue removal: a literature review.*Agronomy Journal*96**:**1-17; and Soil Quality National Technology Development Team, USDA, NRCS, 2006, Crop Residue Removal for Biomass Energy Production: Effects on Soils and Recommendations, http://soils.usda.gov/sqi/management/files/sq_atn_19.pdf, accessed October 2011. These latter two include substantial bibliographies addressing the issue of harvestable residue quantities. See also Appendix A.

The amount of residue left in the field can be controlled by managing the height of the working edge of the cutter, the rake, or the baler. Whetherany root systems are collected is dependent on soil and rootconditions for each field. In general, it is better for the soil, for control of erosion, and for the biorefinery operations if the harvested crop residue contains primarily above-ground plant materials.

The density of the stover at harvest is around three pounds (dry matter basis) per cubic foot. Baled field residues have a density of approximately nine pounds per cubic foot. Baling residues is more difficult than balinghay crops, primarily due to the structure of the crop being baled and the nature of the field surface from which the crop is taken.

At harvest, the moisture content of field residues is generally twice that of the harvested grain. The biorefinery contractthe Contractor obtained establishes pricing based on ―bone dry" tons (Appendix B); the water content of baled stover and straw is generally targeted at 25 percent or lower.[43]Higher moisture levels risk fires ignited by decomposition within the bales.

There are substantial costs associated with the machinery to harvest these crop residues. If the machinery is on hand, the opportunity costs are low. If the machinery needs to be leased or purchased, or if the services of a custom harvester are used, the costs of harvest may be prohibitive. One producer expressed considerable skepticism about the long-term economic viability of crop-residue based cellulosic ethanol production.In areas where straw has historically been harvested, it can be expected that the threshold for resistance to harvest of biomass for energy will be substantially lower.

Storage Activities

Generally producer contracts require delivery on a schedule designed around the needs of the biorefinery. Consequently, the baled crop residues are initially stored on the farm. One-ton, 4x4x8 ft rectangular bales and net-wrapped 6 ft round bales are the most common sizes accepted at biorefinery facilities. However, it is difficult to bale residues firmly enough to shed water. Producers viewed problems with crop residue storage as a risk of substantial concern.

Contracts are very specific about the acceptable baling practices. Twine wrapped round bales tends to disintegrate with handling. Cost per ton for baling is generally less whenusing the round baler, primarily because the capital cost of the baler.Since the bales are stored on the farm, there are costs associated with handling (i.e., moving and/or stacking) the bales. It is anticipated that losses in quality and quantity of salable biomass while in storage will not be insurable under any potential pilot insurance program.

Marketing Activities

As noted previously, residues can be used for feed, fodder, bedding, mulch, or as a biofuel production facility feedstock. There are spot markets for crop residues used for feed and fodder. The sales of residues to production facilities are by contract. The Contractor obtained a redacted version of one such contract and has included it as Appendix B in this report.

[43] Gould, K., 2007, Corn Stover Harvesting, http://www.beef.msu.edu/Resources/Nutrition/CornStoverHarvesting/tabid/595/Default.aspx, accessed October, 2011.

To date, sales of crop residues as biofuel production facility feedstock have been quite limited due to the small number of cellulosic ethanol biofuel production facilities. Some of these facilities employ consolidators to obtain a supply of residues for processing and manage the logistics of delivery. Other processing plants assign these responsibilities to processor personnel. Due to the large supply of residue and the relatively restricted market, base contract prices paid to producers are generally consistent and are comparable to the baled-residue feed cost and cost-estimated values of the crop.[44]

[44] As noted earlier, the BCAP-CHST subsidies have created an artificial price basis to assist in the establishment of biofuels refineries and assure supplies of feedstocks are available.

SECTION VII. STAKEHOLDER INPUT

The Contractor gathered stakeholder input during discussions with producers, insurance industry representatives, and processors. Stakeholder information gathering was conducted in Emmetsburg, Iowa, on August 16, 2011; in Hugoton, Kansas, on September 23, 2011; and in Boardman,Oregon, on November 2, 2011. Many conversations outside these venues were held in conjunction with listening sessions or in follow-up conversations as a result of leads provided at a listening session. It should be noted Emmetsburg and Hugoton are corn/soybean production areas with existing or planned biorefineries while Boardman is a wheat production area with two existing biorefineries. One of these is a grain ethanol facility while the other produces cellulosic ethanol. The listening sessions were conducted in a manner to address the constraints imposed by the Paperwork Reduction Act. Consequently the discussion was driven by an agenda rather than by a set of questions. See Appendix C for a sample listening session agenda.

Emmetsburg, Iowa

The initial stakeholder information gathering session in Emmetsburg was scheduled to coincide with a producer meeting coordinated by the management of an existing grain ethanol biorefinery. A cellulosic ethanol biorefinery is in the early stages of development, with crop residue purchases already contracted to establish a reliable feedstock supply. This gathering brought together more than 50 producers;10 employees of the biorefinery with a range of responsibilities for the crop residue project; and allied industry representatives including bankers, transportation companies, equipment vendors, and insurance industry personnel. The Contractor‘s presence in Emmetsburg at the conference was announced by the host organization and through flyers distributed to every producer at the conference. The Contractor was stationed at a ―break-out” table and workshop attendees had the option of a one-on-one conversation with the Contractor‘s representative. Those who participated in a break-out were provided a very brief summary of the crop insurance development process and encouraged to express their opinions concerning the feasibility of insuring crop residue production for use as a biofuel feedstock. These individual discussions ran between 5 and 40 minutes.

The producers had operations ranging from 500 to over 10,000 acres. Most already provided feedstock to the grain ethanol production facility and about half had contracts for delivery of crop residues. All the producers who expressed an opinion were enthusiastic about the possibility of insurance for their field residue crops. None indicated he/she had any available quantitative data on residue production or harvest. As is typical during a feasibility study, producers indicated a willingness to buy crop insurance ―if the price is right.”

<u>Follow-up Information Gathering</u>

The Contractor gathered additional information from producers who indicated an interest in or willingness to participate in follow-up discussions. The vast majority of producers indicated a satisfaction with crop insurance as a risk management tool. Those who commented on their premiums indicated a satisfaction with the rates for their corn insurance and an interest in protecting the value of their potential stover production with crop insurance. Again, none indicated they knew of any available quantitative data on residue production or harvest. Several acknowledged the benefits of the premium subsidy available for FCIC insurance products.

