

DRAFT

FOR PARTICIPANT COMMENT

EASTERN REGIONAL ROADMAP WORKSHOP SUMMARY

September 19-20, 2006
Syracuse, New York

Roadmap Chair: Douglas Hawkins

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Purpose

EPAct 2005 requires the Vision and Roadmap documents developed by the Biomass R&D Technical Advisory Committee be updated. A Vision workshop was held in November 2005 and Vision goals were updated. In 2006, three roadmap workshops were held to highlight the regional differences in the United States with respect to biomass barriers, R&D, and policies related to biomass technologies. Over 100 experts from industry, academia, and government participated in the three regional Roadmap Workshops. The structure of the original Roadmap was kept intact and the discussions focused on key barriers to the biomass sector, R&D to address those barriers, and policies to help facilitate the R&D were discussed.

In the following sections, the results of the Eastern Regional Roadmap Workshop are highlighted. The summary is organized based on the major categories discussed during the workshop: Feedstocks, Infrastructure, Processing and Conversion, End Use, and Cross Cut. Policy discussions are woven into the main categories which include barriers to R&D, R&D needed to overcome those barriers, and policies which will help R&D. A list of attendees for the Eastern Regional Biomass Roadmap Workshop can be found in Appendix B.

This document contains:

- *A summary of the discussion of the Eastern Regional Roadmap Workshop. Workshop participants are asked to provide comments on the document.*
- *For reference purposes, Appendix A provides a compilation of participant inputs posted during the workshop. Numbers in parentheses indicate number of votes received during prioritization process. Appendix B is a list of the Eastern Regional Roadmap Workshop participants.*

Following completion of each of the three regional roadmap workshops, combined results will be used to develop a draft Roadmap. All workshop participants will be provided the opportunity to comment on the Roadmap.

1. FEEDSTOCKS

Feedstock production is the cornerstone for the biomass industry. Without cheap, plentiful, sustainable feedstocks to convert into biomass, this industry will not succeed. Plant Science and Genetics are vital to Feedstock Production. Plant science can improve the technical understanding of plant biochemistry and enzymes to produce high value and low cost feedstocks. Breakthroughs in genetics will provide higher yields and fewer inputs in feedstocks production. Each of these areas is extremely important if progress in feedstocks is to be made towards achieving the Vision goals for a biobased economy in the future.

Technical Challenges

A number of technical challenges face the biomass industry in feedstocks development. Specific eastern specific barriers were identified, which need to be addressed in addition to the national efforts towards feedstock development. In the eastern region of the U.S. there are many small landowners who require a different system from large farms found in the Central and Western U.S. There is also a lack of experience in large scale farming and infrastructure to handle feedstocks for biomass. Woody biomass is available as a feedstock but there is a lack of experience among growers to harvest it for biomass and there is a lack of farm policies for woody biomass.

High priority barriers identified in the eastern region are:

- Is the amount of energy use compared to the amount of biomass available for conversion sustainable? E.g., Lack of environmental resources
- Public acceptance of genetically modified organisms (GMO), and resistance from environmental advocates
- Feedstock availability and the perception of food vs. fuel issues

Research Needs for Achieving the Vision Goals

The Roadmap attempts to provide guidance for the U.S. to achieve the far reaching Vision goals. Eastern specific R&D was identified to focus the region's efforts to achieve those goals. Region-specific feedstock yield research (i.e. poplar, willow, etc.) needs to increase as well as research into the efficient transportation and utilization of these feedstocks.

High priority R&D barriers identified in the eastern region are:

- Basic research on the biochemistry of plant materials and biobased products
- Improving crop traits, cold tolerance, drought tolerance, nitrogen efficiency
- Ensuring local farm profitability
- Developing methods to increase yield in a sustainable manner
- Improving diversity in feedstocks
- Developing methods or practices to reduce nutrient loss from soil
- Resource management methods

Plant science and feedstock production: Genomics and Breeding
Eastern Region specific R&D Needs:

- Feedstock yield research (southern pine, willow, switchgrass; energy cane, sugar cane, hybrid poplar, miscanthus, others). Improve yield in species/crop provide best biofuel/ energy for a specific local condition (max Btu)

Other high priority R&D needs:

- Continue gene mapping of plant species; improve yield, drought and insect tolerance [urgent for perennials (N-T)]
- Continue conventional breeding; plant science to improve plant characteristics of biomass; composition yield, structure; disease resistance; drought resistant, diverse plants, hardy plants (N-T)

Plant science and feedstock production: Agronomics

Eastern Region specific R&D Needs:

- Conduct normalized field tests by region (yield, impacts) EPA model; head to head comparison input-output of biocrops in specific soils (N-T)
- Identify new agronomic practices (double cropping) increase land use efficiency (tons/acre/year); plant cold-resistance for northeast region (M-T)
- Increase productivity to grow biomass on less land (M-T)

Other high priority R&D needs:

- Conduct research on production practices for alternative biomass crops; fund long term growing programs for feedstocks (N-T)
- Enable Inter cropping (duo crops-farm; research pilots) (M-T)

Plant science and feedstock production: Resource Management

Eastern Region specific R&D Needs:

- R&D demonstrations of energy crops on CRP land and marginal land; study crop use for biomass effect on wild life biodiversity, environment (N-T)
- Enhance / support “bio” species evaluation for eastern region (M-T)
- Investigate other bio species not in the east (M-T)

Additional research needs include:

- Investigate domestic solid waste and sludge as an eastern solution (M-T)
- Study long term value of biomass technologies including use outside of U.S. (L-T)

Plant science and feedstock production: Plant biochemistry and physiology

Research needs include:

- Need basic research in carbohydrate lipid protein chemistry and underlying genetics (N-T)
- Identify properties of crop oils desired for industrial use and R&D to create the CMO and chemical (N-T)
- Improve understanding of carbon flow and balance and other input/output balance in feedstocks to enable control (N-T)

Public Policy Needs for Achieving the Vision Goals

A number of policies are needed to help promote the biomass industries in plant science, genetics, and feedstock production for conversion to energy and products. Many of these challenges are specific to the eastern regional of the United States.

