Biomaterial Industry of The Future

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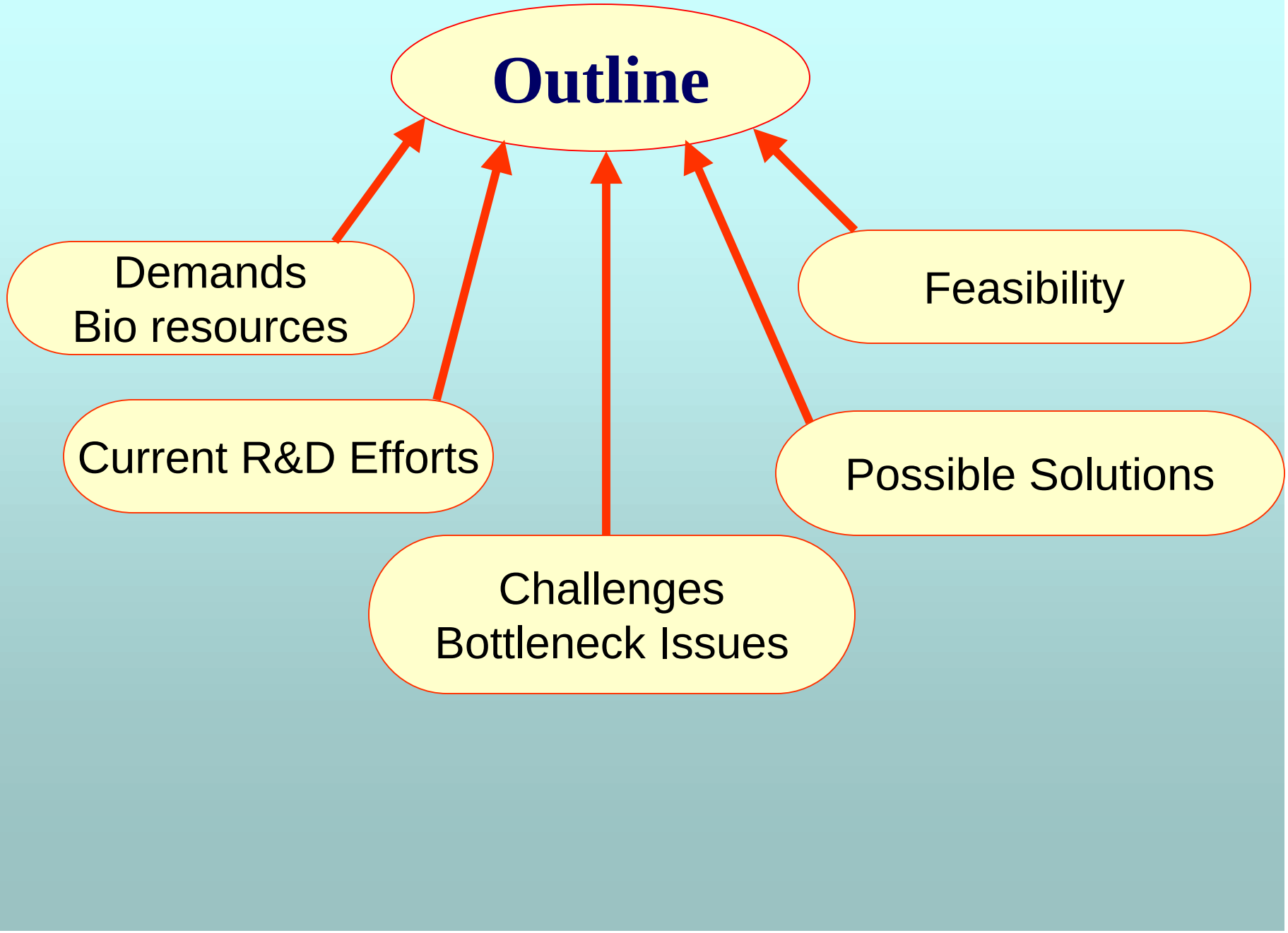