While the processor personnel were eager to support the feasibility study, they had limited data available for such an effort. Data on purchases of residue reflect their efforts to develop a supply line of field crop residues and do not reflect commercial biorefinery operations. The insurance industry personnel were aware of the feasibility study and indicated an endorsement modeled on the Cottonseed (Pilot) Endorsement Insurance was likely to be the most effective approach for insuring crop residues. The general consensus was that the residues would never be a major source of revenue for the farming operations in the Corn Belt.

Hugoton, Kansas

A second stakeholder information gathering session was held in Hugoton, Kansas. It was scheduled to accommodate the schedules of producers as well as the processor personnel responsible for establishing a nearbybiorefinery. The timing of the session coincided with actual ground breaking for the biorefinery construction (as opposed to a ceremonial ground breaking). The Contractor‘s presence in Hugoton was announced by the processorand through local insurance representatives. The session was attended by representatives of two major insurance companies operating in Hugoton. The insurance industry personnel indicated their interest in the product development and suggested producers would likely purchase insurance for their residue as an endorsement to their crop insurance. No one present thought the producers would consider the residue as a distinct crop; rather,it would be considered as a revenue source associated with the primary crop production.

<u>Follow-up Call</u>

The Contractor gathered additional information from a producer who subsequently indicated an interest in the insurance. He currently buys crop insurance for his commodity crops and would be interested in expanding coverage to include the value of crop residues once these become a cash crop. He indicated he was not yet harvesting residue except for on-farm use.

Boardman; Oregon

The finalCorn Stover, Straw and Other Crop Residuesstakeholder information gathering session was held in Boardman,Oregon. Boardman is home to two existing biofuel refineries: The Pacific Ethanol plant is a commercial-scale facility using corn as a feedstock. Much of the Pacific Ethanol feedstock is transported by barge on the Columbia River. Production began in 2010 and Pacific Ethanol has already established distribution channels for ethanol produced in Boardman. The second biorefinery, a Zeachem 250,000 gallon-per-year demonstration-scale biorefinery, is being commissioned with production scheduled to start in late 2011. The Zeachem facility will use straw, stover, and woody biomass as feedstocks. Zeachem is also developing a commercial-scale biorefinery in Boardman for the production of advanced biofuels (sustainably-produced, cellulosic ethanol) and biobased chemicals. This third refinery, due to come on-line in late 2014, will also use straw, stover, and woody biomass as feedstocks.

The Boardman session was attended by two processors from the Zeachem team, two RMA personnel from the Spokane Regional Office (RO), a producer (who is also a major consolidator for straw and stover), and an insurance industry representative. The stakeholders discussed the modest producer turnout and stated the low turnout was not an indication of producer interest, but instead reflected the substantial demands on producer time during the September-through-November harvest and planting period. In spite of the turnout, the discussion was quite animated. Many of the participants sought information from the others in the room, so the Contractor rarely needed to provide a prompt to maintain the flow of information.

All the participants acknowledged the limited data on residue production and production risks. Those familiar with crop production endorsed the concept of a strong correlation between residue production and grain production. There was enthusiastic support of a risk management tool for crop residues structured as an endorsement to the underlying crop. The enthusiasm stemmed from both the simplicity of the approach and the high potential for producer uptake of the product, most likely at a buy-up level. Both the RO staff and the producer indicated there were substantial wheat production data available through the Oregon Wheat Growers‘ League and in the RMA database, and these data would provide a useful foundation in building a residue risk management tool.

There was substantial discussion about residue pricing, with the development of a consensus that cost-based pricing (based on historic production cost pricing analysis with an appropriate margin) would provide the most effective risk management tool. In all, there was considerable support for a crop residues insurance product and a suggestion that a 2013 to 2014 crop year launch would be well timed.

Summary of Stakeholder Input

Four processors were involved in the coordination of the stakeholder information gathering. Three of the four indicated their belief that the availability of insurance was important for the development of feedstock supplies. Producers in two of the three regions considered a potential insurance product to be a substantial benefit to their operations and to the cellulosic residues biorefining industry. Producers in the third region were mute on the subject. While the Contractor does not believe producers generally consider this insurance essential to their long-term survival, it is clear producers believe a simple mechanism to manage production risks associated with the harvest of crop field residues as biofuel feedstocks would be beneficial to their operations. The processors, on the other hand, feel the insurance of feedstocks is a crucial link in the development of essential feedstock supply lines. In general, the development of cellulose-based biorefinery operations requires coordination of a number of activities, including productionand transportation of feedstocks, biorefinery activities, distribution of biorefinery products, etc. Producers, consolidators, and processors all indicated risk management tools for producers were essential for growth of these integrated activities.

SECTION VIII. FEASIBILITY ASSESSMENT

In evaluating the feasibility of development of insurance for crop residues, the Contractor considered three different development approaches. The first was a simple yield approach (either as a stand-alone APH product or as an endorsement to a yield or revenue insurance policy.) The second was use of AGR and AGR-Lite whole-farm gross-revenue instruments to include revenues from sales of crop residues. The third was to consider proxy data to support development of a residue insurance product. As the Contractor came to understand the production of crop residues, this latter approach appears to be the only viable candidate for consideration. There are limitedspecific data on crop residue yields. The Contractor did not identify any time-series data that could be used to establish associations of risk factors with yield variability. What was evident was the substantial literature correlating residue yields to crop yields in a variety of locations and under a variety of circumstances.

Crop residueproducers face production risks. Changes in ―yield" appear to track the changes in the yield of the underlying crop. It can be inferred that the changes in residue yield result from the same causes affecting the yield of field and row crops producing the residue.

Insuring crop residue production raises challenges that do not complicate development of crop insurance for plants. Due to the unique nature of field residue production, the feasibility analysis of a production insurance product for this sector must address not only the literature on agricultural risk, but also appropriate management practices for the removal of the residue. Since the crop dries in the field, underwriting to address issues of ―standing storage" must be considered. The good farming practice that only a fraction of the crop be removed further complicates any ―yield" quantification.

Producer concerns about risk to residue ―crops" includeconcerns about typically insurable production perils. Loss during storage was also a concern of particular interest to producers. While potentially affecting stakeholder‘s net revenue, losses during storage are uninsurable under the Act, the same as the grain crop from which the residues are derived.

In addition to the issues raised previously, Section 2.0 of the SOW requires the Contractor to keep in mind the criteria of feasibility when recommending a possible insurance program. These are addressed sequentially below.

