

## Why Biomass is Important -- The Role of the USDA Forest Service in Managing and Using Biomass for Energy and Other Uses

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### Introduction

Across the United States, major discussions are taking place regarding the relationships among energy, economic growth and security, the environment, and national security. A critically important part of these discussions is the intersection of energy security, environmental quality, and economic health (Fig. 1). Integrated production, management, harvesting, and conversion of woody biomass to efficiently produce energy and replace a significant portion of fossil fuels are fundamental to optimizing this balance. Our Nation's forests are a strategic asset in this arena.

As a Nation, we use science-based conservation and management to renew and restore our forests and sustainably enhance our economy and social well being. Forest Service, university, and industry researchers and other partners have led the way and have worked together to better restore, enhance, manage, use, and protect our forest resources. Our Nation's forests provide clean water and air, critical habitat, and abundant recreation opportunities to the American people. Our nation has vast forest resources that reflect the American conservation ethic and our history of science-based management.

**Woody Biomass:**  
trees, including limbs, tops, needles, and other woody parts, wood and wood wastes, residues, and municipal wood wastes.

Biomass is a complex issue that will need to be addressed through many disciplines and integrated programs involving wood science, silviculture, engineering, climate change, water and air quality, economics, and many more.

Woody biomass is an integral component of forest management that offers both problems and opportunities for managers, landowners, and for the nation. The issues concerning biomass utilization involve challenging science questions and policies, and technical barriers.

#### Goals of Biomass for Energy

- Enhance National security
- Benefit the environment
- Balance trade deficits
- Bolster rural economics

Taken from speech at 25x'25 Summit II, March, 2006, Washington, DC.

There are opportunities to use our forests as a cornerstone of the biobased revolution, a fundamental change in the way we produce and conserve energy and industrial products (Biomass Technical Advisory Committee 2002).

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We can derive products as diverse as fuels, lubricants, heat and electricity, chemicals, food, feed, building materials, paper, clothing, and much more from biological resources. Biomass will have an important role in energy, the environment, and economy of the future.

### **Energy, Environment, Economy and Forest Management**

Energy, Environment, and Economy – the three big E’s are so intertwined that it is almost impossible to discuss any one independent of the other two. Our dependence on oil brings with it concerns for long-term environmental impacts, energy security, and rising costs of living.

Biomass for energy, especially biofuels, has positive attributes that contribute to a healthy environment and economy. Biomass utilization can reduce forest management costs, help mitigate climate change, reduce risks to life and property, and help provide a secure, competitive energy source. Shifting to a homegrown, renewable energy economy provides opportunities for growth and expansion, especially for rural communities as these renewable feedstocks are directly connected to the land, primarily agricultural and forestry lands.

Our forests are a renewable strategic asset in meeting the Nation’s need for secure and affordable energy, environmental services, and economic health. Our ability to sustainably manage our resources without degradation to ensure secure and affordable access to goods and services is still the most critical priority for the future<sup>1</sup>. Forestry has always had a crucial role in protecting the environment and securing the U.S. economy. Now forestry has a significant role and opportunity in providing renewable energy, and liquid biofuels that can support our large transportation system.

Sustainability explicitly considers both present and future generations, and the triple bottom line of social, economic and environmental factors. Sustainability is place-based. In discussing sustainability we recognize that places can be as small as homes or communities, and as large as the earth itself. We seek economic actions that fully consider society’s need and operate in a way that promotes and enhances the environment. Increased use of renewable biomass for fuels and biobased products as replacements for fossil fuel intensive commodities fits within this integrated context by providing substantial societal benefits.

### Energy

Dependence on oil is an environmental concern and dependence on foreign oil weakens our national security and our economy. Oil imports and costs have climbed to record highs (see Figs. 2<sup>2</sup> and 3<sup>3</sup>). The U.S. cannot continue to rely on foreign wells and

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<sup>1</sup> Ecosystems and Human Well-being: Opportunities and Challenges for business and Industry.  
<http://www.maweb.org/en/index.aspx>

<sup>2</sup> Energy Information Administration, Annual Energy Review 2004, Report No. DOE/EIA-0384(2004)  
Posted: August 15, 2005, <http://www.eia.doe.gov/emeu/aer/pdf/perspectives.pdf>

facilities for petroleum, especially for our transportation fuels. About 59% of our current oil use is imported, with approximately 20% coming from the Persian Gulf. America is a mobile country – our economy is built on transportation systems; our quality of life is dependent on access to low-cost transportation.

