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Renewable Energy and Rural Development

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Chairman Harkin, members of the Senate Committee on Agriculture, Nutrition, and Forestry, thank you for the opportunity to appear today to discuss the potential impacts to agriculture and the nation as we pursue increased renewable energy. I am Daniel De La Torre Ugarte, an Agricultural Economist located at the University of Tennessee. Both of my colleagues Burton C. English and Kim Jensen send their regrets for not being able to attend this hearing.

We have been involved in a number of studies during the past several years that examine the impacts increased renewable energy might have on the agricultural sector and the nation's economy. Two recent studies have been completed for the Governors' Ethanol Coalition and for the 25X'25 Economic Work Group. Both these studies have similar findings, hence we are going to focus on the 25X'25 study but integrate some information learned form the Governors' Ethanol Study near the end of the testimony. Both of these studies are available on the World Wide Web at: http://beag.ag.utk.edu/.

The 25X'25 study was designed to determine the feasibility of America's farms, forests and ranches providing 25 percent of U.S. total energy needs while continuing to produce safe, abundant and affordable food, feed and fiber. In addition, the analysis projects the associated impacts of achieving the goal on the agricultural sector and the nation's overall economy. According to the U.S. Dept. of Energy (DOE), estimated energy use in 2005 was 100.5 quadrillion British Thermal Units (quad). Based on DOE estimates and a recent RAND study, the nation will annually consume about 117.7 quads of energy by 2025. To put a quad in perspective, about 4.4 million households would consume a quad of energy through electricity and gasoline use in one year.

To meet the 25x'25 vision, 25 percent of the projected 117.7 quads or 29.42 quads are needed from renewable energy sources. At present, an estimated 1.87 quads are produced from biomass (agricultural/forestry) resources in the production of electricity and/or heat. Based on information from the RAND study, it is estimated that, by 2025, 12.10 quads will be annually produced from geothermal, solar photovoltaic, hydro, and wind generation. Therefore, to meet the 25x'25 goal of 29.42 quads, an additional 15.45 quads would need to come from agricultural and forestry feedstock sources.

Key findings in this analysis:

? America's farms, forests and ranches can play a significant role in meeting the country's renewable energy needs.

? The 25x'25 goal is achievable. Continued yield increases in major crops, strong contributions from the forestry sector, utilization of food processing wastes, as well as the use of over one hundred million acres of dedicated energy crops, like switchgrass, will all contribute toward meeting this goal. A combination of all of these new and existing sources can provide sufficient feedstock for the additional 15.45 quads of renewable energy needed.

? The 25x'25 goal can be met while allowing the agricultural sector to reliably produce food, feed and fiber at reasonable prices.

? Reaching the goal would have an extremely favorable impact on rural America and the nation as a whole. Including multiplier effects through the economy, the projected annual impact on the nation from producing and converting feedstocks into energy would be in excess of $700 billion in economic activity and 5.1 million jobs in 2025, most of that in rural areas.

? By reaching the 25X'25 energy goal, the total addition to net farm income could reach $180 billion, as the market rewards growers for producing alternative energy and enhancing our national security. In 2025 alone, net farm income would increase by $37 billion compared with USDA baseline projections.
? Reaching the goal would also have significant positive price impacts on crops. In the year 2025, when compared with USDA baseline projections, national average per bushel crop prices are projected to be $0.71 higher for corn, $0.48 higher for wheat, and $2.04 higher for soybeans.

? With higher market prices, an estimated cumulative savings in government payments of $15 billion could occur. This does not include potential savings in fixed/direct or Conservation Reserve Program (CRP) payments.

? In the near term, corn acres are projected to increase. However, as cellulosic ethanol becomes commercially viable after 2012, the analysis predicts major increases in acreage for a dedicated energy crop like switchgrass.

? The higher feed crop prices do not result in a one-to-one increase in feed expenses for the livestock industry. Increases in ethanol and biodiesel production result in more distillers dried grains (DDG's) and soybean meal, which partially compensate for increased corn prices. Moreover, the integrated nature of the industry allows for the adjustment of animal inventories as a way to adjust to the environment and increase net returns. In addition, the production of energy from manure and tallow could provide additional value for the industry.