The proposed insurance coverage must conform to RMA‘s enabling legislation, regulations, and procedures that cannot be changed. The enabling legislation, Title 7, Chapter 36, Subchapter I of the U.S. Code, as amended,authorizes crop insurance policies for the commodity crops that produce the field crop residues. The Act defines agricultural commodities (Section 518) as wheat, corn, barley, etc. It does not define an agricultural commodity as wheat grain, corn grain, or barley grain. It seems reasonable that the entire product of the plant could be considered as an agricultural commodity.

The correlation of residue and grain harvests provides potential proxy data for establishing production guarantees for the residues as well. Feed and energy (fuel oil and/or gasoline) prices provide potential proxy data for establishing prices. Proxy data have been used in establishing pilot programs under the Act in the past. The one significant difference between their use historically and their use in insuring crop residues is that proxy data in most cases are eventually replaced by actual data collected during the pilot. While this transition should be possible for the pricing analysis, proxy yields likely will remain a feature of an insurance program for residues. The ability of a loss adjuster to determine whether the harvested portion of the residue is equal to, greater than, or less than the recommended fraction is conjectural.This yield relationship approach has been accepted by the FCIC board as a basis for yield risk assessment in the existing Cottonseed (Pilot) Program.

Producers or their agents must be willing to pay the appropriate price for the insurance. As noted previously, the willingness of producers or their agents to pay is influenced by the coverage available and the costs associated with the insurance offer. Insurance participation for major commodity crops is high. Producers indicated during the stakeholder gathering that they would be interested in insuring the crop residues assuming the rates for the residue insurance were comparable to the rates on the underlying commodity crops. This would be the case if the underlying crops' data are used to establish rates for the crop residue insurance.

The insurance product must be effective, meaningful and reflect the actual risks of the producers. Some perils of concern to producers,such as storage,are uninsurable. While the producer's perception of the utility of the insurance will be influenced by exclusion of uninsurable risks that affect the producer's cash flow and revenue, the Contractor does not believe this constitutes a barrier to participation.

The perils affecting production must be identified and categorized as insurable and non-insurable. Reportson the correlation of grain to residue production suggest a proxy approach will appropriately address the requirement that ―perils affecting production must be identified and categorized as insurable and non-insurable."Limited additional underwriting will be required if insurance structured as a crop residue endorsement based on the underlying crop production is adopted.

Be ratable and operable in an actuarially sound manner. There are no public residue data series to allow rating specific yield variability for crop residues. Published data are limited, but consistently report a high correlation of grain and residue within a relatively narrowrange of correlation coefficients. The use of the underlying commodity as a proxy provides the only mechanism for developing an actuarially-sound rating and operations structure; this is the approach that is currently in use in the Cottonseed (Pilot) Program.

Contain underwriting, rating, pricing, loss measurement, and insurance contract terms and conditions. These elements would be created during development phase. No insurmountable barriers are anticipated for the creation of a proxy product. The Contractor believes it is not possible to create these insurance components for yield or revenue using any other approach.The major consideration of a development effort would be related to evaluating any differences in risk for loss of residue relative to loss of the primary crop. Pricing and insurance contract terms and conditionsalso would be required.

There must be an appropriate geographic distribution of production to ensure a sound financial insurance program. As noted earlier, the Contractor understands this requirement to apply to the FCIC portfolio, which is distributed throughout the United States. Furthermore, the crop residue sector has wide geographic distribution, even if individual species are grown in more limited geographic areas. This requirement is not seen as a barrier to feasibility.

There must be enough interest for the risk to be spread over an acceptable pool of insureds. As noted earlier, the Contractor understands this requirement also applies to the FCIC portfolio, which involved more than 1.1 million policies and almost $80 billion of insured liability in 2010. However, the Contractor notes there was little evidence of strong demandfor residue production insurance amongproducers at this time.Instead, producers were happy to consider a vehicle that might increase their insurable liability without increasing their rates.Consequently, producers expressed a willingness to pay a proportionate additional premium relative to the increase in liability.Should markets for crop residue develop as expected, the producer demand for risk management tools can be expected to increase commensurately.

Customers must not be able to select insurance only when conditions are adverse. As a proxy to an existing insurance product, the residue insurance is no more subject to adverse selection than is the existing product.

Moral hazards must be avoidable or controllable. Insurance already exists for the underlying crop. As conceived, the proxy insurance would be an endorsement to that underlying commodity crop insurance product. This approach would not increase the moral hazard beyond any level that exists for the underlying products in as much as the rates would not change and the premium increase would be proportionate to the change in the liability.

There can be no chance of beneficial gain. Crop residue insurance structured as a proxy-based endorsement to an underlying commodity crop insurance product would offer no more chance of beneficial gain than the underlying insurance.

There must be no unacceptable change in market behavior or unacceptable market distortions in terms of either a change in quantity supplied or shift in the supply curve. The value of the grain crop will remain the dominant consideration influencing producers' decisions. The net value of the residue most likely will not be sufficient to modify planting decisions.

Summary of Feasibility Assessment

The corn and wheatcrop insurance programsare among the oldest in the Federal Crop Insurance Corporation portfolio. These programsgenerally have high participation levels and often have high levels of buy-up coverage. In 2010, corn, soybeans, and wheat had more insured acreage and more insured liability than any other named cropsinsured by RMA.

In recent years,production agriculture has seen major changes in the value of production. As more processors accept crop residues as biofuel feedstocks, the value of those residues will become an element of the whole farm income stream and one which producers indicate a desire to insure.

The crop residue endorsement concept utilizes a proxy approach to crop insurance, converting base crop production to residue equivalents to provide the basis of insurance and to calculate indemnities. Agronomic data support the proposed design as an appropriate and actuarially sound method of providing an effective guarantee for producers without imposing additional reporting burdens. The proposed approach is a logical and practical alternative.

Under the proposed proxy endorsement approach, the relationship of residue to crop is assumed to be constant for any producer. The Contractor acknowledges that as a result of this assumption the residue guarantee will be slightly too high for some producers and slightly too low for others due to inherent variability in the residue to crop ratio. It is important to note this does not affect the probability of an insurable loss inasmuch as the same conversion factor would be used to set the guarantee and to determine production to count. The producer cannot affect the production to count of residue independently of the production to count of the underlying crop. This design is consistent with the goals of the spirit of the Paperwork Reduction Act, which encourages creative alternatives to imposing additional paperwork burdens on the public. However, the Contractor would recommend the residue crop must be grown under some form of production contract for the biomass to be eligible for the proposed endorsement. Otherwise,insurance of the crop residuecould become a liability scaling instrument.