High priority policies should encourage the sensible use of CRP lands and transitional policy on energy crops on CRP land. Federal agencies such as the National Science Foundation (NSF) should provide more funding for basic research for biochemistry. There must be a clear consistent policy on GMO as well as provide funding for near term commercialization.

High priority barriers identified in the eastern region are:

Plant Science and Genetics

- NSF funding for basic research for bio chemistry
- Tie in GMO funding to near term commercialization
- Clear and consistent policy on GMO
- Promote consortia of national labs, universities, and private companies (e.g. standard agreements)

Feedstocks

- Encourage the sensible use of Conservation Reserve Program (CRP) lands; transitional policy on energy crops on CRP land
- Energy Crops treated like commodity crops in farm bill; commodity program for energy crops; restructure farm subsidies to incentivize biomass production for energy
- Promote sustainable energy-crop farming practices; promote sound resource management. Use CRP resources for planning land, water, soil carbon conservation
- Develop new incentives toward cellulosic matter
- Public-private partnership to deliver feedstocks for biofuels and productions
- Intellectual property rights and ownership
- Develop partnerships with tribal communities to develop feedstock resources and foster production.

2. INFRASTRUCTURE

Infrastructure development will be critical to the biomass industry chain. Once feedstocks are developed, harvesting, storing, and transporting those feedstocks to biorefineries cheaply and consistently is important to produce biobased products, fuels, and power. The major areas under infrastructure include transportation, distribution, and storage.

Technical Challenges

A number of technical challenges face the biomass industry infrastructure development. Specific barriers to the Eastern region of the U.S. were identified, which need to be addressed in specific, transportation issues associated with biomass and mitigating long haul transportation to biorefineries is an important barrier to overcome.

High priority barriers identified in the eastern region are:

Transportation

- Infrastructure; rail; truck; barge
- Moisture content; low bulk density

Storage

- Long term storage
- Stranded costs/ lack of year-round supply

Distribution

- Transportation infrastructure; need for more advanced modes of transport (pipelines); ethanol distribution (pipelines)

Research Needs for Achieving the Vision Goals

Eastern-specific R&D needs include the need to address issues with bulk density and variable feedstock profiles. Additional R&D should focus on distribution systems such as rail, barge, and on-road highway transportation which will cost-effectively transport feedstocks to biorefinery centers. High priority barriers identified in the eastern region are:

Conversion – Thermochemical

- Managing bulk density – linking preprocessing and transportation techniques
- Use of an integrated approach, harvesting – preprocess, maximize efficiency for system (NT)
- Assess current technology to meet requirement (NT)

Additional R&D needs should address distribution of biobased products, fuel, and power. There needs to be economic research on local and regional use of biofuels and develop distribution infrastructure accordingly. Major research should be done on pipelines, which are the most cost effective method of distribution. The incompatibility of biofuels to be transported through pipelines needs to be addressed.

Distribution

- Economic research on local/regional use of biofuels (NT)
- Economic research on pipeline transport of biofuels (NT)

Public Policy Needs for Achieving the Vision Goals

High priority barriers identified in the eastern region are transportation and distribution of feedstocks. Since the existing infrastructure will be unable to support the aggressive Vision goals, development of transportation infrastructure is important. Infrastructure improvements will be expensive to implement. Federal agencies should share the financial risk and show its support of building the biomass infrastructure through R&D dollars, grants, and loans to support collection sites and storage centers. Railroad cars to haul feedstocks and biobased products, fuel and power need to be developed and produced to support the high quantities needed to achieve Vision goals.

Transportation

- DOE/USDA need to share financial risk at early stages
- Policies that support the development of biomass depots for distributed harvest and collection sites; incentives for more co-ops (feedstock, producer and marketer)
- Policy to assist short line railroads to serve dense biomass feedstock transport
- Policy to create incentives for biofuel transport and distribution
- Upgrading the lock and dam system in the U.S.

3. PROCESSING AND CONVERSION

Processing and Conversion technologies will improve the conversion efficiencies and increase the output of useful energy and product per unit of input while reducing negative environmental impacts. Major areas include harvesting, pre-processing, and conversion.

Technical Challenges

A number of technical challenges face the biomass industry infrastructure development. The major issues include harvesting, pre-processing, and conversion. Eastern specific barriers included the near term need for a biorefinery model specific to the Eastern region which accounts for eastern specific feedstocks, infrastructure and product needs.

Other technical challenges include:

Harvesting

- Forest residue collection
- Inefficient and costly harvesting; low crop yield

Pre-processing

- Cost efficient fractionation of feedstocks

Conversion

- Transportation infrastructure; mode of transport (pipelines); rail, truck, barge, pipeline; ethanol distribution (pipelines); pipelines restricted due to low volumes
- Need demos at scale
- Cost effective technology

Research Needs for Achieving the Vision Goals

Research and development in processing and conversion should focus on harvesting, pre-processing and conversion to improve biochemical, and thermochemical conversion.

