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# *Environment and Energy Industry*

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The Environmental and Energy Workshop Group considered a number of issues in the light of precedents being set by specific new products and services, as well as possible long term ramifications of new markets being opened up through partnerships between agriculture and these sectors. Participants had limited experience directly in these sectors, but perceived several generic opportunities and concerns.

The Group identified numerous opportunities for non-traditional products. High among these is the opportunity to replace non-renewable petroleum-based products with products derived from renewable plant or microbial products. The public is likely to view environmentally friendly products in a positive light, particularly when they bring about a corresponding decrease in the use of chemicals and are more sustainable than traditional crops, and if they bring about new economic growth.

However, participants perceived that the lack of a consensus vision on the future of agriculture is impeding both producer adoption and public acceptance of new products from biotechnology. A better understanding is needed of economic and societal trade-offs based on full-cost accounting of benefits and costs. Strategies were suggested to involve the public at an early stage in the decision-making process through more comprehensive communication and education initiatives.

## CREATING NEW MARKET OPPORTUNITIES

The Environment and Energy Group identified the most promising opportunities for non-traditional products from agricultural biotechnology. These included:

- Petroleum alternatives based on renewable resources including ethanol, industrial oils from plants, rubber alternatives (guayule), plastics based on starch or microbial products, industrial chemicals replacing ethylene, starch based compostable containers for the food industry.
- A variety of products resulting from linking pharmaceuticals with plant and animal molecular biology.
- Stress tolerant and pest-resistant plants for agriculture and forestry production, and agricultural animals with more efficient metabolisms.
- Industrial fiber alternatives for the paper industry.
- Plant and microbial bioremediation techniques.
- Nonfood products developed from sludge and sludge-using crops.

A number of factors were recognized as barriers to creating new market opportunities:

- Lack of consumer understanding of science-based issues and the difficulty of communicating to non-science publics who are skeptical and fear the unknown consequences associated with new technologies.
- Reluctance of producers to move into new ventures because of an insufficient consensus vision on the future of agriculture and the role of producers in the new agriculture, uncertainty about the potential risks assumed by first adopters, and lack of understanding of the economics of the new agriculture and the potential profit in value-added products.
- Lack of an appropriate basic marketing infrastructure for non-traditional products including handling, transportation and processing through alternative marketing channels; and inadequate performance data on the marketing of new products.
- An insufficient understanding of economic and societal trade-offs based on full-cost accounting of internal and external benefits and costs such as waste disposal vs. reuse, energy inputs vs. energy outputs, land required for food vs. nonfood products etc.
- A public policy framework that may stifle rather than provide incentives to engender marketing opportunities for nontraditional, nonfood products.
- Lack of venture capital and funding for starting up some new ventures and for the commercialization and marketing of new technologies.

- Inadequate technologies and facilities to manage wastes associated with phytoremediation and to remove potential contaminants in sludge.

Key actions need to be taken to overcome barriers and to seize opportunities:

- Formation of producer and marketing cooperatives based on a consensus vision for the new agriculture, with better assurances that producers have significant decision making roles in vertically integrated enterprises with most power and profit residing elsewhere; and the development of new marketing channels for nontraditional products.
- Formation of research and development teams and technology transfer at universities with cross-cutting multidisciplinary and systems frameworks, providing assured sources of genetic materials, technical assistance, and providing neutral environments to convene stakeholder partners.
- Development of new models for funding based on equitable investments in research and development and providing funding partnership roles for institutions in the public, private and nonprofit sectors.
- Formulation of models for life cycle analysis and full cost accounting to better assure that the development and commercialization of new technologies solve existing problems without creating new ones such as potentially polluting by-products of new technologies and processes, the excessive use of prime farmland for crops used to produce new nonfood products (e.g. corn to produce ethanol)
- Identification of the key stakeholders and their common interests to facilitate the formation of partnerships.

A number of measures can best assure that the public will play an appropriate role in the creation of new market opportunities:

- Explore ways to stimulate public interest and involve publics early in the process of product development.
- Encourage the formation of community-based interest groups to advise the biotech industry.
- Encourage the nonprofit sector to develop visions for the future and to facilitate joint initiatives (such as the Turner and Kellogg Foundations are doing).
- Develop educational programs at all levels to encourage thinking in a systems framework, the identification of societal trade-offs, and full cost accounting — in the development and marketing of products based on new technologies and processes.

*Recommendations were made by the Environment and Energy Group to help create new market opportunities for agricultural biotechnology products that are beneficial to society:*

- Develop strategies that represent a balance of broad perspectives based on inputs from the major stakeholders (public interest groups, industry, government, scientific community, farmers).*
- Encourage government to take the lead in framing an approach to developing novel products (e.g. alternative fuels to replace petroleum-based fuels) that reflects long-term considerations, taking into account implications for the economy, the environment, national security, and other relevant issues.*
- Develop educational programs at all levels from K-12 to professional schools and continuing education — emphasizing critical thinking, systems frameworks, full cost accounting and life cycle analysis, societal trade-offs (both current and intergenerational), and communication of complex issues in science and technology.*

## **SOCIAL ISSUES, REGULATIONS AND ETHICS**

The Environment and Energy Group considered what the public is most likely to be concerned about with new agricultural biotechnology products in this sector. The most widely cited concern is:

- Unanticipated and potentially adverse impacts on environmental quality.