Based on this approach, the proposed residue insurance conceptwould fill a gap in currently available coverage, and provide a mechanism by which crop residue biofuel feedstock insurance products can be developed.

SECTION IX. SUMMARY OF FINDINGS

Corn, soybeans, wheat, sugarcane, sugarbeets, rice, sorghum, barley, oats, and rye comprise the commodity crop grouping in the United States producing the largest quantities of crop residues. Corn stover has been estimated to comprise as much as 80 percent of ‗harvestable' field residues with wheat accounting for an additional 10 percent. Since the vast majority of the harvestable residue is associated with corn and wheat production, the major focus of the feasibility research effort was on residues from these two crops.

Over the course of interactions with stakeholders, the Contractor gathered feedback from 30 individuals including more than 11 producers, 14 processors or processor representatives, and 4 insurance industry personnel.[45] The feedback was consistent geographically and among the stakeholder types. Every stakeholder who spoke to the issue believed insurance would be useful. No stakeholder was able to identify data to support a traditional (yield-based) crop insurance development effort.

The amount of energy contained in crop residues is enormous:40 to 60 percent of biomass, and consequently of the captured energy, is embodied in the residue. Biorefineries using crop residues for feedstocks convert a portion of this energy intoenergy stored in ethanol. The feasibility of insuring these biorefinery crop residue feedstocks is the subject of this study. For crop residues, data traditionally used to establish rates and prices for insurance are sparse and have been collected using inconsistent protocols. Consequently, the development of a yield-based policy using historical residue yield data is not feasible.

Producers in a number of states do not have access to AGR and/or AGR-Lite products. For example, among the most relevant crop residue states, neither AGR nor AGR-Lite are available in Indiana, Iowa, and Nebraska, and only the AGR-Liteproduct is available in Minnesota. Getting the AGR and AGR-Lite products into relevant areas would require substantial expansion of those programs.Even where AGR and/orAGR-Lite are offered, covering straw would require expansion efforts, since straw is not an approved commodity in all states/counties. Currently, adjusted gross revenue coverage of strawseems to be concentrated in the Atlantic Coastal states, the Southeast, and the Pacific Northwest.

Where AGR and/orAGR-Lite are offered, residues should be insurable under the ―other crops" category (commodity #0609). If revenue from sales of any form of a crop is not authorized, then the procedures documents must specifically exclude it. Corn stover is not excluded, and thus could be insured under the other crops category. However, since stover is not presently included in AGR and/orAGR-Lite as anamed insurable cropin any state, to encourage coverage, it would likely need to be added.

However, operations producing stover may have total gross incomes larger than the liability limits available under AGR-Lite, and the proportion of income that would be derived from the stover would not allow stover to be used in calculating a diversity score. In addition, on most operations producing crop residues as a biofuel feedstock, the straw and/or stover would be the only crop not insurable using a yield-based program. Nonetheless, in states where AGR or

[45] Inasmuch as stakeholders are not required to identify their affiliations, some stakeholders represent more than one constituency and others may speak for a constituency without identifying that role.

AGR-Lite are available, straw is often an insurable commodity (commodity #0940) and stover (and straw where it is not specifically listed) could be included under other crops

AGR and/orAGR-Liteare primarily intended to provide a risk management alternative for farms with a variety of smaller-value crops. Many areas where straw and stover are produced are characterized by a limited number of crops, particularly corn and soybeans. These crops have effective yield and revenue protection alternatives, and even where available, AGR and/orAGR-Litehave not had significant market penetration. There is no reason to anticipate that this behavior will change.

Finally, insuring residue under either the AGR or AGR-Lite plans of insurance can result in significant differences in premium rates for related crops. For example, in Columbia County, Oregon, wheat has a rate at 75 percent coverage for an APH equal to the county reference yield of7.2 percent for optional units. Straw in this county has an AGR-Lite premium rate of 5.5 percent at 75/90 coverage. Similarly, a basic unit of spring wheat inColumbia County, Oregon, with an APH of 70 bushels(again the county reference yield) is insurable with the following rates:

Revenue protection for wheat grain = 10.9%
Yield protection for wheat grain = 8.8%
AGR-Lite protection for wheat straw =5.5%

Obviously, the protection provided is not precisely the same and differences in rates would be expected. AGR protection is not exactly congruent with either a revenue or yield product. However, it is not likely that the appropriate rate for a single commodity under AGR-Lite should be that much lower than the rate for the underlying crop.

However, inasmuch as there is substantial literature that correlates residue production to the production of the underlying crop, the Contractor believes the grain yield data, risk data, and rating can be used as a proxy for insuring the crop residues. There are also data available for pricing residues using one of a number of proxy approaches: cost pricing, feed pricing, or energy pricing. If these proxy approaches are acceptable to FCIC and RMA, the Contractor believes it is feasibleand relatively simple to develop an endorsement to the Coarse Grains and Small Grains Crop Provisions to insure the stover and straw from these cropsharvested as a biofuel feedstock. To illustrate the potential of this approach, the Contractor presents an outline of the basis for developing insurance of corn stover, straw, and other crop residues using this approach.

SECTION X. THE BASIS OF CROP RESIDUE YIELD GUARANTEE

Under the proxy approach for insuring crop residues harvested as biofuel refinery feedstocks, the yield guarantee foran endorsement to the underlying crop policy can be based on a transformation of the producer‘s approved yield for the underlying crop policy using a conversion factor. Research has indicated that residue yields are a direct function of crop yield. Therefore, residue yields can be determined by multiplying the crop yield by a conversion factor to calculate the approved residue yield. The Contractor proposes the same conversion factor used to establish the guarantee also be used to determine production to count. However, it is important to note, there are no data examining residue yields at extremely low crop yields. Nonetheless, it is reasonable to assume when there is little or no crop available for harvest, the available amount of residues would be small and removal would not be a good farming practice.