Currently, excluding hydropower, only about 4% of our energy is from renewable sources and primarily produces power and heat. About 10% of biomass energy is being used for transportation fuels and that is primarily corn ethanol. We have long used agricultural and forestry biomass, primarily forest and wood waste, to generate electricity, supply heat and steam power, and to heat homes. The critical opportunity before us is to displace petroleum consumption using biobased products and biofuels from biomass. Additionally, energy can be conserved by using more energy-efficient housing products and manufacturing processes.

A question that has been asked is whether we have sufficient supplies of biomass to displace significant amounts of fossil energy. A recent joint Department of Energy (DOE)/U. S. Department of Agriculture (USDA) study (Perlack and others 2005) showed that the U.S. can realistically displace 30% of our current petroleum consumption with biomass – an amount approximately equivalent to one billion dry tons of biomass (Fig. 4).

There are several aspects to energy and biomass that are important attributes to set the stage for discussions in this paper:

- Creating transportation fuels from biomass is technically and politically possible;
- Using fuels from biomass is the only feasible, renewable, mass transportation fuel alternative for the short- to mid-term;
- Being “home grown from our lands” provides improved rural economic opportunities now and into the future;
- Having our own conversion facilities in a “new industry” improves energy security, National security, and U.S. economic health; and
- Having the needed feedstock supply is dependent on America’s working farms and forests.

Brazil has already gone to an ethanol economy. They have the largest commercial application of biomass in the world, using sugar cane to produce ethanol. When the sugar markets plummeted and oil imports got too high, Brazil converted the sugar industry to ethanol production. The conversion was made possible by having a land base, an appropriate crop, good growing conditions, public and private capital, and government action.<sup>4,5</sup> Like Brazil, the U.S. has a substantial land-base in agricultural and forestry uses.

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<sup>3</sup> Energy Information Administration, This Week In Petroleum, page last modified on Wed Mar 8 12:59:54 EST 2006. [http://tonto.eia.doe.gov/oog/info/twip/twip\\_crude.html](http://tonto.eia.doe.gov/oog/info/twip/twip_crude.html)

<sup>4</sup> <http://www.truthabouttrade.org/article.asp?id=5029>

<sup>5</sup> <http://brazilembassyinindia.com/proalcool.htm>

The focus in the U.S. has switched from grain ethanol to cellulosic ethanol production because of our capacity to provide additional feedstock for ethanol without displacing food and forage crops.

### Environment

The total U.S. greenhouse gas emissions in 2003 were approximately 6,900 million metric tons carbon dioxide equivalent (CO<sub>2</sub> Eq). (US EPA 2005). The largest portion of this results from fossil fuel combustion (Fig 5).

Forests and wood products in the U.S. sequester 753 million metric tons CO<sub>2</sub> Eq, approximately 11 percent of total annual U.S. greenhouse gas emissions. More carbon can be sequestered by our forests through improved forest management including replanting, thinning, forest productivity improvements, low-impact harvesting, managing the forest products pool, species/genotype selection and optimizing rotation length. The use of the material in long-lived wood products and as energy offsets have been shown to be a low-cost carbon mitigation measure (Birdsey and others 2000). We have just completed working with the DOE on the revised 1605(b) Guidelines for Voluntary Greenhouse Gas Reporting<sup>6</sup> as a way to register carbon credits and to provide an incentive for owners to develop policy and plans for enhancing carbon sequestration.