Harvesting

Focus Areas through 2009

- Develop understanding of soil/ecosystem impacts of different types of biomass removal. (Modeling) and field studies.
- New equipment for small forestry and agriculture stover residues harvesting one-pass harvesting
- Research “harvesting” technique bio resource

Pre-processing

- Less energy intensive fractionalization

Conversion – Biodiesel

- improved biodiesel catalyst process to handle crude oil (N-T)
- biodiesel byproduct utilization research; (N-T)

Conversion – Integration

- R&D team focused on pulp and paper industry; (N-T)
- Demonstrate Biorefinery (new and existing) (N-T)
- Conversion of processes to transform proteins and lignin's into valuable co-products (M-T)
- Conversion technologies for multiple feedstocks – large and small scale (M-T)
- Separation technologies more efficient and cost effective (M-T)

Conversion - Enzyme Bioconversion

Near Term

- Cheaper conversion of cellulosic to monomer sugars, reduce cost (N-T)
- Combined corn starch and cellulose feedstock ethanol plants (N-T)
- Fermentation: improved use of C-5 and C-6 sugars; improve efficiency of cellulosic ethanol production (enzymes, process technologies) (N-T)

Conversion – Thermochemical

- Use of pyrolysis liquid in crackers (N-T)
- Syngas demonstration; commercial gasification of biomass; clean up and use for power
- On-conversion (thermochemical of fossil and bio) (N-T)
- Pyrolysis liquids; better yields; different feedstocks; upgrading to transportation fuels; direct combustion (M-T)
- Gasification: gas cleaning; better synthesis catalysts (M-T)

Public Policy Needs for Achieving the Vision Goals

Policy needs identified in the eastern region are to create tax incentives, grants, and expand existing federal programs such as USDA's Commodity Credit Corporation support for infrastructure development.

High priority policy needs are:

Harvesting

- Commodity Credit Corporation (CCC) Payments for initial feedstock requirements for biorefineries
- Tax credits for forest land owners to develop a sustainable harvest management plan
- Grants and technical assistance to farmers to establish growing trials for new biomass crops
- USDA Agricultural Research service (ARS) land grant research to develop policy regarding sustainable crop residue removal
- Federal and state governments should develop education and information elements in their bioenergy policies

Conversion

- Fund basic research to the order of \$2-3 billion

- Government funding should not pick winners (e.g. biochemical and thermochemical conversion should be treated equally; don't choose winners of biofuels versus bioproducts in funding; products can be transition technologies for fuels.
- Federal funding on small scale biofuel generation

4. END USE & CROSS-CUTTING

End use of biobased products, fuels, and power include the consumers of these products such as biofuels, biobased products, and biobased power. Integration of these products into existing consumer markets to offset fossil fuel use and to achieve the Vision goals. This also includes R&D, barriers, and policies which cut across the previously mentioned categories of feedstocks, processing and conversion, and infrastructure.

Technical Challenges

Eastern specific barriers highlight the disconnect between emission regulations and intended biobased fuels use which will address those intended reduction in emissions. There is also a lack of environmental standards and general lack of consideration of the important applications of biobased products.

High priority barriers identified in the eastern region are:

End Use

- Mismatch of emissions regulations and intended fuel usage;
- Barriers to permitting power plants
- Lack of standards for fuel ethanol quality
- Lack of retail infrastructure (pumps and vehicles)
- End use – develop and use for polysaccharides (xylem derivatives)
- Applications of markets to bioproducts in certain areas/regions
- Complexity of multiple new product introductions from biorefineries

Commercial

- Difficulty in risk management and lack of bridge funding to overcome the valley of death; There exists a first mover syndrome and government should share the risk for new technology; existing venture capital models don't work;
- Expiration of closed loop PTC; high production cost of cellulosic ethanol; varying prices for feed, incentives are a moving target
- Scientific results may vary – creates public confusion; conflicting messages from scientific community

Cross-Cut

- Need for long term government policy/funding coherence; consistency of government support; eliminating differing tax credits compared to other renewables; closing the Energy Policy Act of 2005 loophole: Flexible Fuel Vehicles don't need to use alternative fuel
- Inadequate integration of all technology components
- Need for valuation of environmental benefits
- Public mindset education; consumer demand/awareness biobased products; end use: consumer confusion; NIMBY, water, air, local, state, regional; meeting consumer expectations, consumer resistance; acceptance of biofuels

- Plant construction capacity – engineering/construction services; sheer diversity of “biomass” many needs and drivers
- Lifecycle analysis market forces vs. regulatory
- Inadequate sensors and controls
- “bigger is better” cultural mentality not always true

Research Needs for Achieving the Vision Goals

Eastern specific research and development needs are to develop applications for industrial products and new uses of co-products. High priority R&D identified in the eastern region are:

End Use

- Develop end-use applications for industrial products i.e., polymers and materials (2007-12)
- New uses for co products (2007-12); understand better how to use co products structure function – application (2007-12)
- Research test methods for quantifying impurities in biofuels (2006-07)
- Research low permeability seal materials (2007 now)
- Research to stabilize biofuels (2006-07)
- Higher value lignin uses (2007-12)
- Identify specific bioproduct end uses – unique properties (2007-12)

X-cut

TIMELINE – biorefineries 700 tons/day minimum
2007 – 1st plants – shovel in ground
2010 – 3rd plants – shovel in ground
2011 - 2nd plants operational
2012 – 3rd plants/co-operating; technology stabilized
Energy Policy Act of 2005 *932 (d) fully funded; *L.G. FY07-12 – projects approved
Biorefinery roll out
2010 – 3 plants – 60 million gallons
2011 – 6 plants – 120
2012 – 9 plants – 300
2015 – 18 plants – 1.2 billion
2020 – 93 – 8.7
2030 – 388 – 37

- Sustainability metrics across entire process; sustainability, environmental economic social (short now -10); life cycling carbon recycling; social science research – all areas of bio resource
- Public opinion survey re: biobased industries; identify public misconceptions & social barriers to biomass commercialization (start now)
- Clearing house on bio resource eastern; review old literature (start now); center of R&D excellence – specific bio resource area
- System integration including economic evaluation; fund experts whose primary function would be to interface the bio industry with conventional industry;

- integrated optimization, funds teams “virtual” in all areas (now-on); integrated optimization includes: analysts (process & technical), engineers, end use representatives, agronomists/foresters, biologists, economists (ongoing, broaden)
- Eastern region workshop on bioresources for Native American communities (2007)

Public Policy Needs for Achieving the Vision Goals

Eastern specific public policy needs should target biomass within renewable portfolio standards (especially in the southeastern states).