- **Annual Yield:** Producers already certify annual acreage and crop production under the individual crop policies for corn and wheat. The producer is not required to report historical residue yields to qualify for the endorsement.
- **Approved Yield:** The average of all crop yields certified by the producer plus adjusted or unadjusted transitional yields and any eligible yield substitutions requested by the producer under their base crop policy according to the terms of the Common Crop Insurance Policy Basic Provisions (11-BR).[46]
- **Approved Residue Yield:**A quantity, expressed in tons per acre, determined by multiplying the approved yield for the crop by the conversion factor.
- **Conversion Factor:** A value, published on the county actuarial documents, used to calculate Approved Residue Yield and Production to Count. The Conversion Factor incorporates a limit on the proportion of the residue to be harvested as well as the relationship between the residue produced and the grain produced.
- **Coverage Level:** The proportion of the Approved Residue Yield, selected by the producer, which is insured. The Coverage Level for the endorsement is equal to the coverage level selected by the producer for the underlying individual crop policy.
- **Guarantee:**The Guarantee is calculated as the product of the Approved Residue Yield, the number of contracted acres, the producer‘s share, and the Coverage Level.
- **Production to Count:**To be defined in the endorsement, Production to Count for the residue will be an amount determined by multiplying the production to count of the grain for the contracted acres by the Conversion Factor. The grain yield would be determined before quality reductions.
- **Residue PriceCap:**A value, published in the Special Provisions, used to establish the maximum insured liability per unit of production under the endorsement.This could also be handled through a maximum price factor (as it is currently applied in Specialty Soybean and Specialty Barley contract price coverages).
- **ResidueContract Price:**A value in the producer‘s contract for sale of crop residues as a biofuel feedstock, used to establish the maximum insured liability under the endorsement.

[46] The actual production history (APH) yield, calculated and approved by the verifier, used to determine the production guarantee by summing the yearly actual, assigned, adjusted or unadjusted transitional yields and dividing the sum by the number of yields contained in the database, which will always contain at least four yields. The database may contain up to ten consecutive crop years of actual or assigned yields. The approved yield may have yield adjustments elected under section 36, revisions according to section 3, or other limitations according to FCIC approved procedures applied when calculating the approved yield.

- **Residue Insurance Liability:** The amount of insurancefor the producer, expressed in dollars, applicable to residue coverage. Liability is calculated as the product of the guarantee and the contact price (subject to a cap) times the share.
- **Underwriting:** Under the pilot construct, only residue produced on acreage under a production contract for biomass refinery operations would be insurable.
- **All other terms are as defined in the Basic Provisions or are defined in the endorsement parallel to those definitions.**

X.A. Calculation of a Residue Yield Guarantee and Liability

The following process illustrates the determination of a residue yield guarantee:

Step 1. Determine the Approved Yield for the underlying crop individual policy.
Step 2. Multiply the result of Step 1 by the Conversion Factor.
Step 3. Multiply the result of Step 2 by the coverage level, the number of acres, and the producer‘s share.

For example, assume the following corn grain production history for a corn producer in Iowa

Year	Annual Producer Yield per Acre (bushels per acre)
2003	161
2004	175
2005	180
2006	165
2007	176
2008	170
2009	185
2010	180
Average	174

Further assume the county actuarial documents publish a Conversion Factor for corn stover of 0.0056 tons of stover/bushel of corn and a Residue Price Election of $50 per ton. The Residue Contract Price in the producer‘s contract with the biorefinery is $40 per ton after deductions for the transportation costs from farm-gate to the biorefinery. The number of acres, share, and Coverage Level are the same as those used in the underlying crop policy. In this example, assume the producer insures 800 acres of corn, has a 100 percent (1.00) share, and selected a 75 percent (0.75) coverage level.

Assume the producer has no yield substitutions or ―plugs.” The producer‘s Approved Yield for corn is 174 bushels/acre. The second step in determining the residue yield guarantee is to multiply the Approved Yield by the Conversion Factor. The producer‘s Approved Residue Yield is:

Approved Residue Yield = Approved Yield * Conversion Factor
Approved Residue Yield = 174 bushels/acre * 0.0105 tons/bushel
Approved Residue Yield = 1.83 tons/acre

The third stepin determining the residue yield guarantee is to multiply the Approved Residue Yield by the producer's share, the number of acres, and the producer's selected Coverage Level. The residue yield guarantee is calculated as:

Guarantee = Approved Residue Yield * Coverage Level * Number of Acres * Share
Guarantee = 1.83 tons/acre * 0.75 * 1.00 * 800 acres
Guarantee = 1,098 tons

The producer's liability for residue insurance is then calculated as the product of the Guarantee and the lesser of the Residue Contract Price. In this example, the liability is calculated as:

Liability = Guarantee * Min(Residue Contract Price, Residue Price Cap)
Liability = Guarantee * Min($40/ton, $52/ton)
Liability = 1,098 tons * $40/ton
Liability = $43,920

The producer's liability is $43,920. If the Production to Count of corn multiplied by the conversion factor is less than 1,098 tons as a result of insured causes, the producer will receive an indemnity for the difference.

X.B. Calculation of a Crop Residue Endorsement Premium

The producer premiums for the endorsement are calculated using the same procedure that is used for the yield component of the underlying crop policy since the conversion factor makes the risk of loss exactly equivalent *assuming any quality losses can be translated directly to loss of residue or that this source of loss is not significant.The treatment of losses in the event of prevented planting and for replants also must be established before the equivalence of the premium rate can be established.* Total premium for the endorsement is calculated as the product of the premium rate and the residue liability. As residue production is treated as a direct function of crop production, with the same insurable perils, the same premium rate is applied to the residue premium calculation as would be applied yield protection. In this example, assume the premium rate for the producer is sixpercent.

Total Residue Premium = Residue Liability * Premium Rate
Total Premium = $43,920 * 0.06
Total Premium = $2,635

As is consistent with federal law for individual insurance policies, the endorsement is supported by premium subsidies based on the coverage level selected by the producer. At the 75 percent coverage level, producers are eligible for a 55 percent premium subsidy.

Subsidy = Total Premium * Subsidy Rate
Subsidy = $2,635 * 0.55
Subsidy = $1,449

The producer premium is then calculated as the total premium less the subsidy.

Producer Premium = Total Premium – Subsidy
Producer Premium = $2,635 – $1,449
Producer Premium = $1,186

X.C. Calculation of a Crop Residue Indemnity

The amount of an indemnity, if any, is based on the producer's guarantee, the corn Production to Count, and the Residue Contract Price. As residue yield is treated as a direct proportion of the underlying crop yield, no separate yield assessment process is required. The Production to Count from the underlying crop is converted to the residue Production to Count using the same Conversion Factor used to establish the guarantee. Recall the Conversion Factor from the county actuarial document is 0.0105 tons/bushel. Assume the corn production to count is 96,000 bushels

Production to Count = Corn Production to Count * Conversion Factor
Production to Count = 96,000 bushels * 0.0105 tons/bushel
Production to Count = 1,008 tons

The production loss is determined as the maximum of zero and the Guarantee less the Production to Count. Recall in the example the producer's Guarantee is 585 tons.