There are many direct and ancillary benefits associated with managing and utilizing excess forest biomass. Many of our forests are unnaturally dense, leading to increased likelihood of large-scale wildfires that endanger life and property, especially communities in the forest-urban interface. They are less resilient to pests and invasives, which can lead to epidemic-level mortality. Landscape-level forest health issues can result in poorly functioning watersheds, and declining and degraded habitats and functions. Removal of biomass can help restore forest vitality and reduce crown fires, and protect and improve habitat for certain species

There are several aspects to biomass and the environment:

- Removing excessive levels of forest biomass can reduce fire risk which results in improved air quality and reduced greenhouse gas emissions;
- Managing biomass can improve productivity and improve forest health and habitat;
- Using biomass in biobased products or for bioenergy can provide CO<sub>2</sub> offsets and reduce greenhouse gases and air pollutants;
- Ensuring sustainable production systems that protect and enhance the environment is a hurdle for transitioning the country to biobased, renewable fuels in sufficient quantities to significantly reduce fuel imports and benefit our economy; and
- Maintaining critical ecosystem services is dependent on maintaining America's working farms and forests.

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<sup>6</sup> <http://www.pi.energy.gov/enhancingGHGregistry/>

## Economy

The U.S. economy has made a dramatic shift from raw materials conversion and the mass production of commodities for world trade to a new paradigm of providing services and being an economy of distribution systems. The service sector accounted for a 42% of the US Gross Domestic Product in 2005 compared with 34% in 1985<sup>7</sup>. The current list of Fortune 500 companies contains more service companies and fewer manufacturers than in previous decades.<sup>8</sup> These shifts, and the movement of people in the U.S. from rural to urban areas, are distancing the linkages to the land in both cultural and economic frameworks in America. The U.S. is increasingly importing lumber, paper, and pulp. The U.S. trade deficit increased from about \$617 billion to \$724 billion, as imports increased nearly twice as much as exports (Fig. 6).<sup>9</sup>

Developing options for creating value from biomass rather than consistently treating it as a disposal problem has significant economic and social values, including potentially improving air quality by reducing fire risks, reducing landfill costs, reducing reduction/removal costs, reducing fire suppression costs, and increasing public safety.

There are several aspects to the role of managing biomass in our forests and creating a biobased economy:

- The high costs of removing excessive biomass can be reduced or reversed through productive use of biomass;
- Reducing biomass can provide tangible and intangible values to landowners and the general public;
- Technical advances are still needed to reduce costs for feedstock production and conversion to biofuels and other products;
- Creating jobs in rural American and keeping our forest-based infrastructure can be an outcome of the biobased revolution; and
- Competing successfully in the global marketplace is an important aspect of a future green economy.

In a report considering wood processing, forest, agriculture, and urban wood residues, the author determined that 4.9 fulltime jobs per megawatt of net plant generating capacity were created, associated with biomass power plants (Morris 1999). These jobs provide stability to local and regional economies and the power plants increase the community tax base.

Currently, 22 states have adopted Renewable Energy Portfolio Standards (RPS), and 29 States have adopted Climate Action Plans (Fig. 7 and Fig. 8)<sup>10</sup>. A national Renewable Fuels Standard for transportation fuels was passed as part of the 2005 Energy Policy Act,

<sup>7</sup> U.S. Department of Commerce Bureau of Economic Analysis. National Economic Accounts Table 1985, 2005. <http://www.bea.gov/bea/dn/nipaweb/SelectTable.asp?Popular=Y>

<sup>8</sup> <http://www.investordictionary.com/definition/service+economy.aspx>

<sup>9</sup> [http://www.bea.gov/bea/newsrelarchive/2006/trad0106annual\\_fax.pdf](http://www.bea.gov/bea/newsrelarchive/2006/trad0106annual_fax.pdf)

<sup>10</sup> Pew Center on Global Climate Change. Learning from state action on climate change. March 2006 update. <http://www.pewclimate.org/docUploads/UpdatePewStatesBriefMarch2006%2Epdf>

and many states are adopting their own Renewable Fuels Standards. The presence of these rules and authorities create incentives and new markets for biobased products and bioenergy.