High priority policy needs identified for the eastern region are:

End Use

- Restructure vehicle efficiency and pollution control policies to encourage fuel diversity; link efficiency and biofuel policies for vehicles
- Incentives for bioproducts similar to biofuel
- Support an E85 corridor along the major interstates; future growth in transportation fuels met with non-petroleum sources; vehicle fuel efficiency improvements
- Strengthen and enforce fuel quality standards
- Reclassify ethanol as a non-toxic emission

Commercialization

- Biofuels “Manhattan Project”. Characteristics would include: expect that research failures are part of the research process; focus on full cycle from plant science to end use; communicate the sense of urgency involved; obtain commitment from Congress; fund basic research through commercialization; be prepared to pick a few winners and fund about 3 commercialized plants to develop lessons learned; see what the private sector has already done that is near commercial ready and use that as a starting point if appropriate; include training. Put floor price on oil and use that tax to help fund a Manhattan Project type effort. Alternative sources of funding could be from the Office of Science. If oil remains inexpensive there will never be a reason to diversify.
- First commercial plant(s) must be constructed ASAP; policy to support early commercialization; relax the requirements for loan guarantees and grants; standardized risk (fed support); on commercialization government must be risk takers – private sectors the analysts; full funding for Energy Policy Act of 2005 programs. These measures will address risk management.
- Explore opportunities to fund biomass development with environmental trust type organizations; focus on promoting state level policies; spend federal bioenergy dollars via state agencies.
- Target bioenergy demonstration projects for state public benefits funds
- “Synthetic fuels” – government sponsor, management by private – biofuels only
- Harmonize policies maintain policy continuity. Ongoing policy impact evaluation

Crosscut:

- Promote public education; increase consumer awareness; materials for k-12, undergrad, grad level; emphasize role of biofuels in national security, economic development, etc.; advise and educate policy makers during election process to support platform development and to make sure that desired policies are implemented.
- Carbon tax; create carbon revenue policy state/federal; amend clean air act to include CO2
- Revisions to FB4P; focus on DOD as a biobased products customer; create state/federal “buy bio” programs to jumpstart markets
- Federal information exchange
- Policy to create continuous funding opportunities; integrated appropriations process for funding the roadmap
- Federal funding of Indian communities for biofuel power

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APPENDIX A: East Roadmap Inputs Matrix

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**EAST REGIONAL
BIOMASS ROADMAP WORKSHOPS**

**EDITED DOCUMENTATION OF RECOMMENDATIONS PROVIDED
BY WORKSHOP PARTICIPANTS ON:
BARRIERS TO ACHIEVING VISION GOALS
AND
POLICY AND RD&D RECOMMENDATIONS TO OVERCOME THOSE
BARRIERS**

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
GMO acceptance and process; genetics to end use targets; resistance from environmental advocates to genetically modified organisms; public acceptance for genetically	11		x										
Basic research, biochemistry of plant materials, biobased products	8		x										
Intellectual property rights and ownership	5		x										
Crop traits, cold tolerance, drought tolerance, nitrogen efficiency	5		x										
Lower cost cellulose			x										
Reduce hemicellulose content			x										
Plant genetics universities releasing patents			x										
More funding for basic plant science for bioproducts			x										
Local farm profitability; economics (\$/ton)	7			x									
Yield needs to be increased; sustainable yield	8			x									
Sustainability, environmental resources; feedstock opposition to food vs. fuel.	17			x									
Many small landowners; woody biomass; lack of farm	14	x		x									

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
policies for biomass; lack of experience among growers													
Diversity of feedstocks	1			x									
Nutrient loss from soil	2			x									
Resource management	1			x									
Pest resistance				x									
Where can you grow biomass for energy? CRP lands				x									
Agronomics				x									
Feedstock: Soy, Canola, Wood – growing risk				x									
No crop insurance				x									
Delay in yield/ economic return from establishment to sale of biomass				x									
Public perception ()?				x									
Increased food costs				x									
Forest residue collection	7				x								
Inefficient and costly harvesting; low crop yield	5				x								
Moisture content at harvest (corn stover and wood)					x								
Soil contamination					x								
Equipment and economics					x								
Balance of shrink vs. nutrient balance					x								
Transportation: mitigating long haul transportation	8	x				x							
Infrastructure; rail; truck; barge	11					x							

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
Transport: gathering multiple feedstocks						x							
Moisture content; low bulk density	7					x							
Get the economies of scale up – we will provide most efficient use of that rail – you can provide incentives to throw money at distribution terminals of providing money to develop distribution terminals.						x							
Transportation is related to feedstocks – and the density of feedstocks (biomass) is much less than feedstocks (fossil fuel) – therefore less cost efficient.						x							
Availability of rail cars and barges						x							
Loss of non-structural materials; shrink							x						
Long term storage with single harvest; harvesting, transportation storage, annual harvest	3						x						
Stranded costs/ year-round supply	2						x						
Odor (animal)							x						
Storage: mitigating water absorption							x						
Economics, storage-preprocessing							x						
Cost efficient fractionation	7							x					
Process integration	4								x				
Yeasts for sugars	1								x				
Need demos at scale	12								x				
Conversion intensification of processes for smaller plants	2								x				

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
Cost effective technology	6								x				
Enzyme cost, speed of reaction									x				
Low conversion efficiency									x				
Water usage in bioconversion	1								x				
Processing mixed feedstocks (enzyme hydrolysis)	2								x				
Multiple feedstocks conversion	4								x				
Inflexibility of current enzyme technologies									x				
Conversion: combining multiple renewables to increase efficiency									x				
Too much focus on biochemical conversion	4								x				
Bio co-product processes	1								x				
Fouling – need data (minerals in biopower pollution equipment)	1								x				
Permits: new source review (policy)	2								x				
Consistent blending methods not available	1								x				
Low yield from soft woods (enzyme hydrolysis)									x				
Transportation infrastructure; mode of transport (pipelines); rail, truck, barge, pipeline; ethanol distribution (pipelines); pipelines restricted due to low volumes	12									x			
Distributed generation, grid connect										x			
Transmission grid upgrades										x			
Sourcing feedstock										x			

