Biofuels: Roadmap to Sustainable Landscapes

QuickTime™ and a
decompressor
are needed to see this picture.

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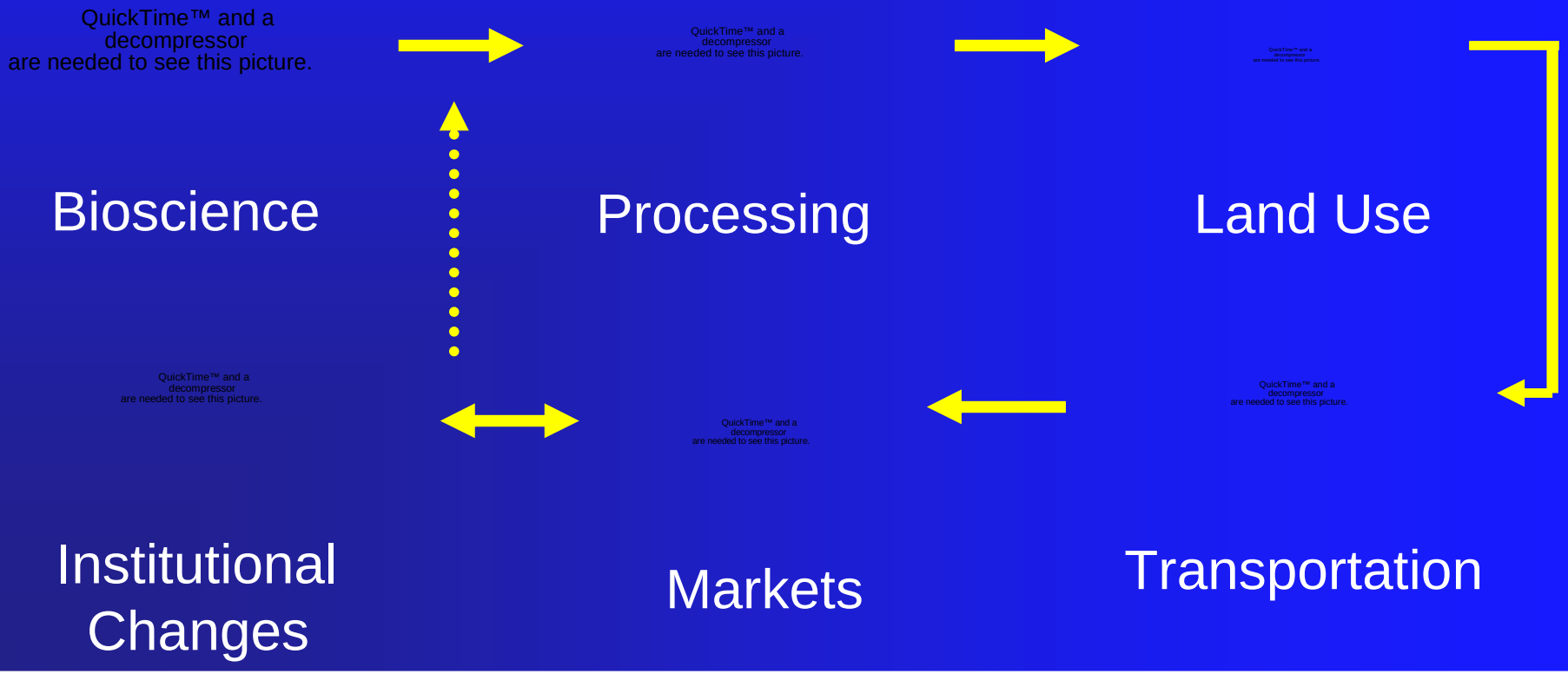
Roadmap to Sustainable Landscapes

The prevailing belief is that we move toward sustainability by focusing on a rational array of components consisting of innovative technologies, shifting land uses, market processes, and institutional arrangements.



Roadmap to Sustainable Landscapes
A Component Focus

Maximum viable yield of crop residues

Institutional and policy changes

Analytical tools

Landscape ecosystem services

QuickTime™ and a decompressor are needed to see this picture.

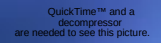
Community and agribusiness impacts

Feedstock GHG flux and SOC features

Lignocellulosic conversion processes

Transportation and aggregation of feedstocks

Roadmap to Sustainable Landscapes
A Systems Perspective



"*Biofuel sustainability has environmental, economic, and social facets that all interconnect. Tradeoffs among them vary widely by types of fuels and where they are grown and, thus, need to be explicitly considered by using a framework that allows the outcomes of alternative systems to be consistently evaluated and compared*." (*emphasis added*)

Robertson et al., Science, 2008, P. 48.

Roadmap to Sustainable Landscapes
A Systems Perspective

Moving toward sustainable landscapes implies attempting to understand and influence complex, dynamic systems across different scales.