? Contributions from America's fields, farms and forests could result in the production of 86 billion gallons of ethanol and 1.2 billion gallons of biodiesel, which has the potential to decrease gasoline consumption by 59 billion gallons in 2025. The production of 14.19 quads of energy from biomass and wind sources could replace the growing demand for natural gas, diesel, and/or coal generated electricity. These renewable energy resources could significantly decrease the nation's reliance on foreign oil, fossil fuels, and enhance the national security of all Americans.

Methodology:

This type of cutting-edge research on the economics of alternative energy required UT researchers to combine two computer models in order to provide a comprehensive outlook at both the agricultural sector and the national and state economic impacts. A computer simulation model, POLYSYS, and an input-output model, IMPLAN, were used for the study. POLYSYS has been used for a number of national agricultural studies that require projections on the impacts on agricultural acreages and production by U.S. Agricultural Statistical Districts as the result of federal farm policy changes. IMPLAN contains state level input-output models that provide an accounting of each state's economy.

The methodology we used determines the impacts that are likely given the scenario being evaluated and comparing those results to a baseline. In this case, we used the 2005 USDA baseline to the year 2015 and extended it out to the year 2025 (or 2030 in the case of the Governors' Ethanol Coalition project). Some major assumptions in these analyses include: the need to produce approximately 30 quads of energy from renewable sources (Figure 1), increase in yield trends (50% increase in the rate assumed by USDA from 2016 through 2025) above USDA projected increases, commodity programs remain as they are today, corn to ethanol average conversion efficiency increases to 3 gallons/bushel by 2025 and cellulosic ethanol increases to 89 gallons/ton.

Land availability is also an important assumption, in the 25x'25 analysis, we assumed 15 million acres of CRP was available for conversion to switchgrass along with 61 million acres of cropland pasture and a portion of the 395 million acres of pastureland. No forestlands were incorporated into the analysis though the workgroup is seeking to find additional funding so that these lands can be incorporated.

Renewable fuel feedstocks include a variety of agricultural residues, wastes, and dedicated energy crops. The feedstocks incorporated in this analysis are represented in Figure 2.

Results

The remainder of this testimony will present some of the results and challenges that we see as we move toward a cellulosic future. Results discussed include projections on the feedstock converted to energy, land use shifts, changes in commodity prices, distribution of cellulosic materials and dedicated energy crops, impacts of the policy on net farm income and government payments, and finally economic impacts to the national economy.

Feedstocks for Energy

Bioenergy production is derived from several feedstocks (Figure 3). In the initial years of the scenario, corn for grain provides the foundation of the bioenergy industry. By 2012, nearly 14 billion gallons of ethanol is projected to be produced from this nation's grains. Even after the introduction of the cellulosic-to-ethanol conversion technology (in 2012) , corn is projected to continue to play a key role in the overall Supply of feedstock.

However, additional mill wastes, and forest residues enter in as feedstocks in 2012. Reaching the energy goal requires a significant use of cellulosic Attaining the goal is also dependent on the successful introduction of bioenergy dedicated crops such as switchgrass and conversion of wood to ethanol. As production reaches the year 2025, the contribution of bioenergy dedicated crops is over 50 percent of the total feedstock required by the bioenergy industry. In 2015, dedicated energy crops, are supplied from western Tennessee, eastern Texas, and other parts of the Southeastern United States, plus parts of North and South Dakota, Minnesota, Michigan, and northern New York, and the New England States (Figure 4). By 2025, many of the Agricultural Statistical Districts in the Southern United States are producing in excess of a million tons of cellulosic material from dedicated energy crops. The regions in which dedicated energy crops will first expand are in the Southeast and Southern plains. After a few years, dedicated energy crops expand towards the north, but the Southeast and Southern Plains remain the areas with a higher density.

2015 2025

Figure 4. Distribution of the Dedicated Energy Crops.