Outline
Demands
Bio resources
Current R&D Efforts
Challenges
Bottleneck Issues
Feasibility
Possible Solutions

Demands

Homeland Security
Environment, Energy,
Petroleum resources, Terrorists,
Sustainable World Development

R&D Urgent Needs
Bioproducts
Affordable,Durable,Stable,
& Sustainable

New Demands
Biomaterials
Bioproducts

Ag Resource Potential
Grain: 550 MMT
Ag residues: 500 MMT

Market Size
56 B lb thermoplastics
20 B lb adhesives
75 B lb composites
…….

Resource Availability

Ag Resource Potential
Grains: 550 MMT
Ag residues: 500 MMT

Ag Residues Uses
20% back to fields
15% current uses
65% available = 325 MMT

Grain Uses
10 -15% Foods
40% Animal feeds
50 % available = 275 MMT

Contribution to Bioproducts
Total demands = ???
325 MMT = (glucose + lignin) + fiber
275 MMT = glucose + amino acids + fatty acids

Contribution to energy
97 Quad BTU/yr
40% (39 Quad) is fossil fuels
325 MMT = 5.7 Quad BTU
275 MMT = 10 Quad BTU

Sustainability

- Sustainable development provides evolvable growth of ecological integrity and social equity to meet basic human needs through viable economic development over time