Renewable energy and biobased products from biomass have “green” value from reducing impacts to, adding value to, and protecting the environment while producing goods and services. “Green economics” is a co-evolution of ecological, environmental, and economic systems and could have an important role in forestry management, specifically for biomass. Green economics is about the world of work, human needs, the Earth’s materials, and how they mesh together most harmoniously. Biomass utilization can have a broader context of a “new economy” that addresses ecological and social concerns. An analysis of the economic contribution of such services was found to be approximately \$33 trillion per year, greater than the activities in the entire global market economy, which totaled about \$25 trillion (Costanza and others 1997).

#### U.S. Fuels Reduction and Biomass Policies

- Biomass Research and Development Act
- Energy Title of the Farm Bill
- 10-year Comprehensive Strategy Implementation Plan
- Healthy Forest Initiative
- Healthy Forests Restoration Act
- MOU on Woody Biomass Utilization
- Energy Policy Act

Forests have an important role in carbon sequestration and climate change as previously mentioned. Forests, and how we manage our forests, have critical environmental implications beyond climate change. Biomass management is one of, if not the most, significant keys to healthy, productive, and sustainable forests for the future. Biomass utilization can be the key to energy security, environmental quality, and a strong domestic economy. In a changed world of petroleum displacement, woody biomass can become an interwoven thread supporting rural communities and ways of life.

#### **Roles of the Forest Service**

Our Agency has invested in biomass management, responding to fuel reduction needs on public and private lands to reduce fire risks and restore ecosystems. The problem is becoming an opportunity using biomass to reduce treatment costs and to provide economic and environmental benefits.

We are integrating several programs across the FS, taking advantage of the full suite of authorities in our National Forest System, State & Private Forestry, and Research & Development programs. The FS also is collaborating with other federal agencies through a formal inter-agency woody biomass utilization working group. Since biomass opportunities exist in agriculture as well as forestry, USDA has a Biobased Products and Bioenergy Coordination Council to ensure that we call upon all our agencies to promote biomass utilization.

## Forest Management

The increased frequency of large-scale forest fires since 1994 has focused attention on forest health problems and heavy fuel loads on both public and private lands across the entire Nation. New laws, policy, and additional funding have sparked an effort to restore and better manage our nation's treasured forests and rangelands. As many as 190 million acres of Federal land in the lower 48 states face high risk of significant insect, disease, and/or catastrophic fire episode.<sup>11</sup> Many of these acres need to be treated to reduce the risks, and can provide biomass for an array of products. USDA has a formal Memorandum of Understanding with the Department of Interior (DOI) and DOE to enhance woody biomass utilization<sup>12</sup>. It calls for:

- Communicating to our employees and partners that the harvest and utilization of woody biomass by-products can be an effective restoration and hazardous fuel reduction tool that delivers economic and environmental benefits and efficiencies;
- Promoting consideration of woody biomass utilization from restoration and fuels treatment instead of burning or other on-site disposal methods; and
- Encouraging development of new mechanisms that increase the benefits and efficiencies of woody biomass utilization.

A major issue for biomass utilization on federal lands is ensuring a reliable and consistent supply to justify developing infrastructure investments and markets. Many forests needing hazardous fuels treatments are in areas that no longer an industrial infrastructure, and market development is a challenge when investors have doubts about the future supply. New laws and policies are making it easier to make long-term contracts on federal lands (side box). Coordinating biomass supply across ownerships in a local area, such as the "Coordinated Resource Offering Protocol" (CROP)<sup>13</sup> is an example of being able to levelize the flow of biomass from public lands and provide a reliable source of material to attract conversion facility investments.

Another issue is the cost of conducting fuels and restoration treatments over such a large area. Utilizing biomass that must be removed can ultimately reduce treatment costs. Early results from one year of improved woody biomass utilization in northern Arizona's White Mountain Stewardship Contract area are demonstrating cost savings in the range of \$200-\$600/acre. This project has resulted in an example of new policy in action with the recently announced 20-megawatt biomass electrical generating plant in Arizona. The plant will use biomass thinning from fuels treatments around communities and contribute to the State's Renewable Energy Portfolio Standard.