Other cellulosic feedstocks (crop residues, wood residues, and wood thinning) are initially concentrated in the corn growing areas of the Midwest. Then, the production of feedstock expands towards the Southern Plains and the Southeast. Importantly, the sources of feedstock expand to nearly all 48 contiguous states.

The Midwest and Northern Plains would be the major sources of crop residues (corn and wheat), while the Southeast and Western states would be a major source of wood residues and forest thinning. It is important to reiterate that no forest is specifically harvested for energy purposes in these scenarios. However, the addition of forest resources could have substantial impacts on bioenergy markets and should be the subject of future research. By 2025, in both renewable energy scenarios, the Midwest portion of the country ranging from Texas to North Dakota and from Kansas/Nebraska to Kentucky/Tennessee supplies the bulk of bioenergy materials.

Land Use Shifts

To support the level of feedstock reported above, significant changes in land use are projected to be necessary. Use of agricultural cropland changes when compared to the baseline as agriculture attempts to meet the energy goal (Figure 5). Dedicated energy crops, such as switchgrass, will likely become major crops in U.S. agriculture, with 105.8 million acres planted. Significant shifts from current uses (2007) are projected. For instance, about 20 million acres of soybeans would slowly shift into dedicated energy crops, along with 9 million acres of wheat. In the case of corn, during the last five years of the analysis period, a shift of about 3 million acres would occur, as acreage becomes constrained and more energy per acre is required to achieve the target reflected in both scenarios.

Perhaps the most significant projected change is the shift of pastureland/rangeland and cropland in pasture, hereafter referred to as pastureland, towards the production of energy under the assumption that the feed value of the converted pastureland is replaced through hay production. A share of the shift of 172 million pasture acres (100 million acres) will be used to produce more intensive grasses for animal feed, and the remaining pasture in cropland and the grassland (not cropland) are projected to experience an increase in their management intensity, as it is well recognized that pasture and grassland are significantly under utilized. Consequently, this increase in management intensity is likely to occur at a very low additional cost, and while causing changes in the livestock industry, would not likely jeopardize the welfare of the livestock industry.

Commodity Price and Net Returns Impacts

With a dramatic shift in land use toward energy crops, a corresponding change in average crop prices is anticipated. Therefore, as most major crops have some acreage shifted to energy dedicated crops, an overall increase in commodity prices is projected. Notably, when compared with the baseline prices, the crops that experience larger increases in price have the largest acreage decreases, as is the case of soybeans and wheat (Figure 6). However, the price increases are within price ranges experienced in the last decade.

Crop	For the Projected year of:			
	2010	2015	2020	2025
	$/bu from the Baseline			
Corn	0.16	0.02	0.16	0.71
Wheat	-0.12	-0.23	0.33	0.48
Soybeans	0.09	0.16	1.69	2.04
	$/dry ton			
Dedicated Energy Crops	0	46.85	60.90	81.85
	$/gallon			
Cost of Ethanol	1.57	1.38	1.44	1.60

Figure 6. Projected Change in Prices from the Baseline.

Yields for traditional crops, which increase at rates greater than baseline, are projected to dampen price increases as a result of acreage conversion to energy crops. The price impacts without the higher yields would be significantly higher, and even exceed market prices experienced in the past, especially for corn, wheat, and soybeans. Therefore, expansion of a biofuels industry has to be accompanied not only by investments in bioenergy related elements of the supply chain, but also investments in traditional crops. This will increase the likelihood of success of the bioenergy industry growth.

The impact of the increased demand for agricultural resources, as a result of expanding the role of agriculture as a source of bioenergy, can be observed in the changes in net farm income. A 16.5% increase in realized net returns occurs to the agricultural sector when meeting the energy goal. In the baseline, producers could expect over the entire 20 year period a realized net income of over $900 billion. An increase in realized net farm income of $180 billion is projected to occur over the period of analysis with larger gains in realized net farm income occurring in the latter years under the energy goal. In 2025, for instance, a gain of $37 billion is projected (Figure 7).