Production Loss = Max (Production to Count – Guarantee, 0)
Production Loss = 1,098 tons – 1,008 tons
Production Loss = 90 tons

The producer's indemnity for residue is then determined as the Production Loss multiplied by the Residue Contract Price adjusted for post-harvest costs. The reader will recall the Residue Contract Price in the example is $40/ton while the Residue Price Election was $50/ton.

Indemnity = Production Loss * Residue Contract Price
Indemnity = 90 tons * $40/ton
Indemnity = $3,600

X.D. Units

The endorsement uses the same unit structure as the underlying individual crop policies to which the endorsement applies.

X.E. Insurable Types and Practices

The endorsement would use the same types and practices as the underlying individual crop policies to which the endorsement applies.

X.F. Coverage Levels

Coverage would be available in 5 percent increments from 50 percent to 85 percent. Coverage for the crop residue should be the same as for the underlying grain crop. The endorsement should not be offered for CAT level coverage, consistent with the terms of the CAT Endorsement that prohibit optional coverage from attaching to the CAT Endorsement. Written agreements for residue should not be offered; however, a written agreement for the underlying crop is acceptable as long as the underlying crop is not insured under a pilot program.

X.G. Insurance Dates

The endorsement should use the same insurance dates as the underlying individual crop policies to which the endorsement applies, as recorded in the special provisions of insurance.

X.H. Eligibility

The endorsement can use the same eligibility requirements as the underlying crop policies to which the endorsement applies.

X.I. Pilot Counties

The endorsement can apply to all counties where the underlying crop policies are available. However, the endorsement will only be available to producers who have a production or crop residue productionunder contract for delivery of as feedstock for a biofuel refinery. Consequently, the pilot areas would expand as these refineries come on-line and as they expand their biofuels production using crop residues.

X.J. Insurable Causes of Loss

Any cause of loss that triggers a loss under the yield component of the underlying crop coverage also triggers a loss under the endorsement.

X.K. T-Yields and Yield Substitution

All rules applicable to determining the approved yield for the primary crop remain in effect. The approved yield for the residue is simply a factor of those determinations.

X.L. Methods to Formulate Expected Prices

The recommended price is the Residue Contract Price subject to a cap. There are very limited data available to document actual sales of crop residue. Much of the residue harvest is used on-farm, except in areas where substantial feed use occurs. However, data on residue sales for biofuel feedstocks should become available over time and can eventually be used to formulate the cap. Until those data are available, the Contractor recommends initially using an approach that incorporates both cost basis and alternate use prices. The cost basis analysis would take into account the costs associated with fertilizer (i.e., the mineral value removed from the farm soil), the maintenance and harvest costs (i.e., the costs of cutting, raking, and baling), and an adjustment to account for net revenues from the residue harvest and sales. The alternate use analysis would examine feed, fodder, and bedding prices to the extent they are available. Following this initial development, a price conversion factor could be developed to establish the caps for residues for corn and wheat based on the underlying grain prices.

X.M. Loss Adjustment Procedures

Production to count for the crop residue is simply a multiple of the published factor and production to count prior to any quality adjustment for the primary crop. While an adjustment to production to count of the primary crop might be needed to account for quality losses of that primary crop, no such adjustment will be made for the residue. Problems with residue quality are generally caused by post-harvest conditions rather than by conditions affecting production of the residue. No additional in-field loss adjustment procedures beyond those for the primary crop are needed. The DAS currently includes all the data required to calculate production to count for residue except the published factor. Consequently, no change in in-field procedures would be needed; only a change in the use of the data already collected.

X.N. Recommended Year of Implementation

If RMA and FCIC accept the endorsement concept as an appropriate mechanism to insure corn stover, straw, and other crop residues used as feedstocks for biorefinery operations, the total development time should not exceed six months. Consequently, if the development is fast-tracked, it should be possible to have the endorsement in place for the 2013 crop year. With a more unhurried pace, it should be possible to launch the pilot for the 2014 crop year.

Appendix A

Selected Crop Residue Yield and Harvest Limits Resources

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Wilhelm, W.W., J.M.F. Johnson, J.L. Hatfield, W.B. Voorhees, and D.R. Linden, 2004, Crop and soil productivity response to corn residue removal: a literature review. Agronomy Journal 96:1-17, includes a substantial bibliographies addressing the issue of harvestable residue quantities.

Appendix B

Crop Residue Biofuel Feedstock Contract

Contract # NNNNNNNNNN

Master Biomass Purchase Agreement

This Master Biomass Purchase Agreement (this ‗Agreement') is made by a buyer with a place of business at ________________________________
and (‗Seller'), with a place of business at ___________________________________.

By its signature below, each party to this Agreement agrees that this Agreement constitutes its legal, valid and binding agreement, enforceable in accordance with its terms. Once signed, any reproduction of the Agreement or any exhibit or attachment to it made by reliable means (for example, electronic copy, photocopy, or facsimile) will be considered an original, and all Cobs ordered under this Agreement are subject to it.

Seller: _____________________

By: ______________________ Authorized Signatory

By: ________________________ Authorized Signatory

Date: ____________________

Date: ____________________

1. QUANTITY. During the period from _______ to _______, the Buyer agrees and commits to order and purchase, and Seller agrees and commits to sell and deliver upon order by MM/DD/YY not less that the following amounts of Bone Dry Tons of second pass bales (‗Second Pass Bales') of corn cobs and other high cut corn plant material other than corn cobs and corn grain (such bales of cobs and material, ‗Cobs'), on and subject to the terms and conditions of this Agreement.

12-Month Period	SecondPass Bales of Cobs
10/1/2011-9/30-2012	NNN Bone Dry Tons (+/- 10%)
10/1/2012-9/30/2013	NNN Bone Dry Tons (+/- 10%)
10/1/2013-9/30/2014	NNN Bone Dry Tons (+/- 10%)
10/1/2014-9/30-2015	NNN Bone Dry Tons (+/- 10%)

The amount of Cobs for each 12-month period set forth above may be adjusted +/-25% by the parties, in light of changes in the amount of land farmed and cropping rotations by Seller, by an amendment to this Agreement signed by both parties in accordance with clause (b) of the first sentence of Section 13 below. During the period from October 1, 2011 through September 30, 2015, Seller may offer to sell and deliver and the Buyer has the option to purchase from Seller pursuant to Section 6 below, additional amounts of Cobs, on and subject to the terms and conditions of the Agreement.