Resource Availability

Land Uses
Biodiversity
Soil Conservation

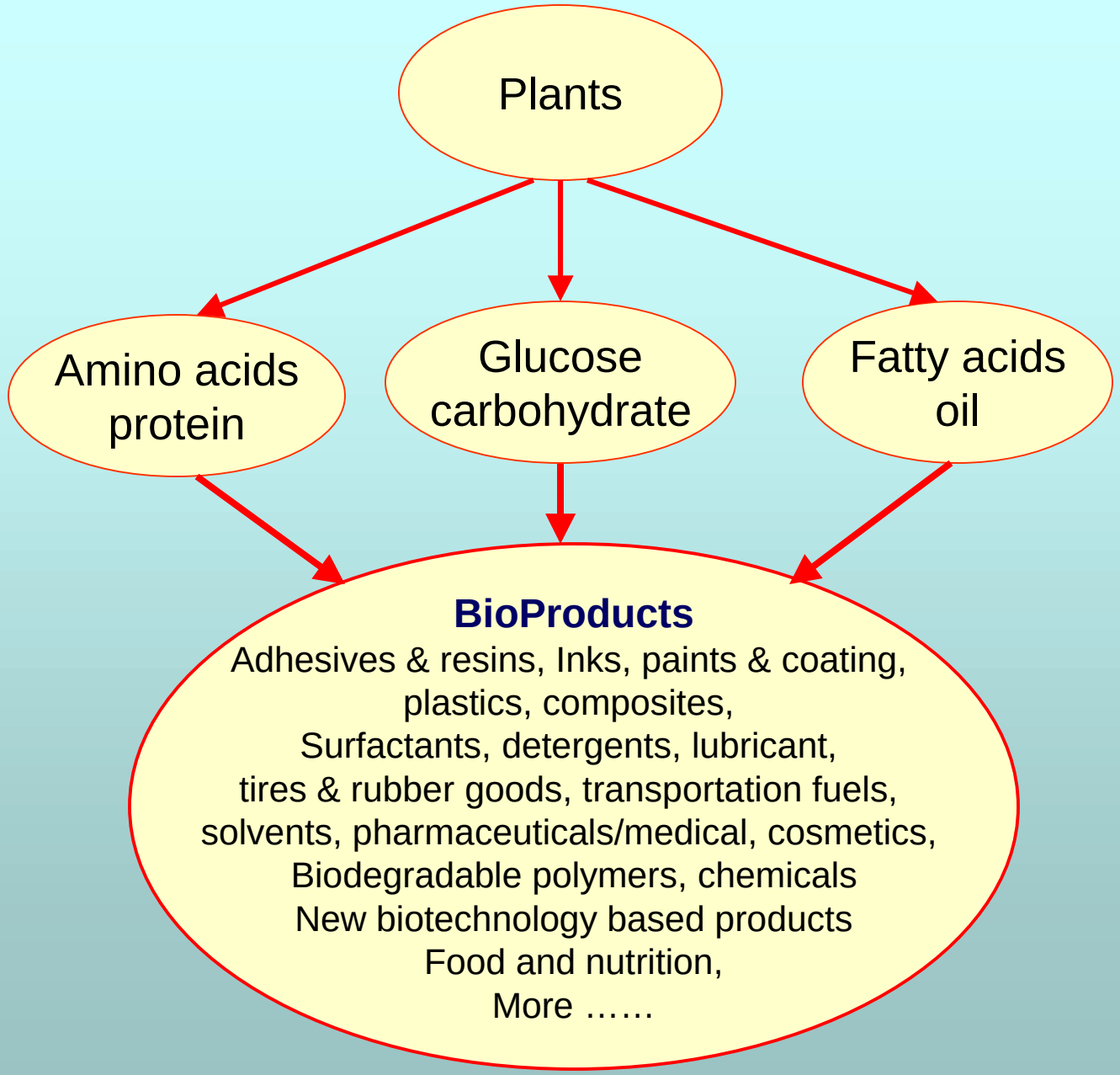
Environment Impact

Energy Efficiency

Social Community Impact

Mission of Biomaterial R&D

- Promote widespread use of biobased industrial products from renewable resources to meet future national and environmental needs


Plants
Amino acids
protein
Glucose
carbohydrate
Fatty acids
oil
BioProducts
Adhesives & resins, Inks, paints & coating,
plastics, composites,
Surfactants, detergents, lubricant,
tires & rubber goods, transportation fuels,
solvents, pharmaceuticals/medical, cosmetics,
Biodegradable polymers, chemicals
New biotechnology based products
Food and nutrition,
More ……