In response to stimulating markets and market accessibility, the Forest Service is providing over \$4 million of grants each year to assist with woody biomass utilization projects for small businesses and communities. One goal is to help leverage capital costs of rebuilding infrastructure for woody biomass utilization. Under the Energy Policy Act

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<sup>11</sup> The Healthy Forests Restoration Act – Interim Field Guide. USDA Forest Service. 2004. <http://www.fs.fed.us/projects/hfi/field-guide/documents/haz-fuel-cvr.pdf>

<sup>12</sup> Policy Principles for Woody Biomass Utilization. 2003. <http://www.fireplan.gov/reports/404-418-en.pdf>

<sup>13</sup> [www.healthyforests.gov/initiative/biomass\\_conference/presentations/mater.ppt](http://www.healthyforests.gov/initiative/biomass_conference/presentations/mater.ppt)

of 2005, communities using waste material removed for forest health or fuels reduction for energy and other purposes can receive grants up to \$20/dry ton to assist with transportation of woody biomass for energy, once appropriations are provided.

We have also worked with State and local partners to demonstrate how providing biomass fuels in schools can not only reduce the fuels heating costs, but also provide local use of forest fuels treatments and provide the students with a platform for environmental education. The “Fuels for Schools” initiative is catching on across the country, and builds on successful woody biomass heating demonstrated in the Northeast for many years.

### Research and Development

Forest Service R&D addresses the issues of biomass management and utilization in a holistic approach (Fig 9). The goal is to ensure sustainable systems while providing goods and services. The portfolio includes:

- Improving our forest management and wood utilization options by integrating the use of small-diameter material for biobased products and bioenergy to extend our natural resources, provide renewable energy, increase carbon sequestration, reduce fire and pest risks, and improve forest health.
- Developing new or improved processes for ethanol conversion from wood, small scale wood to energy technology, biobased products from low-valued sources, separation technologies for high value products from wood, and applying new technologies such as nanotechnology and biorefining to product development.
- Providing economical and environmentally acceptable woody cropping systems at multiple operational scales, and integrated management systems for feedstock production.
- Developing and helping deploy integrated management, production, utilization, and conversion systems and technologies for biobased products and bioenergy.
- Improving understanding of the ecological consequences for removing, chipping in place, piling and burning, and other disposal options for woody biomass.
- Improving estimates of woody biomass supply under various fuels treatment, insect and disease outbreak and storm damage scenarios.

We are working with science partners in universities, industry and other federal agencies, and forest landowners and managers to accomplish this work. Wood-based feedstocks include: forest residues (slash and integrated recovery) and wood wastes, material from thinnings and fuel and restoration treatments, short rotation woody crops, and pre-extraction and recovery from commercial wood in biorefineries and through new technologies and market development

The Consortium for Research on Renewable Industrial Materials (CORRIM) has been partially supported by FS R&D in collaboration with the forest industry and universities. A new CORRIM report provided a life-cycle database for quantifying the environmental impacts and economic costs of wood building materials through the stages of planting,

growing, manufacturing, construction, operational use, and demolition. The report shows that wood homes reduce both energy use and carbon emissions (Bowyer and others 2001). CORRIM was heralded as one of the most significant contributions to wood use in wood science history (Youngs 2003).

The Agenda 2020 Technology Alliance<sup>14</sup> is an industry-led, research and development partnership with government and academia to advance innovation in processes, materials and markets. The collaborative, pre-competitive research, development, and deployment supported through Agenda 2020 provide the foundation for new technology-driven business models for the industry to meet competitive challenges and contribute to strategic national needs. FS R&D has been a supporter of the Sustainable Forestry and Biorefinery components of the program since 1999. Significant progress has been made in enhancing forest productivity, reducing environmental impacts, enhancing energy efficiency, and using woody biomass for energy including ethanol made from wood.

The Biomass Research and Development Act of 2000 calls for collaboration between USDA and DOE in research and in technology applications. Through funding in the 2002 Farm Bill, the program has supported research and technology transfer efforts through competitive research funding and in grants and loans for commercialization. The Federal Agencies with a role and goals related to bioenergy and biobased products are coordinating their efforts through an interagency Woody Biomass Utilization Working Group.