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
Distribute markets for co-products and primary products										x			
Liability to power generators for grid										x			
Sudden switch from MTBE to ethanol – quantum leap in demand from one product to another – the rail industry had a temporary problem trying to get caught up. The infrastructure impediment is a temporary one.										x			
Lack of standards; ethanol use: fuel quality	7										x		
End use tailored to the fuel	1										x		
Environmental considerations	7										x		
Not enough pumps and vehicles	6										x		
End use – develop and use for polysaccharides (xylose derivatives)	2										x		
Applications of markets to bioproducts in certain areas/regions	5										x		
Complexity of multiple new product introductions from biorefineries	4										x		
Mismatch of emissions regulations and intended fuel usage; regulations; permitting power plants	9										x		
Closed loop PTC expires; commercialization: high production cost of cellulosic ethanol; varying prices for feed, incentives – moving target												x	
Commercialization: diversity of business models	1											x	

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
Scientific results may vary – creates public confusion; conflicting messages from scientific community	1											x	
Risk management; no bridge funding for valley of death; first mover syndrome; government share of risk for new technology; high risk technology and financing; venture capital models don't work; cross-cutting returns to commodity businesses are low: investment high loan guarantees	33											x	
Public mindset education; consumer demand/awareness biobased products; end use: consumer confusion; NIMBY, water, air} local, state, regional; meeting consumer expectations, consumer resistance; acceptance of biofuels	4												x
Inadequate integration of all technology components	5												x
Valuation of environmental benefits	4												x
Long term government policy/funding coherence; lack of government funding; long term planning: consistency of government support; differing tax credits compared to other renewables; Energy Policy Act of 2005 loophole: Flexible Fuel Vehicles don't need to use alternative fuel	16												x
Plant construction capacity – engineering/construction services; sheer diversity of “biomass” many needs and drivers	2												x

EASTERN BARRIERS													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Barriers To Achieving Vision Goals													
Lifecycle analysis market forces vs. regulatory	1												x
Inadequate sensors and controls	2												x
“bigger is better” cultural mentality not always true	1												x
Lack of strong single voice of industry, academia, and government for all biomass													x
Quality control; disproportionate subsidies/government support for fossil fuels vs. biofuels	2												x
Lack of biomass industry interaction with fossil energy industry													x

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Promote public education; education policy: consumer awareness, k-12, undergrad, grad; biochemist, land grant university; emphasize role of biofuels in national security, economic development, etc.; advise and educate policy makers during election process to support platform development and to make sure that desired policies are implemented.	12												x
Carbon tax; create carbon revenue policy state/federal; amend clean air act to include CO ₂	9												x
Need to identify metrics for measuring the progress of the roadmap (2002 and 2006 Roadmap)													x
Define biomass -- clearly, regionally; all biomass should be included: corn, agricultural residue, perennial crops													x
Regular continuous biofuel education (increase) federal													x
Target biomass within renewable portfolio standards (especially in the southeastern states)		X											x
Systems focus-bring different systems together for the entire process through funding													x
Federal information exchange	4												x
Create/pass federal RPS & RFS; separate RFS for biodiesel; additional RPS	2												x
Model federal bioenergy/agriculture policies after													x

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Washington state's.													
Revisions to FB4P; focus on DOD as a biobased products customer; create state/federal "buy bio" programs to jumpstart markets	8												x
Long-term extension of renewable energy technologies PTF for full amount	1												x
Policy to create continuous funding opportunities; integrated appropriations process for funding the roadmap	3												x
Federal funding of Indian communities for biofuel power	3												x
Policy increase multiple renewable energy parks, distributed generation + biofuel + wind													x
Fund a new "National Presidential Bio-resources" award \$1,000,000	2												x
Fully fund the Energy Policy Act of 2005 will address the barrier of risk management													x
Biofuels "Manhattan Project", characteristics of a "Manhattan Project", expect failures, focus on full cycle from plant science to end use; communicate the sense of urgency involved; obtain commitment from Congress; fund basic research through commercialization; be prepared to pick a few winners and fund about 3 commercialized plants to develop lessons learned; see what the private sector has already done that is near commercial ready and use that as	24											x	

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
a starting point if appropriate; include training. Put floor price on oil and use that tax to help fund it. Alternative sources of funding could be from the Office of Science. If oil remains inexpensive there will never be a reason to diversify.													
Target bioenergy demonstration projects for state public benefits funds	1											x	
“Synthetic fuels” – government sponsor, management by private – biofuels only												x	
Harmonize policies maintain policy continuity. Ongoing policy impact evaluation	4											x	
First commercial plant(s) must be constructed ASAP; policy to support early commercialization; relax the requirements for loan guarantees and grants; standardized risk (fed support); on commercialization government must be risk takers – private sectors the analysts; full funding for Energy Policy Act of 2005 programs (appropriations process); fund what is authorized in the Energy Policy Act 2005. These measures will address risk management.	14											x	
Explore opportunities to fund biomass development with environmental trust type organizations; focus on promoting state level policies; spend federal bioenergy dollars via state agencies.	6											x	
“Tax” incentive for bioproducts similar to biofuel	11										x		

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Encourage states to enact direct monitoring legislation											x		
Set standards for biodegradability; provide standards and incentives for biodegradable packaging where appropriate	1										x		
Nationalize all energy production											x		
Emissions certify flex-fuel vehicles on ethanol and E85; restructure vehicle efficiency and pollution control policies to encourage fuel diversity; link efficiency and biofuel policies for vehicles	5										x		
Support an E85 corridor along the major interstates; future growth in transportation fuels met with non-petroleum sources; vehicle fuel efficiency improvements	3										x		
Strengthen fuel quality standards; enforce fuel quality standards, tax breaks to dollars penalties	12										x		
Reclassify ethanol as a non-toxic emission	4										x		
Concerns about fuel quality limit application of high concentration blends											x		
Not pick winners in terms of funding research											x		
Net metering											x		
Accelerated depreciation for dedicated ethanol pipelines										x			
Study of ethanol pipeline	2									x			
Interconnection and net metering										x			
Promote consortia of national labs, universities, and private companies (e.g. standard agreements)	4		x										