Transformation

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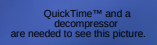
Not Substitution

This means systems that are nonlinear where inputs and outputs are not necessarily proportional, change can be episodic and abrupt rather than gradual, feedback loops may emerge or change polarity, and multiple equilibria will be the norm.

Roadmap to Sustainable Landscapes
A Systems Perspective



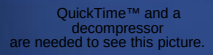
A framework that compares complex, dynamic systems will also require that we are also consider serendipity and surprise.

Serendipity & Surprise in Science

Source: Current Science 80:1, 2001, P. 6.

Serendipity & Surprise in Science

Transformation Toward a Sustainable Biofuel System



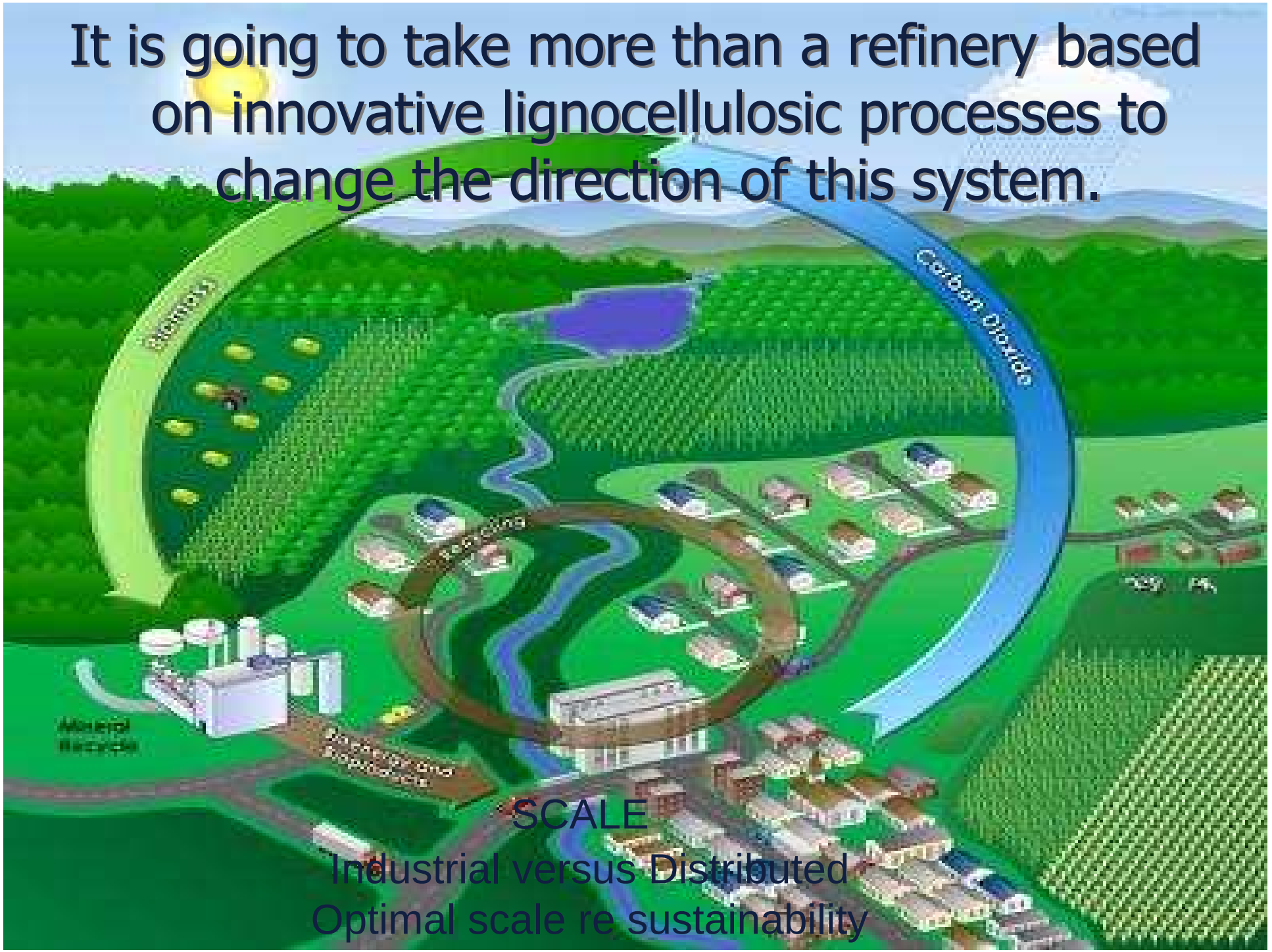
How would we design or move toward a more sustainable landscape in the Yahara chain of lakes?

You are here

Moving Away from Sustainability

- Eutrophication of lake systems
- Farm systems facing land constraints
- Health issues due to Hg/NO3 in water
- Fragmented habitat, invasive species
- Increasingly "flashy" hydrological system
- Loss & fragmentation of farms and agribusiness
- Approaching non-attainment on air emissions
- Beach closing due to pathogens in water

It is going to take more than a refinery based on innovative lignocellulosic processes to change the direction of this system.