#### Agenda 2020

- Public and private forestry partnership
- Save energy
- Enhance productivity
  - FS supports
    - Sustainable forestry
    - Biorefinery

Short rotation woody crops (SRWC) are an environmentally acceptable and potentially economically efficient method of producing wood for fiber and fuel. As demand increases for fiber, new readily available sources are needed to reduce demands on upland and bottomland forests. SRWC plantations can reduce demands on public lands, improve local rural economic development, and ensure future wood supplies. The environmental benefits of sustainable woody crops are also important. Woody crops can reduce the rate of atmospheric CO<sub>2</sub> buildup by sequestering carbon and by substituting for fossil fuels. Substitution through the use of woody crops for energy can also reduce SO<sub>2</sub> and NO<sub>x</sub> emissions by reducing the use of fossil fuels. At the local environmental level, woody crops can reduce soil erosion, filter soil leachates from water entering streams and ground water, and promote greater wildlife habitat and biodiversity. With the existence of successfully developed genetically superior clones, and the potential for producing more specific woody feedstocks, interest has substantially increased in the entire scope of SRWC operations. Successful commercialization of SRWC as either a source of fiber or as an energy feedstock material depends on a diversity of practices,

<sup>14</sup> <http://www.agenda2020.org/About/about.htm>

availability of genetic material, and equipment for handling and processing of these highly specialized crops.<sup>15</sup>

Agroforestry practices are intentional combinations of trees with crops and/or livestock that involve intensive management of the interactions between the components as an integrated agroecosystem. Agroforestry technologies can be readily incorporated into most farm and ranch operations and are also useful to many communities. These practices provide cost-effective ways to diversify production and increase income, while simultaneously enhancing natural resource conservation. Maintaining healthy working forests requires an understanding of changing market conditions, rapidly evolving forest threats, and the socio-economic aspects associated with landowner decision making. Options, practices, and management systems for forest biomass are being developed to support keeping forest lands in working forests, thus preventing fragmentation and loss of habitat.

### **Future Opportunities**

It is clear that the Forest Service has an important role in connecting with the forestry sector and sustainable practices on the land as we look at opportunities for energy from woody biomass. We also provide technical assistance, pilot and demonstrate new ideas in our facilities and with partners who are willing to try new paths to achieving mutual goals. Implementing a fully integrated vision and strategy for woody biomass utilization that includes bioenergy not only will contribute to national energy security, but also contribute to rural economies and environmental stewardship.

What do we need to do? and How do we do it?

- **Need to level the playing field for biomass with other renewables**
  - After a very long effort, “open loop” systems were added to the Energy Act of 2005, which allows woody residues to be used for energy and receive a tax credit. The only problem is that open-loop systems get half the 1.9 cents per kilowatt-hour credit offered closed loop systems.
  - Additional research funding for feedstock development is needed in USDA, a department with advantages in land management research. Although 60-80% of costs are in the feedstocks, little funding has been directed at the issue. A significant barrier is sustainable production systems that need additional and accelerated research programs.
  - The biorefinery concept is important to forestry as it is to agriculture in maintaining and developing sector infrastructure and economic value. Funding is needed to overcome hurdles and demonstrate its value for both integrated pulping and stand-alone systems.
- **Science and Research**
  - Improved productivity – role of genomics and biotech in energy. The basic tenant for the biobased revolution is that our land can provide all the goods and services needed to ensure a high quality of life in the future.

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<sup>15</sup> <http://www.woodycrops.org/charter.html>

With energy becoming a major output and land use challenges in the future, science is needed to direct the policy as well as to provide the pathways needed to ensure adequate supplies of energy, fiber, water, and other benefits.