2. ORDERING AND PRICING. Each Order must specify the amount of Cobs to be purchased from Seller and the date or range of dates for Delivery. If an Order does not specify the address were the Cobs are to be delivered, then the address for delivery by Seller shall be deemed to be _______________. Each order shall be governed by and subject to the terms and conditions of this Agreement. Each Order shall be deemed accepted by Seller upon issuance to the extent that such Order does not require Seller to deliver more than its minimum sale commitment amount set forth above for such calendar year (as adjusted from time to time pursuant to Section 1 above) of Cobs. The Buyer may authorize its Affiliates to place Orders hereunder by identifying such Affiliates to

Seller, provided that the Buyer shall remain fully responsible to Seller for each such Affiliate's compliance with this Agreement. The price to be paid by the Buyer for Cobs sold and delivered by Seller pursuant to an Order shall be determined at the time of Delivery as follows (subject to discount as specified in Section 3 below):

Calendar Quarter of Delivery	
Sep 30 – Dec 31	$___ per Bone Dry Ton
Jan 1 – Mar 31	$___ per Bone Dry Ton
Apr 1 – Jun 30	$___ per Bone Dry Ton
Jul 1 – Sep 30	$___ per Bone Dry Ton

3. PAYMENT. Without limiting the Seller's warranties contained in this Agreement, Seller and Buyer agree as follows: The price payable by the Buyer for Cobs sold pursuant to an Order shall be discounted, or Cobs rejected by the Buyer based upon the amount of (a) moisture (_Moisture'), (b) dirt, rocks, and similar natural debris (_Debris'), and (c) corn stalk (_Stalk') contained therein at the time of Delivery, in each case as determined by _________ as follows:

Moisture			Debris			Stalk		
0 to 35%	35.1 to 50%	50% +	0 to 3%	3.1 to 5%	5% +	0 to 25%	25.1 to 30%	30% +
No discount	___ per BDT discount	Rejected – no sale	No discount	___ per BDT discount	Rejected – no sale	No discount	___ per BDT discount	Rejected – no sale

In addition, the price payable for Cobs delivered a week or more after the date or range of dates specified in the applicable Order shall be discounted $2 per Bone Dry Ton. The price payable by ____ for Cobs sold pursuant to a particular Order shall be due and payable 15 days after all Cobs covered by the Order have been delivered. ____ shall pay Seller such price plus any applicable sales and other similar taxes. Seller agrees that it shall be solely responsible for and shall pay all freight, transportation, in-transit insurance and similar charges and amounts, and shall promptly reimburse ____ for the same if ___ incurs any such charges and amounts on Seller's behalf. The price payable by ____ for Cobs may be adjusted from time to time by an amendment to this Agreement signed by both parties in accordance with clause (b) of the first sentence of Section 13 below to reflect changing market prices and conditions affecting the parties.

4. TITLE, RISK OF LOSS, DELIVERY AND ACCEPTANCE. Seller agrees to deliver all Cobs to the Buyer FOB Destination at the address specified or deemed specified in the Order (_Delivery'). Seller agrees to use a carrier selected from a list of carriers provided by the Buyer and based on availability to meet the delivery schedule. Such carrier shall not be an agent of the Buyer and the Buyer shall have no liability for the performance of the carrier. Title to and risk of loss for the Cobs shall transfer to the Buyer upon Delivery. Acceptance by the Buyer of the Cobs shall be deemed to occur upon Delivery unless the Buyer rejects the Cobs at Delivery or within a reasonable time thereafter. Seller agrees that the Buyer may return to Seller or dispose of all rejected Cobs and that Seller shall, on demand, (a) reimburse the Buyer for all costs and expenses incurred by the Buyer in connection with the rejection, storage, return, and/or disposal of any cobs.

5. SELLER'S WARRANTIES. Seller represents and warrants to the Buyer and agrees as follows: (a) Seller will deliver, at the time of Delivery thereof, good and marketable title to all Cobs, free and clear of any and all (i) liens and encumbrances and (ii) restrictions on use or sale; (b) all Cobs will be, at the time of Delivery thereof, of merchantable quality and fit for their intended use, and produced and collected in conformity with the Buyer**'s** specifications and standard operating procedures therefore as from time to time made available by the Buyer (and Seller hereby agrees to permit the Buyer and its agents and nominees to enter upon its premises and inspect and audit at reasonable times Seller's Cobs, Cob production and collection practices and records; (c) Cobs formed into round bales will be wrapped with **buyer-**approved net wrap; and (d) all Cobs will, at the time of Delivery thereof, (i) be free of man-made and foreign materials, (ii) have been grown, produced, collected and sold in compliance with all applicable laws and regulations, including but not limited to land use, agricultural, environmental and labor laws and regulations, (iii) consist (as determined by the Buyer on a BDT basis) of not less than **NN percent** corn cobs and not more than **NN percent** other corn plant material other than corn cobs and corn grain, and (iii) have been

produced through the collection by Seller at harvest of not more than **NN percent** of the above-ground corn plant material other than corn grain.

6. OPTION TO PURCHASE. Seller agrees that the Buyer shall have an option to purchase all or a portion of all Second Pass Bales of Cobs produced by Seller in excess of
Seller's minimum sale commitment amount set forth in Section 1 above ("Excess Cobs"). Seller agrees to complete, sign and return to the Buyer, on the Buyer**'s** documents, a certified inventory in writing, setting forth in detail the amount of Second Pass Bales of Cobs collected by Seller in connection with each harvest within 20 days after the substantial completion of the harvest. the Buyer shall have 90 days from its receipt of such inventory to exercise its option to purchase all or a portion of such Excess Cobs and to provide written notice to Seller of such exercise. Upon and to the extent of any such exercise by the Buyer**,** Seller shall become obligated to sell to the Buyer upon order by the Buyer and the Buyer shall become obligated to purchase from Seller, such Excess Cobs during the 12-month period in which such harvest was completed and otherwise on the terms and conditions contained in this Agreement. The pricing for all such Excess Cobs shall be determined in accordance with Sections 2 and 3 above.