Figure 7. Changes in Realized Net farm Income and Government Payments.

As prices of the major crops increase, a reduction in the level of government payments, such as loan deficiency payments and counter cyclical payments, both based on average market prices, would be anticipated. However, the projected payments under the baseline are already substantially lower than historical farm program spending, so the savings in these government payments are relatively small. Consequently, the savings in either type of payment are relatively minor. The majority of changes reflect the decrease in CRP payments that occur as contracts expire and landowners who are attracted by higher crop prices voluntarily move land into production (an aggregated $28 billion over the 20 year analysis period).

Farmers and rural communities throughout the United States benefit from the renewable energy program, as increase in net returns from agriculture increase across the continental US. The gains first occur as a result of the expanded demand for corn, so they are initially concentrated in the Midwest, but as the use of cellulosic feedstock expands, the gains of net returns also expand to all areas of the country (Figure 8). By 2025, the areas with higher gains are located east of the Rockies, where agricultural lands are concentrated and areas to grow energy dedicated crops were identified.

Impacts on the Livestock Sector

The results of the analysis indicate that the livestock sector would face higher feed expenses. However, of the primary feed sources for livestock - hay, soybean meal and corn - only corn is expected to experience a significant increase in price. Hay price is determined at the regional level and is not determined in the POLYSYS model, but in order for cropland in pasture to come into crop production a portion of pasture must be converted to hay production to make up for the regional loss in pasture forage productivity. By 2025 national hay acreage is expected to rise from 62 million acres to more than 167 million acres, an increase of 100 million acres. This represents an intensification of the management of the pasture land. While there could be a one time cost of shifting cropland in pasture to hay, it is not expected to be of any long term significance. As cropland in pasture is replaced with hay acreage, hay price is not expected to rise.

Although there is a large decline in soybean acreage, the soybean meal supply, a key feed ingredient, does not change significantly. This is due to two major reasons - decreased exports of soybeans and a large influx of soybean meal byproduct from biodiesel production. By 2025, soybean acreage drops quite significantly from 66.9 million acres to 53.3 million acres, a loss of 13.6 million acres resulting in a production drop of 437 million bushels. Increased soybean prices cause exports to decline from 1,099 million bushels to 481 million bushels, a drop of 618 million bushels. Biodiesel production demands 276 million bushels. Soybean crush demand (independent of biodiesel) drops by 138 million bushels. The soybean meal supply actually increases slightly due to 6,284 thousand tons of byproduct from biodiesel production. This causes soybean meal price to increase slightly from $177 per ton to $180 per ton. Note that as the use of soybeans for biodiesel increases, the driving product in the soybeans complex shifts from the meal value of the soybeans to the oil value of the soybeans.

The various components of the livestock industry react differently to the higher feed prices driven by the inclusion of corn in the feed ration, by the importance of the feed expenses in the overall cost of production, and by the ability to transfer the cost of the additional feed expenses to the consumer.

The cattle sector reacts to the cost increase by adjusting cattle inventories. The reduction in inventories leads to higher prices that offset the sector's increased production costs. By 2025, cash receipts from cattle increase $532 million over baseline. Feed costs increase $115 million over baseline and net returns increase by $417 million, which is about a 3.9 percent gain in total net returns to cattle. It is important to note that increased costs incurred as a result of more intensive roughage management are not accounted for in the livestock analysis.

The hog and poultry industries experience decreases in net returns. In both industries, corn is a major component of feed ration, and consequently the cost of feed increases result in noticeable drop in net returns. The increase in feed expenses by 2025 in both industries is above a billion dollars, mostly in the poultry sector. The model results indicate that the production adjustment and increase in prices are not large enough to compensate for that increase in feed expenditures. However, it is very important to emphasize that the model is not fully able to capture the high degree of vertical coordination in the poultry and hog industry. Vertical coordination and associated production contracts make predicting market adjustments difficult. The model also reflects consumption of DDG's by the hog and poultry sectors of up to 10%. Given emerging technologies and genetic improvements, it could be possible that a greater portion of DDG's may become part of the feed ration for these species.