- Reliable and defensible science on forest practices for sustainability, inventories and assessments, and financial analyses – needed at regional levels.
- Overcome problems of harvest, transport, and conversion costs.
- Embrace multiple product vision in biorefineries while optimizing systems that are currently marginal cost-effective for single products such as biopower in co-firing facilities.
- Evaluate implications of different policies, practices, and technologies; refine or develop federal approach.
- Energy conservation and efficiency.
- Green buildings and building products.
- Life cycle analysis and decision tools.
- **Embrace the biobased revolution and economy**
  - Globalization and ensuring U.S. forest industry infrastructure and competitiveness in the future.
    - The first step is to provide the science above to support both the right policy and the innovative technology.
    - Work together to advance the opportunities that biomass provides and to communicate and educate the public.
    - Provide the in depth analyses and management models conducive to making investments at home.
    - Work to ensure standards and codes are internationally acceptable and that U.S. products have both domestic and international competitive advantages.
    - Provide leadership in developing a common goal, vision, and pathway to respond collectively to globalization issues.
  - Place priorities in aligning our science and research in support of the use of biomass by resolving issues and overcoming the barriers.
- **Develop stronger collaboration**
  - Continue the commitment and leverage potential of working with our university collaborators through periods of tight budgets and emerging opportunities. Renew and strengthen our formal and informal cooperation agreements. Work together to build opportunities within and outside our agency and department.
  - Only about half of scientific expenditures come from the government; the other half is from industry. The Forest Service is working with industry to resolve energy issues. Two examples are Agenda 2020 and CORRIM. Additional opportunities need to be explored.
  - In the larger sense, we have opportunities for cooperative conservation. President Bush has said “Stewardship is the daily work of America’s farmers and those who own the land.” USDA Secretary Johanns added that “It’s a vision of cooperative conservation – of working with our

farmers, ranchers, and our timber producers and forest landowners instead of against them.” He further added “Government has a responsibility to be a facilitator of community-based collaborative approaches ... (because it) both improves the environment and strengthens the economy by helping people help the land.” (USDA Press Release 0335.05)

Biomass utilization is a prime example of cooperative conservation with a role for the Forest Service and for all its collaborators.

## Conclusion

This is a critical and important time for moving science and policy forward to expand woody biomass utilization for biobased products and bioenergy as part of the emerging biobased revolution and biomass economy. Success will require accelerated science and technology development and deployment; increased public-private partnerships; and more integrated consideration of energy, the environment, and the economy.

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**Figures**

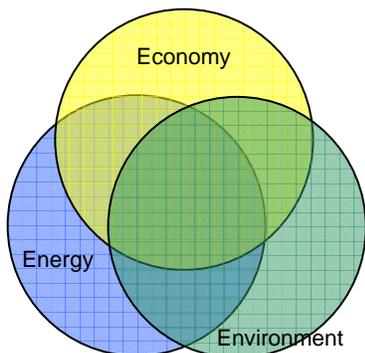


Figure 1. Building the balance of energy security, environmental quality and economic health.

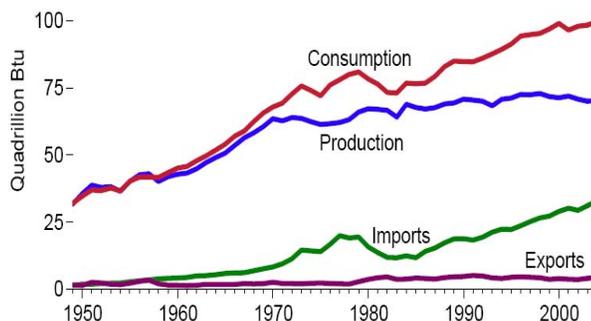


Figure 2. The United States was self-sufficient in energy until the late 1950's.

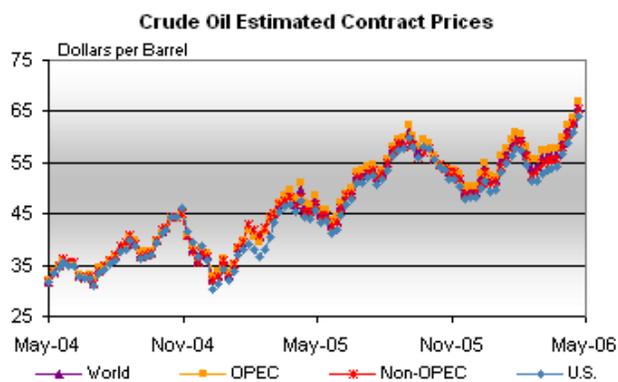


Figure 1. Crude oil estimated contract prices, May 2004 through April 30, 2006.