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Clear and consistent policy on GMO	5		x										
Require ISO 9000 Type QC for GMO chain of custody	1		x										
NSF funding for basic research for bio chemistry	6		x										
Tie in GMO funding to near term commercialization	6		x										
Intellectual property: public release of publicly funding IP after set time if not used			x										
Focusing/new incentives toward cellulosic matter	5			x									
Perennial energy crop harvest permitted on CRP land				x									
Accessibility to crop insurance programs	1			x									
Targeted tax credit for crops for energy/bioproducts				x									
Public-private partnership to deliver feedstocks for biofuels and productions	4			x									
Energy Crops treated like commodity crops in farm bill; commodity program for energy crops; restructure farm subsidies to incentivize biomass production for energy	9			x									
Promote farmer forestry coops that grow and convert biomass	2			x									
Public policy needed to consider fuel/feed dynamics and sustainability issues	1			x									
Establish local guidelines for rotation of crops based on hard knowledge with outreach to farmers and stakeholders				x									
New farm bill that provides for biomass; enough crop diversification and production				x									

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Farm land protection needed (development rights purchase)				x									
Promote sustainable energy-crop farming practices; promote sound resource management. Resource Conservation Reserve Program (CRP) planning for land, water, soil carbon	6			x									
Incentives to putting land back into production	2			x									
Encourage the sensible use of CRP lands; transitional policy on energy crops on CRP land	11			x									
Lack of arable land and productive agricultural land is under pressure from urban sprawl – development regulation. Land areas used for storage – zoning for storage and conversion in these areas are huge.				x									
Commodity Credit Corporation (CCC) Payments for initial feedstock requirements for biorefineries	5				x								
USDA Agricultural Research service (ARS) land grant research to develop policy regarding sustainable crop residue removal					x								
Tax credits for forest land owners to develop a sustainable harvest management plan	2				x								
Federal and state governments should develop education and information elements in their bioenergy policies					x								
Grants and technical assistance to farmers to establish growing trials for new biomass crops	3				x								

EASTERN POLICY													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Commercialization	X-Cut
Recommended Policy Measures for Achieving Vision Goals													
Decentralize rail system						x							
Prevent deconstruction of railroads	2					x							
Rail is probably not the best / most economic form of transport for biomass						x							
Policy to incentivize biofuel transport and distribution	2					x							
Policies that support the development of biomass depots for distributed harvest and collection sites; incentives for more co-ops (feedstock, producer and marketer)	6					x							
Policy to assist short line railroads to serve dense biomass feedstock transport	4					x							
Upgrading the lock and dam system in the U.S.	3					x							
DOE/USDA need to share financial risk at early stages	13					x						x	
Hours of service laws restricted federally – so that might be an issue.						x							
Convert pneumatic transport in rail – use biomass						x							
Fund basic research to the order of \$2-3 billion	5								x				
Government funding should not pick winners (e.g. biochemical and thermochemical conversion should be treated equally; don't choose winners of biofuels versus bioproducts in funding; products can be transition technologies for fuels.	13								x				
Federal funding on small scale biofuel generation	4								x				

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
Virtual research center bringing experts in all of the various areas; plant agronomists, engineers, etc. cover plant science to end-use; five year funding													x
Region-specific feedstock yield research (i.e. poplar, willow, etc.)		x		x									
Highly selective thermochemical catalysts: develop catalyst substrates for specific applications. Highly selective for the product to be produced as opposed to the feedstock.									x				
Plant science and feedstock production: Socio-economic and integration													
Economic modeling of new farm payment systems for bioenergy crops (N-T)			x										
Solicit support from environmental organizations in feedstock production (N-T)			x										
Examine economics and sociology of rural communities as affected by bioindustry. Also impact on infrastructure (N-T)	1		x										
Establish protocols (N-T)	2		x										
Farmer education programs (m-T)	5		x										
Study implications of implementing “billion ton study” for food prices and supply (M-T)	1		x										
Workforce development (M-T)													
Plant science and feedstock production: Genomics and													

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
Breeding													
Continue gene mapping of plant species; improve yield, drought and insect tolerance (urgent for perennials (N-T)	11		x										
Continue conventional breeding; plant science to improve plant characteristics of biomass; composition yield, structure; disease resistance; drought resistant, diverse plants, hardy plants (N-T)	8		x										
Region specific feedstock yield research: eastern region feedstock (southern pine, willow, switchgrass; energy cane, sugar cane, hybrid poplar, miscanthus, others; yield which species/crop provide best biofuel/ energy for a specific local condition (max Btu) (N-T)	1	x	x										
Diversify generates work to more crop species including annuals and perennials; design energy crops high yield for specific applications. Increase cellulose hem. Key components (essential oils, tocoferols); reduce lignin (N-T)			x										
			x										
Plant science and feedstock production: Agronomics			x										
Research on production practices for alternative biomass crops; fund long term growing programs for feedstocks (N-t)	3		x										
Normalized field tests by region (yield, impacts) EPA model; head to head competition input-output of biocrops in specific soils (n-t)	1	x	x										
More work on soil fertility issues related to residue removal			x										

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
(m-t)													
Increase productivity to grow biomass on less land (m-t)			x										
Co-cultivation for soil conservation and input management (basic and applied)			x										
Inter cropping with bio plants (duo crops-farm; research pilots) M-t	2		x										
More research and field trials for the establishment of successful stands for switchgrass (m-t)			x										
New agronomic practices (double cropping) increase land use efficiency (tons/acre/year); plant cold-resistance for northeast region (M-t)		x	x										
Increase productivity to grow biomass on less land (m-t)		x	x										
Plant science and feedstock production: Resource Management			x										
Comprehensive land owner survey to inform policy in use of land for additional biomass production (n-t)			x										
R&D demo energy crop on CRP land and marginal land; study crop use for biomass effect on wild life biodiversity, environment (NEAR TERM)	6		x										
Create a highly detailed feedstock availability map, especially forestry (MID TERM)			x										
Investigate domestic solid waste and sludge as an eastern solution (MID TERM)	2		x										
Enhance / support “bio” species evaluation for eastern	2	x	x										