7. OPTION TO TERMINATE. Anything herein to the contrary notwithstanding, the Buyer may terminate this Agreement effective as of September 30 in any year by giving to Seller (a) written notice of such termination and the effective date thereof not less than **NN days** prior to the effective date of such termination and (b) a termination fee in the amount, as applicable and without duplication, of (i) **$NN** if Seller principally uses a large square baling system in connection with Seller's performance hereunder, (ii) **$NN** if Seller principally uses a loose cob collection system, or (iii) **$NN** if Seller principally uses a round baling system, which fee shall be due and payable on or before the effective date of such termination

8. DEFAULT AND TERMINATION. Seller acknowledges and agrees that any breach or default by Seller of any of its representations, warranties, agreements, covenants or obligations under this Agreement or any Order shall constitute a breach and default under this Agreement and under any other agreement, written or oral, between Seller, on the one hand, and the Buyer, on the other hand. In the event of any such breach or default by Seller, the Buyer may terminate this Agreement, and any of the Buyer or any the Buyer**'s** Affiliate that is a party to any other agreement with Seller may terminate such other agreement, by written notice to Seller. The parties acknowledge and agree that termination or expiration of this Agreement shall not release either party from any obligation, liability, breach or default arising or accruing hereunder or thereunder prior to such termination. Sections 8 through 13 of this Agreement shall survive any termination or expiration of this Agreement.

9. LIMITATION OF LIABILITY; INDEMNITY. Seller understands and agrees that, if the Buyer breaches this Agreement, the Buyer will be liable only for direct contractual damages and not for any other damages, whether consequential, special, punitive or other, including but not limited to loss of business or profits, whether in contract or tort or under any other legal theory or doctrine, even if the Buyer has been advised of the existence or possibility of such damages. Seller agrees to defend, indemnify and hold harmless the Buyer and its Affiliates and the Buyer and its Affiliates' respective directors, officers, employees, members, contractors and agents each, a **xxx** from and against any and all claims, suits, demands, judgments, liabilities, damages, losses, costs and expenses (including the reasonable costs of investigation and reasonable fees of attorneys and other professionals) arising out of or resulting from (a) any breach by Seller of this Agreement or (b) any negligent or other act or omission of Seller or its employees, agents or contractors related to or in connection with performance of this Agreement.

10. FORCE MAJEURE. If either party is delayed or interrupted in performing any portion of this Agreement by causes beyond its reasonable control, or in the case of **xxx** if the Buyer is delayed or interrupted in operating its **facility** at full capacity by causes beyond its reasonable control, including civil commotion, riot, public enemy, insurrection, sabotage, war, governmental actions, regulations or controls, fire, explosion, flood, drought or other accident, casualty or act of God, strike, lockout, labor unrest or disputes, delays by suppliers, manufacturing or technological delays or problems, inability to obtain materials or services, such party shall be excused from performance for the period of the delay or interruption and for a reasonable time thereafter, and **xxx** minimum purchase commitment amount and Seller's minimum sale commitment amount under Section 1 above shall be appropriately reduced.

11. CHOICE OF LAW ARBITRATION. This Agreement and its validity, interpretation, construction and performance shall be governed by the laws of the United States and the **state** exclusive of any conflicts of law

principles. Except for the right of a party to apply to a court of competent jurisdiction for a temporary restraining order, preliminary injunction, or other equitable relief to preserve the status quo or prevent irreparable harm, any dispute in connection with this Agreement shall be exclusively determined by binding arbitration in accordance with the commercial arbitration rules of the American Arbitration Association, **xxx,** before a single arbiter, who shall be a highly regarded commercial trial attorney specializing in commercial disputes. No action or right to arbitration arising out of or in connection with this Agreement or any transaction hereunder may be brought by Seller more that twelve (12) months after the cause of action or right to arbitration has arisen.

12. CERTAIN DEFINITIONS. For purposes of this Agreement: (a) ‗Affiliate' means, with respect to a party, any person that is controlled by, is under common control with or controls such party (whether such control arises from ownership interests by contract of otherwise) (b) ‗Bone Dry Ton' or ‗BDT' means the bone dry-ton weight equivalent as determined by **xxx** with its commercial weight scales and moisture measurement equipment at the time and place of Delivery of the actual tonnage of Cobs delivered by Seller. (c) ‗Order' means a written purchase order (electronic or other) issued to Seller hereunder that specifies an amount of Cobs to be purchased by **xxx** from Seller and the Delivery date(s) therefore.

13. MISCELLANEOUS. This Agreement (a) is the final, exclusive and entire statement of the agreement of the parties and supersedes all previous and contemporaneous written and oral representations, conditions, promises, agreements and communications between the parties with regard to the subject matter hereof; (b) may be amended or modified only by a writing that expressly refers to this Agreement and is signed by an authorized representative of each party; and (c) shall control in case of any inconsistent or conflicting terms set forth on the face or reverse side of any Order or other document, acknowledgment, confirmation or other writing that are different from or in addition to those specified herein, which inconsistent or conflicting terms shall not be binding on the parties even if reflected in an accepted Order unless both parties have expressly agreed to be bound by such terms and conditions in a writing signed by an authorized representative of each that references this Agreement. Seller agrees to keep confidential and not disclose the terms of this Agreement. Seller agrees the Buyerand its Affiliates and agents and contractors may store and use Seller's contact and other information, including names, addresses, phone numbers and e-mail addresses, anywhere they do business and that such information may be processed and used in connection with Seller's and the Buyer**'s**, business relationship, and may be provided to contractors, business partners and assignees of the Buyer and its Affiliates for uses consistent with their collective business activities (for example, for processing orders, for promotions, and for market research). Seller shall not assign or otherwise transfer this Agreement or any right or obligation hereunder without the Buyer's written consent. No decision, action or inaction by a party shall be construed to be a waiver of any rights or remedies available to it. The fact that one of the parties may have drafted this Agreement or any of its provisions shall not be given any weight or relevancy in interpreting this Agreement. If any part of this Agreement is unenforceable, the validity of the remaining provisions shall not be affected. Other than Orders, all notices, requests, demands, or other communications required or permitted to be given hereunder shall be in writing and addressed to the parties or their designees at their respective addresses first set forth above and shall be deemed to have been duly given when mailed by either certified mail or recognized overnight courier, confirmed facsimile transmission (including facsimiles sent via email) or delivered in person. Facsimile signatures shall be deemed to be equivalent to original signatures for purposes of this Agreement.

Appendix C

Stakeholder Input:Listening Session Agenda

Crop Residue Insurance Feasibility Study
Listening Session Agenda

- Introductions
  - Watts and Associates, Inc.
  - Attendees
- Purpose
  - Share Background information
  - FCIC Insurance Feasibility Contracts
  - W&A previous developed co-product insurance
  - Identify insurance issues involving managing risk
  - Gather interest in the concept
  - W&A to make assessment of feasibility under the Act
- Feedback
  - Interest
  - Risks/Perils
  - Production Activities
  - Soil Organic Content/Residue Requirements
  - Potential Co-Product Markets
  - Available Data
- Questions