Economic and Social Aspects of Bioenergy Systems

Mark Downing, Senior Scientist and Agricultural Economist,

Oak Ridge National Laboratory

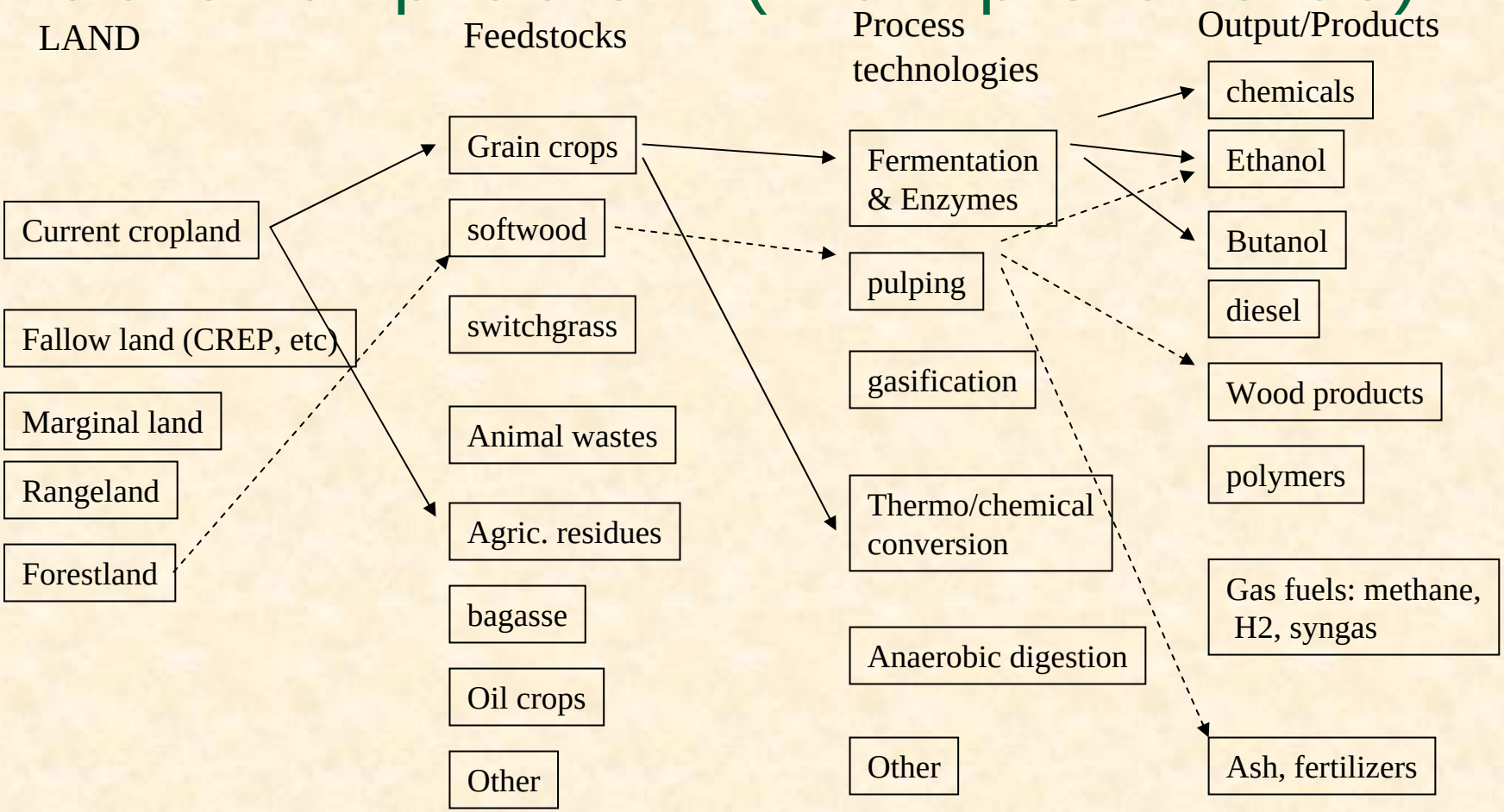
Five points to remember

- What matters is:
  - ✓ **Land use change patterns and effects**
  - ✓ **Oil displaced**
  - ✓ **Greenhouse gas emissions specie, magnitude, and direction**
- There are almost too many options to choose from
  - ✓ **Land-use, feedstocks, conversion, co-products**
- DOE and others are investing heavily in
  - ✓ **Biorefinery development**
  - ✓ **Feedstock assessment**
  - ✓ **Environmental assessment**
- Risks associated integrated biorefinery is great
  - ✓ **CAPEX $ can range from $4 to $9/gal ethanol (installed)**
- Infrastructure matters
  - ✓ **Where's the biomass, and where's the biorefinery?**