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
region (MID TERM)													
Investigate other bio species not in the east (MID TERM)		x	x										
Investigate undesirable plant and animal species for bio (MID TERM)			x										
Research bioresources in Americas (LONG TERM)			x										
Study long term value of biomass technologies including use outside of U.S. (LONG TERM)	3		x										
Plant science and feedstock production: Plant biochemistry and physiology			x										
Need basic research in carbohydrate lipid protein chemistry and underlying genetics (NEAR TERM)	6		x										
Identify properties of crop oils desired for industrial use and R&D to create the CMO and chemical (NEAR TERM)	5		x										
Improve understanding of carbon flow and balance and other input/output balance in feedstocks to enable control (NEAR TERM)	4		x										
Study woody and grassy perennials and chemicals signaling for optimal harvest and transport of non-energy nutrients back to rest of system (NEAR TERM)			x										
CONVERSION – BIODIESEL									x				
- biodiesel byproduct utilization research; (N-TERM)	2								x				
improved biodiesel catalyst process to handle crude oil (N-term)	2								x				
- recovery of corn oil from dry mills for biodiesel (MID TERM)	1								x				

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
- research to develop alternative uses of biodiesel and ethanol plants so they have a future use as markets change (MID TERM)									x				
CONVERSION – INTEGRATION									x				
- R&D team focused on pulp and paper industry; (declining industry?) (NEAR TERM)	6								x				
- Demonstrate Biorefinery (new and existing) (NEAR TERM)	3								x				
- Create model Biorefinery for eastern feedstocks (NEAR TERM)	4	x							x				
- Biorefinery reactors for mixed/blended/staged feedstocks (production, storage, blending and logistics) provide economic flexibility (NEAR TERM)	1								x				
- Use of co-products as chemical feedstocks (MID TERM)	1								x				
- Diversify conversion technologies(MID TERM)									x				
- conversion of processes to transform proteins and lignin's into valuable co-products (MID TERM)	5								x				
- Conversion technologies for multiple feedstocks – large and small scale (MID TERM)									x				
- Separation technologies more efficient and cost effective (MID TERM)	10								x				
- Ionic liquids SC fluid membrane (LONG TERM)									x				
- Improve effectiveness of conversion technologies (LONG TERM)									x				
CONVERSOIN - ENZYME BIOCONVERSION									x				

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
Near Term									x				
Cheaper conversion of cellulosic to monomer sugars, reduce cost (NEAR TERM)	6								x				
Combined corn starch and cellulose feedstock ethanol plants (NEAR TERM)	6								x				
Optimization of enzyme hydrolytic efficiency based on rational understanding of feedstock chemistry and pretreatment; New research on next generation technologies (NEAR TERM)	2								x				
Minimize water use and waste water generated									x				
Fermentation: improved use of C-5 and C-6 sugars; improve efficiency of cellulosic ethanol production (enzymes, process technologies) (MID TERM)	7								x				
CBP Consolidated bioprocess one-stop shop (LONG TERM)									x				
CONVERSION – THERMOCHEMICAL									x				
use of pyrolysis liquid in crackers (NEAR TERM)	4								x				
EHS issues of transport of pyrolysis liquids (NEAR TERM)	1								x				
Co-firing research on pollution control equipment over long term use (NEAR TERM)	1								x				
Lignin to diesel (NEAR TERM)									x				
Pyrolysis oil upgrading and extraction; upgrading pyrolysis fractions (NEAR TERM)	8								x				
Process development for high intensity smaller scale facilities (NEAR TERM)	1								x				

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
Understand catalytic conversion of syngas to “optimal” transport fuel (NEAR TERM)	3								x				
Syngas demonstration; commercial gasification of biomass; clean up and use for power ; con-conversion (thermochemical of fossil and bio) (NEAR TERM)	9								x				
Pyrolysis liquids: characterize environmental properties; transportability and storage issues (MID TERM)									x				
Pyrolysis liquids; ;better yields; different feedstocks; upgrading to transportation fuels; direct combustion (MID TERM)	7								x				
Process development for high intensity small scale facilities (MID TERM)	1								x				
Highly selective thermochemical catalyst (MID TERM)									x				
Improved mixed alcohol catalysts (MID TERM)									x				
Syngas fermentation (MID TERM)	2								x				
Gasification: feeding to pressurized reactors; lower tar production; economics at smaller scale (MID TERM)	2								x				
Gasification: gas cleaning; better synthesis catalysts (MID TERM)	6								x				
Collection and transportation from small community parcels – evaluate, redesign equipment – PR cars						x	x						
Managing bulk density – linking preprocessing and transportation techniques	8					x	x						
Computer model for feedstock – availability and						x	x						

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
dispatching/logistics wood residue/wastes – timing-available													
Understand capacity on road rail, barge system, under large increase of bioenergy feedstocks	1					x	x						
Work on addressing densification to efficiently transport						x	x						
Design parameters first 2007 – 08						x	x						
I. Use integrated approach, harvesting – preprocess, maximize efficiency for system 2007-08	8					x	x						
II. Assess current technology to meet requirement 2007	2					x	x						
Determine quantity of equipment 2009	1					x	x						
III. Characterize product flow and properties at each step in process [standards] 2008						x	x						
Harvest machinery design						x	x						
Rail car design (barge and truck) 2005-15						x	x						
IV. Adapt old or develop new technologies 2010						x	x						
V. Optimization for each feedstock 2015	2					x	x						
Focus Areas – 2009						x	x						
Quantifying effects of contaminants on conversion						x	x						
Managing fossil use inputs to system 2009						x	x						
Reduce impacts						x	x						
System efficiency design focus on transport stage became at cost and petroleum use	1					x	x						
Efficient feedstock flow (timing of \$)	1					x	x						
Reduce costs at all stages						x	x						
Managing contaminates						x	x						