Additional concerns are:

- Potential negative impacts on food, human health, and costs to consumers,
- Doubts about the trustworthiness and reliability of the biotechnology industry, particularly with respect to food products, and
- Loss of biodiversity

Features of new agricultural biotechnology products most likely to be viewed positively by the public in this sector are:

- Replacement of products based on non-renewable resources with those based on renewable resources.
- Potential for environmentally friendly products and processes, with a corresponding decrease in the use of chemicals and pesticides.
- Potential for new classes of products that would be more sustainable than traditional crops and would generate new economic growth.
- Optimism that biotechnology can provide better solutions to difficult problems.

A number of ethical issues that might arise from the introduction of new products include:

- Equity issues relating to proprietary rights and access of small farmers to new technologies and markets.
- Effects of new technologies on established social and economic structures, such as the displacement of traditional products (e.g. vanilla), or the use of land for non-food crops and the effect of this nonfood use on the global food supply.
- Intergenerational responsibility for conserving non-renewable resources.

Participants debated whether there are unnecessary obstacles posed to new agricultural products by regulation. They concluded that:

- Regulatory levels seem appropriate (and less of an obstacle than in the food and pharmaceutical industries), although paperwork can be burdensome and rules are sometimes applied too rigidly (e.g. academic labs governed by industry regulations).

There also was some concurrence in concerns about troublesome gaps in the regulatory coverage of new agricultural products:

- Lack of consistent international standards leading to unfair trade advantages,
- Uncertainty about which agencies will regulate new non-food products,
- Growing weaknesses in the regulatory staffs (cutbacks and inadequate training), and loss of objectivity of the review process with abolition of entire agencies such as OTA.
- Inability to deal with specific “bad actors” without penalizing an entire industry,
- Need for better understanding and balance between regulation/enforcement and incentives.
- Lack of information on gene escape when engineered plants are released for large- scale production.

*Several recommendations were suggested to use public opinion most effectively to shape decisions about new products via biotechnology:*

- *Develop a two-way system of education and communication on public issues, involving citizens' advisory groups early in the process, and giving the public a greater sense of control over the decision-making process.*

- *Devise new mechanisms to convene together diverse sectors (e.g. farmers, environmentalists, consumers, etc.) with a neutral convener in a community-based setting.*
- *Document success stories and highlight positive benefits to society on environmental and energy-related products, and organize a balanced presentation of facts and societal trade-offs.*
- *Conduct more research on how to communicate with the public and how to bridge the gap between information and attitudes and behavior.*
- *Prioritize what products should come on-line first.*

## ECONOMIC AND STRUCTURAL ISSUES

The Group identified both potentially positive and negative impacts for agriculture of new products being adopted by the marketplace in this industry. Among the most positive impacts are:

- Reduction of external costs to the environment and loss of non-renewable natural resources while offering the potential to increase productivity by lowering input costs of production.
- Expanding markets for traditional agricultural products e.g. stress tolerant agricultural plants, crops produced with reduced use of chemical fertilizers and pesticides.
- Opening new markets for alternative products to replace those which are petroleum based or which consume non-renewable natural resources e.g. industrial fibers, liquid fuels etc.
- Creating new markets for agricultural plants (e.g. phytoremediation) and creating income opportunities for farmers in sludge management (e.g. tipping fees, and marketable by-products from clean sludge).

In considering potential negative impacts on agriculture of new products, there was consensus that whether or not the impacts are positive or negative will depend on how technologies are brought forward and on whether new organizational structures are developed.

- There could be a negative impact on small, independent farms if farmers lose decision-making control in vertically integrated enterprises, if there is excessive concentration of power in large corporations, or if there is unequal access to new technologies.
- Unless the full consequences of initially introduced products are carefully thought out and publicly discussed, the increased suspicion of consumers will depress the potential marketability of new products.

- Some believe that unless land use issues are addressed in timely fashion, emphasis on nonfood/nonfeed products could decrease acreage for food agriculture or further deplete forest areas; others believe that market pricing could prove to be a sufficient counter weight to any drastic changes.

*A number of measures can be taken to better prepare farmers for new opportunities in this time of transition:*

- *They can better inform themselves by taking advantage of educational opportunities and by becoming computer literate to be in a position to receive electronically transmitted information and use computer-based technology.*
- *The extension system needs to be broadened to encompass an expanded client base and to include new technology and production and marketing opportunities.*
- *Farmers should join with industrialists, financial institutions, environmentalists, consumer groups, universities and government — to develop a vision for the new agriculture and set a national agenda that takes into account broad views of benefits and costs to the industry and to society.*
- *Farmers should develop cooperatives for investment in new technologies and to create new products (e.g. Ocean Spray, Ontario Federation of Agriculture); such cooperatives may have a greater chance than large corporations with consumer acceptance of new and novel products.*

*Finally, the Group identified new partnerships that need to be forged.*

- *Agricultural cooperatives need to be formed, facilitated by government and universities, and focused on new visions and common goals.*
- *Alliances need to be formed among farmers, industry, environmentalists, and consumer groups in neutral settings provided by universities and the nonprofit sector.*
- *Universities and farmers need to develop new relationships for research and extension based on new realities and market-driven strategies.*
- *New industry/government partnerships need to be formed that are incentive-driven, that facilitate technology assessment and transfer, and that maintain access to technology and capital by small/independent farmers as well as large corporations.*