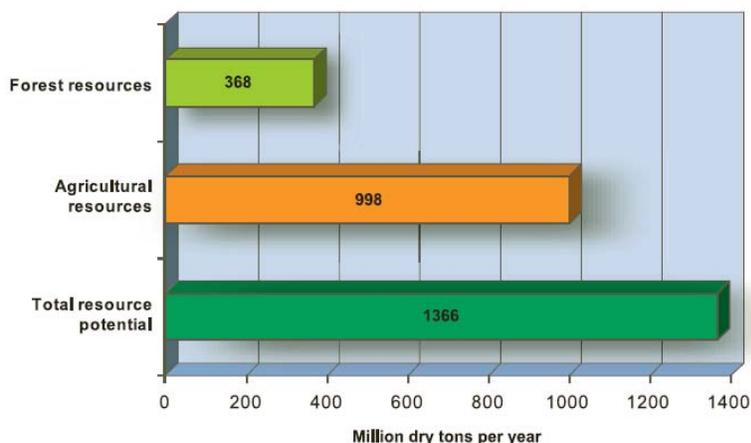


Figure 4. Annual biomass resource potential from forest wastes and residues and agricultural resources

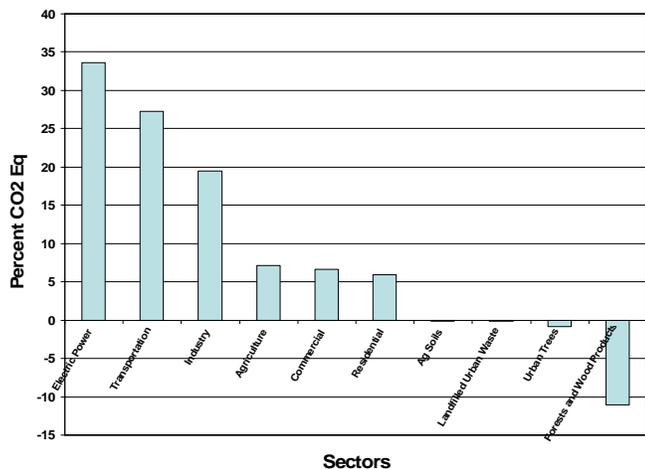


Figure 5. Percent total U.S. greenhouse gas emissions for 2003.



Figure 6. Annual U.S. balance of trade on goods and services.



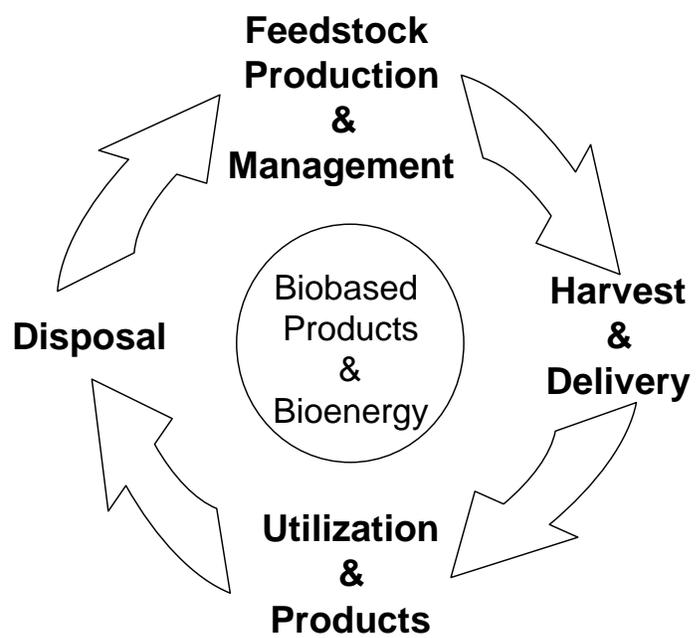


Figure 9. Forest Service R&D integrated biobased products and bioenergy research program