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
More work on methods to address moisture concerns (e.g. stover, wood, etc.)					x								
More research on field chopping					x								
More economic analysis of harvesting	1				x								
New equipment for small forestry and agriculture stover residues harvesting one-pass harvesting	7				x								
Research "harvesting" technique bio resource	6				x								
Develop understanding of soil/ecosystem impacts of different types of biomass removal. (Modeling) and field studies.	9				x								
More research on one pass harvesting of grain and stover					x								
Harvesting technology that facilitates downstream processing	1				x								
Examine highly distributed feedstock transformation (e.g., gasification, saccharification) to reduce transport and storage					x			x					
Integration of feed systems for varying feedstocks (esp. for thermochemical)								x					
Examine details of feedstocks densification and transport – optimize solution for local situation	1							x					
Improve cost effectiveness of pretreatment								x					
Less energy intensive fractionalization	3							x					
Economic research on local/regional use of biofuels (2006-07)	2									x			

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
Economic research on pipeline transport of biofuels (2006-07)	1									x			
Research test methods for quantifying impurities in biofuels (2006-07)	3										x		
Research low permeability seal materials (2007 now)	3										x		
Research to stabilize biofuels (2006-07)	4										x		
New uses for co products (2007-12); understand better how to use co products structure function – application (2007-12)	8										x		
Higher value lignin uses (2007-12)	1										x		
Identify specific bioproduct end uses – unique properties (2007-12)	1										x		
Develop end-use applications for industrial products i.e., polymers and materials (2007-12)	10										x		
TIMELINE – biorefineries 700 tons/day minimum	14												x
2007 – 1 st plants – shovel in ground													x
2009 – 1 st plants – operational; 2 nd plants shovel in ground													
2010 – 3 rd plants – shovel in ground													x
2011 - 2 nd plants operational													x
2012 – 3 rd plants/co-operating; technology stabilized													x
Energy Policy Act of 2005 *932 (d) fully funded; *L.G. FY07-12 – projects approved													x
Biorefinery roll out													x
2010 – 3 plants – 60 million gallons													x

EASTERN RESEARCH AND DEVELOPMENT													
Category	Votes Received	Eastern Specific	Plant Science/ Genetics	Feedstock Production	Harvesting	Transportation	Storage	Pre-Processing	Conversion	Distribution	End Use	Distribution	X-Cut
Recommended Research and Development for Achieving Vision Goals													
2011 – 6 plants – 120													x
2012 – 9 plants – 300													x
2015 – 18 pants – 1.2 billion													x
2020 – 93 – 8.7													x
2030 – 388 – 37													x
Sustainability metrics across entire process; sustainability, environmental economic social (short now -10); life cycling carbon recycling everything; social science research – all areas of bio resource	10												x
System integration including economic evaluation; fund experts whose primary function would be to interface the bio industry with conventional industry; integrated optimization, funds teams “virtual” in all areas (now-on); integrated optimization includes: analysts (process & technical), engineers, end use representatives, agronomists/foresters, biologists, economists (ongoing, broaden)	6												x
Clearing house on bio resource eastern; review old literature (start now); center of R&D excellence – specific bio resource area	7												x
Eastern region workshop on bioresources for native communities (2007)	3												x
Public opinion, monitor/survey, re: biobased industries; identify public misconceptions & social barriers to biomass commercialization (start now)	8												x

APPENDIX B: Participants in the East Roadmap Workshop

Attendee List

First Name	Family Name	Affiliation
Philip C.	Badger	Renewable Oil International LLC
Marco	Baez	Dyadic International, Inc.
Larry	Biles	Southern Forest Research Partnership, Inc.
Tom	Binder	Archer Daniels Midland
Akwasi (Kwesi)	Boateng	U.S. Department of Agriculture
David	Bransby	Auburn University
Ralph	Cavalieri	Washington State University
Jessica	Crawford	O'Brien and Gere
Jennifer	DeCesaro	Clean Energy Group
Kevin J.	Edgar	Eastman Chemical Company
Mark	Emptage	DuPont
Ken	Green	BCS, Incorporated
Bonnie R.	Hames	Ceres, Inc.
Stewart	Hancock	Hancock Public Affairs, LLC
Doug	Hawkins	Rohm and Haas
Maurice	Hladik	IOGEN Energy Corporation
Lou	Honary	University of Northern Iowa, NABL Center
Judy	Jarnefeld	New York State Energy Research Development Authority
Tom	Johnson	Southern Company
Coleman	Jones	General Motors
George	Kervitsky	BCS, Incorporated
Robert	Kozak	Atlantic Biomass
Eric	Larson	Princeton University
F. Henry	Lickers	Mohawk Council of Akwesasne, Environmental Division
Tom	Lindberg	New York State Agriculture & Markets
Mike	Manella	BCS, Incorporated
Jason	Masters	Northern Biodiesel
Daniel H.	Moenter	Marathon Petroleum
Cristina	Negri	Argonne National Lab
Mitch	Peele	North Carolina Farm Bureau
Gary	Pollock	Society of Automotive Engineers (SAE)
Neil	Rossmeyssl	U.S. Department of Energy, Biomass Program
Corinne	Rutzke	Cornell University
Jeff	Serfass	Technology Transition Corporation
Samantha	Slater	Renewable Fuels Association
Bryce	Stokes	U.S. Department of Agriculture, Forest Service
Chris	Veit	Novozymes
Tim	Volk	State University of New York, College of Environmental Science and Forestry
Brian	Ward	CSX Corporation, Inc.
Edwin	White	State University of New York
Rodney	Williamson	Iowa Corn Promotion Board
Jetta	Wong	Environmental and Energy Study Institute
Mae	Wu	Argonne National Lab