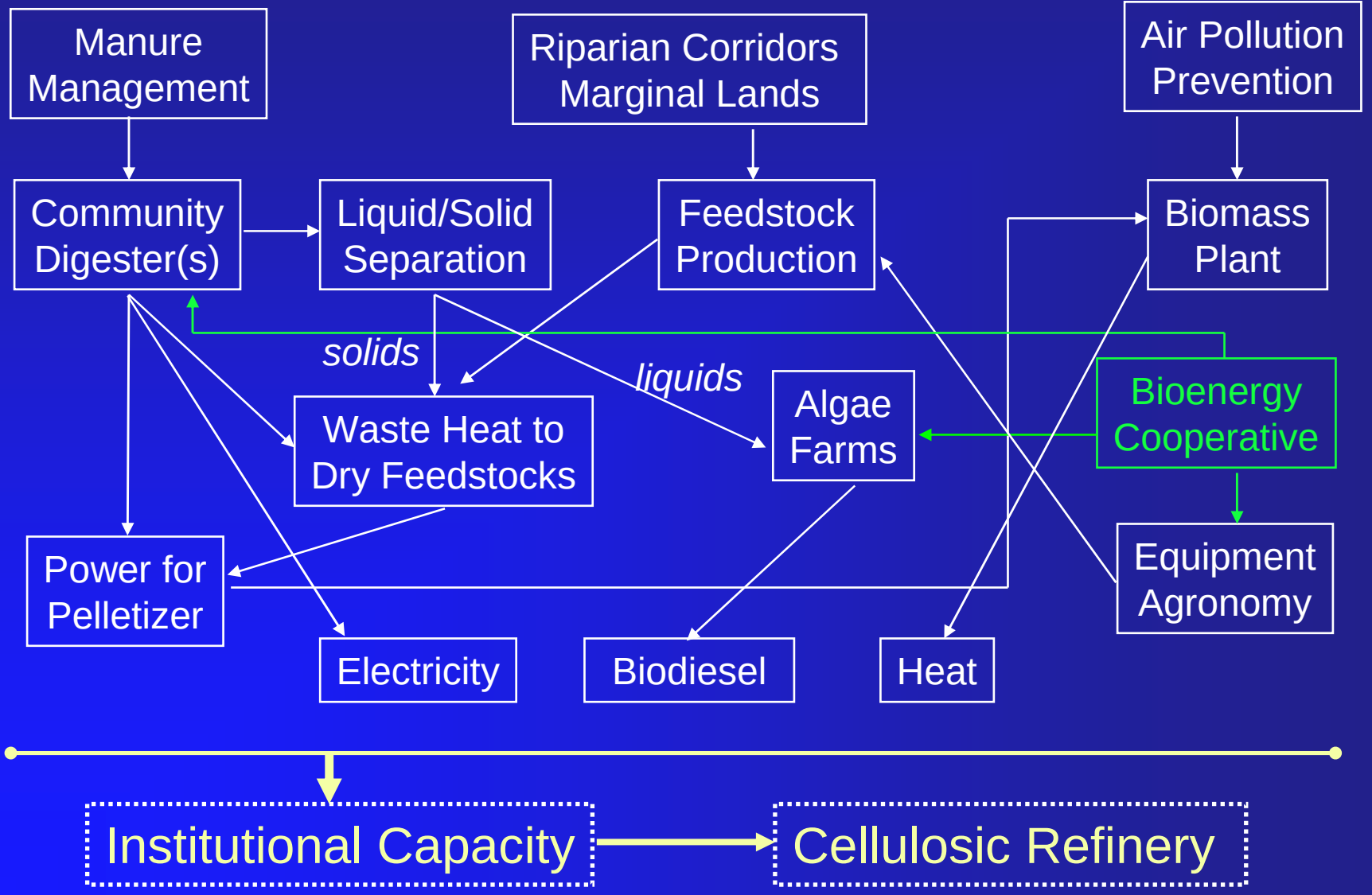


SCALE

Industrial versus Distributed

Optimal scale re sustainability

Emergence of a System



Marshall Toeffel Sustainability Hierarchy[1]

- Diversify income to all farms
- Reduce GHG emissions
- Maintain land in farms (food security)
- Reduce surface & groundwater pollution
- Enhance local economy
- Enhance local energy self-sufficiency
- Increase integration of rural-urban residents

1. Environmental Science & Technology, 2005

Conclusions

1. Disproportionate analytical emphasis is being placed on biofuel components rather than conditions for emergence of systems.
2. Moving toward sustainability requires transformation, yet most policy addresses component substitution.
3. Laboratory and other analytical research needs to be complimented by taking advantage of serendipitous surprises.