Other factors need to be mentioned which have not been accounted for in the quantitative analysis. First, as the production of forage increases as a result of the added management, there would be a long term change in the feed ration of cattle, in which corn and soybean meal would be partially replaced by increased pasture and forages. This would in turn contribute to reduce the price pressure for the feed in the poultry and hog industries. Second, the process of converting cellulosic material to ethanol through fermentation opens up the opportunity to produce byproducts with a high content of protein and energy suitable to replace corn and soybean meal in the livestock industry . This integration of the energy feedstock conversion and livestock production would result in gains for the livestock industry not quantified in this report. Finally, no changes in feeding efficiency are considered during the period of analysis.

Impacts on the Nation's Economy

The impacts on the economy are spread throughout the United States. As a result of changes in the agricultural sector, Illinois, Iowa, Missouri, and Nebraska receive benefits in excess of $10 billion per year (Figure 9). An estimated $533.8 billion dollars is generated annually in the conversion of renewables to energy. Assuming the renewable energy sector is developed in close proximity to the feedstocks, the states that receive the greatest benefit include the same states Illinois, Iowa, Missouri, and Nebraska. However, states receiving over ten billion dollars in increased economic activity include in addition to these four states, Texas, Kansas, Minnesota, and Indiana. Interstate commerce associated with conversion that cannot be assigned to any individual state is nearly equal to impacts that are allocated. Including both allocated and unallocated economic activity, 5.2 million jobs are estimated to be created from the development of a renewable energy sector beyond what exists today. In total, $252 billion is directly generated in the economy purchasing inputs, adding value to those inputs and supplying the energy. These expenditures create additional impacts. The total impact to the nation's economy is estimated at slightly more than $700 billion creating an estimated five million jobs. Since the 29 quads of energy created by the renewable energy sector would not impact current production levels, any reduction in economic activity resulting from current energy industry displacement is minimal and no adjustments were made to the current renewable energy sector. These benefits do not include the impacts of investing in 1,000 new cellulosic ethanol facilities, the wind turbines, the additional corn ethanol facilities, etc. These one time impacts exceed $1 trillion to the economy.

Final Remarks

Pursuit of the 25x'25 vision will not be without challenges and actions required to facilitate meeting this vision. These actions include the following:

? Provide the funding and risk reduction necessary to ensure that the cellulose to ethanol path is commercially available by 2012. This will reduce the pressure on a single crop-corn-strategy;
? Continue investing in agricultural research in the traditional crops, and increase research activities in the agronomics of dedicated energy crops. Higher yields would reduce pressures over the land resource and on prices;

? Create opportunities for the livestock and poultry sectors to improve their ability to utilize the byproducts from this new renewable energy industry as well as for improved efficiency of the nation's pasture lands;
? Define and create public incentives ensuring environmental sustainability and enhanced benefits to rural communities;

? Support the expansion of dedicated energy crops, like switchgrass, to 100 million acres through significant increased extension efforts that disseminate best management practices to farmers;
? Create an environment for agribusiness to gear up its role to satisfy the input demand from energy dedicated crops in the areas of seed, chemical labeling, and machinery;
? Support the efforts to solve key issues in the supply of feedstock to biorefineries including the pre-treatment of feedstocks as well as the transportation, storage, and handling of those feedstocks;
? Create an environment that supports the development of the infrastructure and efforts needed to construct between 700 and 1,200 biorefineries;
? Support the development of an efficient and reliable system to distribute 86 billion gallons of ethanol from the biorefineries to the sales point creating an ethanol infrastructure capable of delivering up to E85 to the public; and
? Define the role of trade.

Finally, members of the committee, it must be stated that while the challenges in meeting such an energy goal are great, rarely are the payoffs fourfold or a win-win-win-win-win situation. In developing this industry, the nation could experience a win for agriculture in terms of net returns, a win for rural development with additional economic activity from producing and converting biomass feedstocks, a win for national energy security, and a win for the environment.