Challenge

- Affordable
- Durable
- Stable
- Sustainable

- Diverse
- Unique

Diverse and Unique: Examples

Protein adhesives & composites

Bioconversion products

Plant oil resins & composites

Liquefaction of biomaterials

Grain processing by-products
i.e., DDG issues

Chitin and chitosan quality

Bioplastics, foams, films,

Plant oil lubricants and recycles issues

Nonwoven composites

Bottleneck Issues

- Economic Viability
- Performance Feasibility

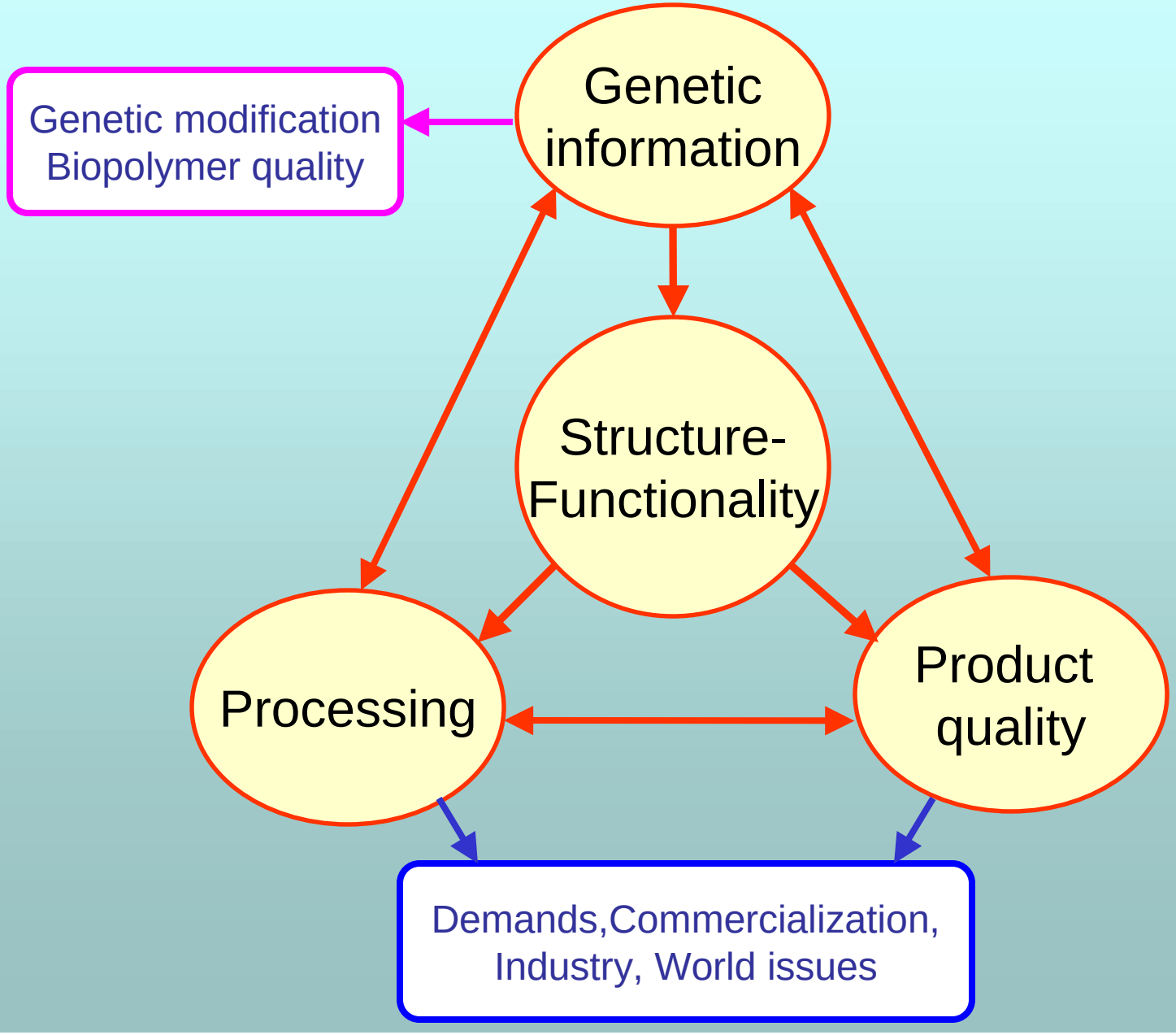
- Diverse
- Unique

- Public Education
- Regulations

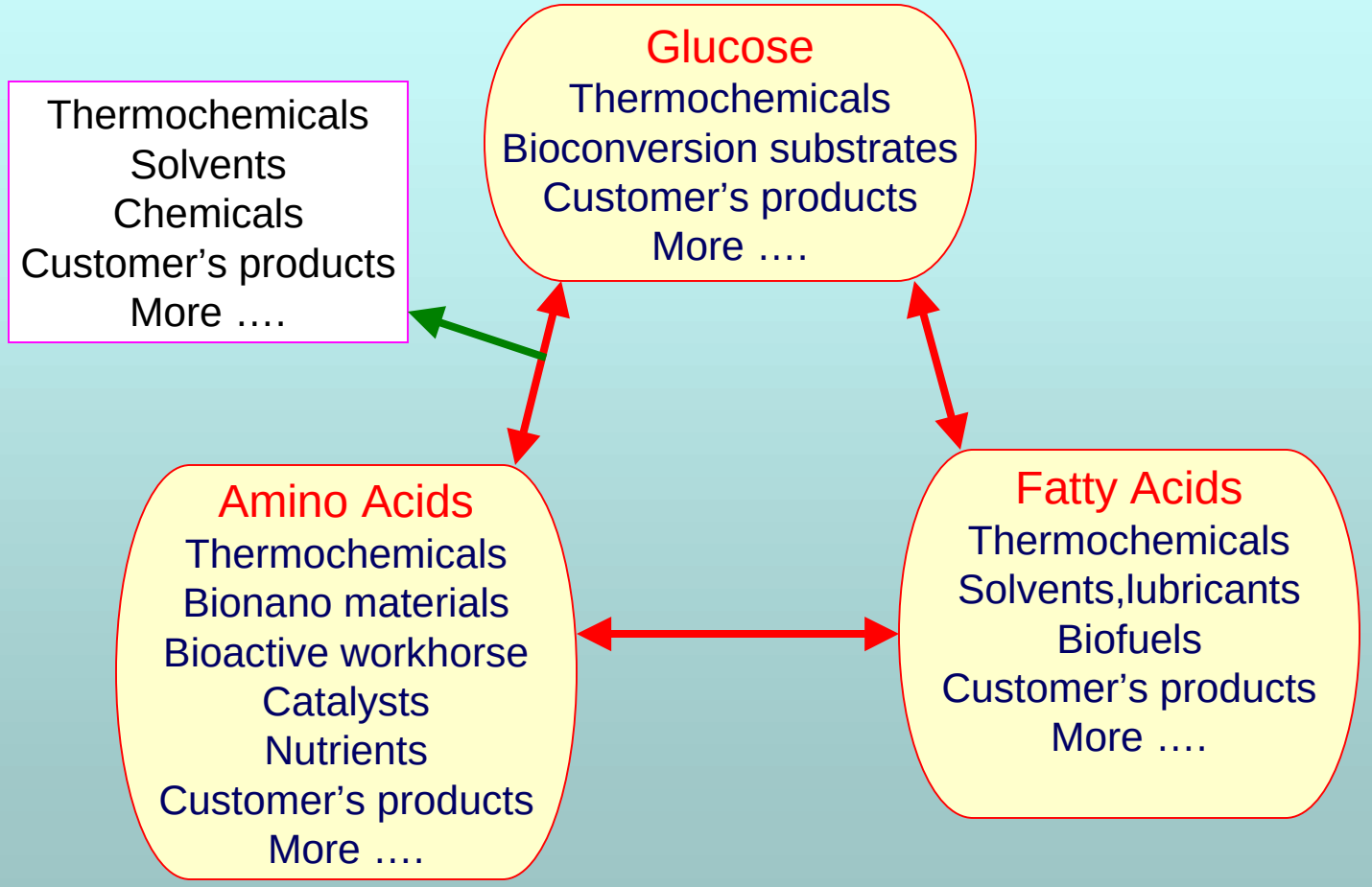
Short Term Research Efforts

- Reduce cost
- Improve performance
- Commercialization value
- Impact on energy and environment
- Impact on market size
  - 1st layer – billion lb or $ B market
  - 2nd layer – million lb or $ M market

Long Term Biomaterial Research Roadmap



Three Powerful Platforms



Integrated Research Team

- BioMaterial Science and Engineering
  - Novel biomaterials, novel bioproduct design,
  - Structure-functional properties, modifications, bioconversions, reactions, catalysts, etc.
  - Property measurements, performance evaluations,
  - Processing design, control, scale-up, etc.
- Plant/Microorganism/enzyme Science
  - Genomics/breading, DNA/gene analysis, genetic engineering, protein cloning, bioinformatics,etc.
- Chemistry/Biochemistry
  - Biopolymer structures, Biopolymer reaction pathways, analytical analysis, etc
- Agriculture Economics
  - Economic analysis, life cycle analysis

Biomaterial Industry of the Future

Bioproducts: Diverse and Unique

One Goal: Economic Viable and High Performance

Three Platforms: Glucose, Amino Acids, Fatty acids

One Complex: Genomics – Structure – Performance