Barriers to Commercialization

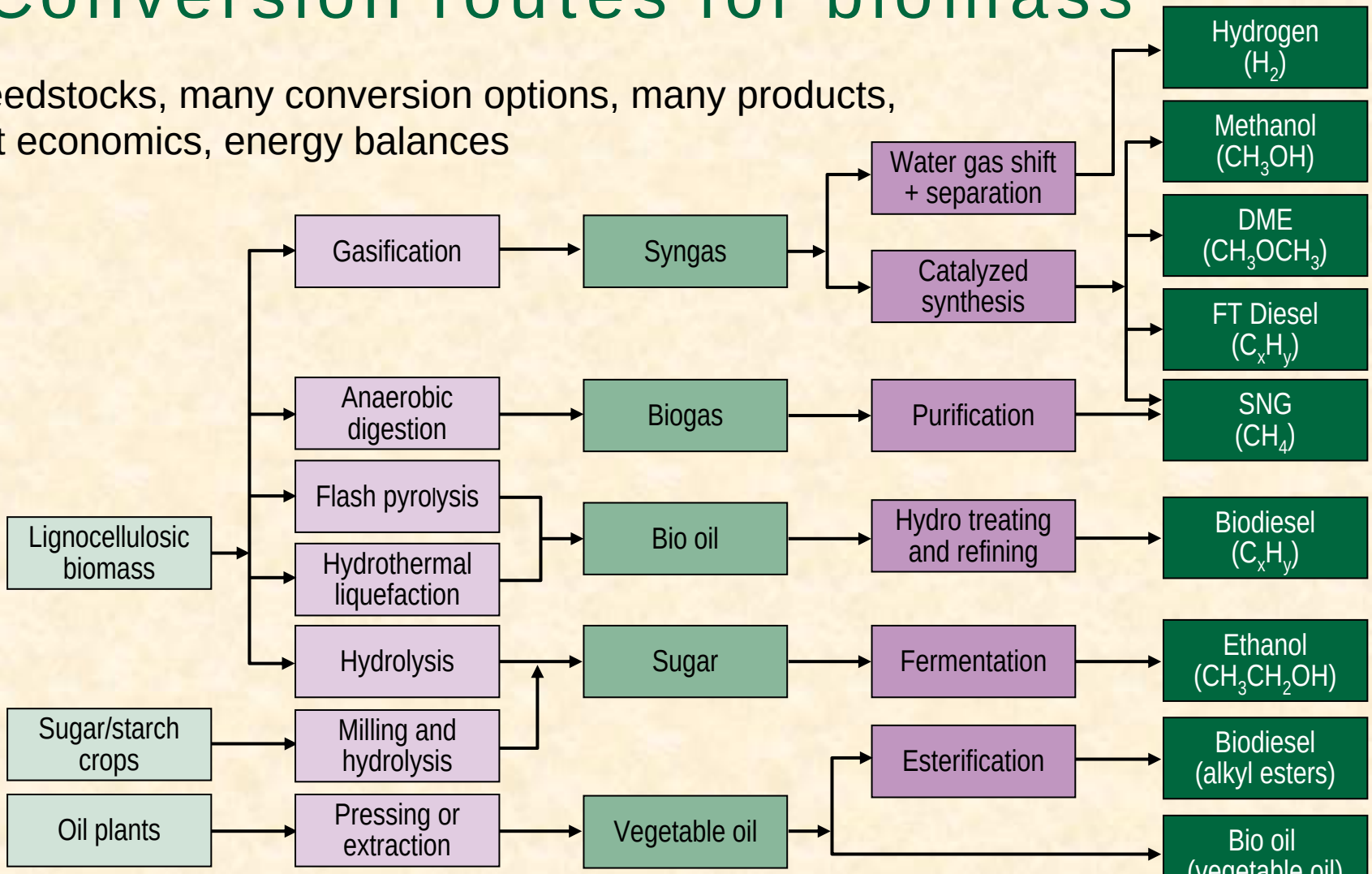
- R&D Success requires:
  - ✓ **Reduce costs associated with biochemical conversion of feedstocks, specifically enzyme and fermentation costs**
  - ✓ **Reduce the cost associated with thermochemical conversion of feedstocks, specifically gasification, gas cleanup, and fuel synthesis**
  - ✓ **2012 goal already accelerated from original 2020 goal**
- Land-use assessment to meet long term requirements
  - ✓ **Environmental, soil carbon, sustainability**
- Immature feedstock supply systems
  - ✓ **Costs range from $5/ton for waste wood to upwards of $50-65/ton for ag residues (depends on need to provide value to supplier)**
- Risks associated with first-of-a-kind plants and high capital investment for integrated biorefineries
  - ✓ **CAPEX $ can range from $4 to $9/gal ethanol (installed)**
- Lack of fuel distribution and vehicle infrastructures
  - ✓ **Estimated 20 to 40 billion dollar capital investment required**

Biomass Utilization is a multi-factorial problem (multiple choice)



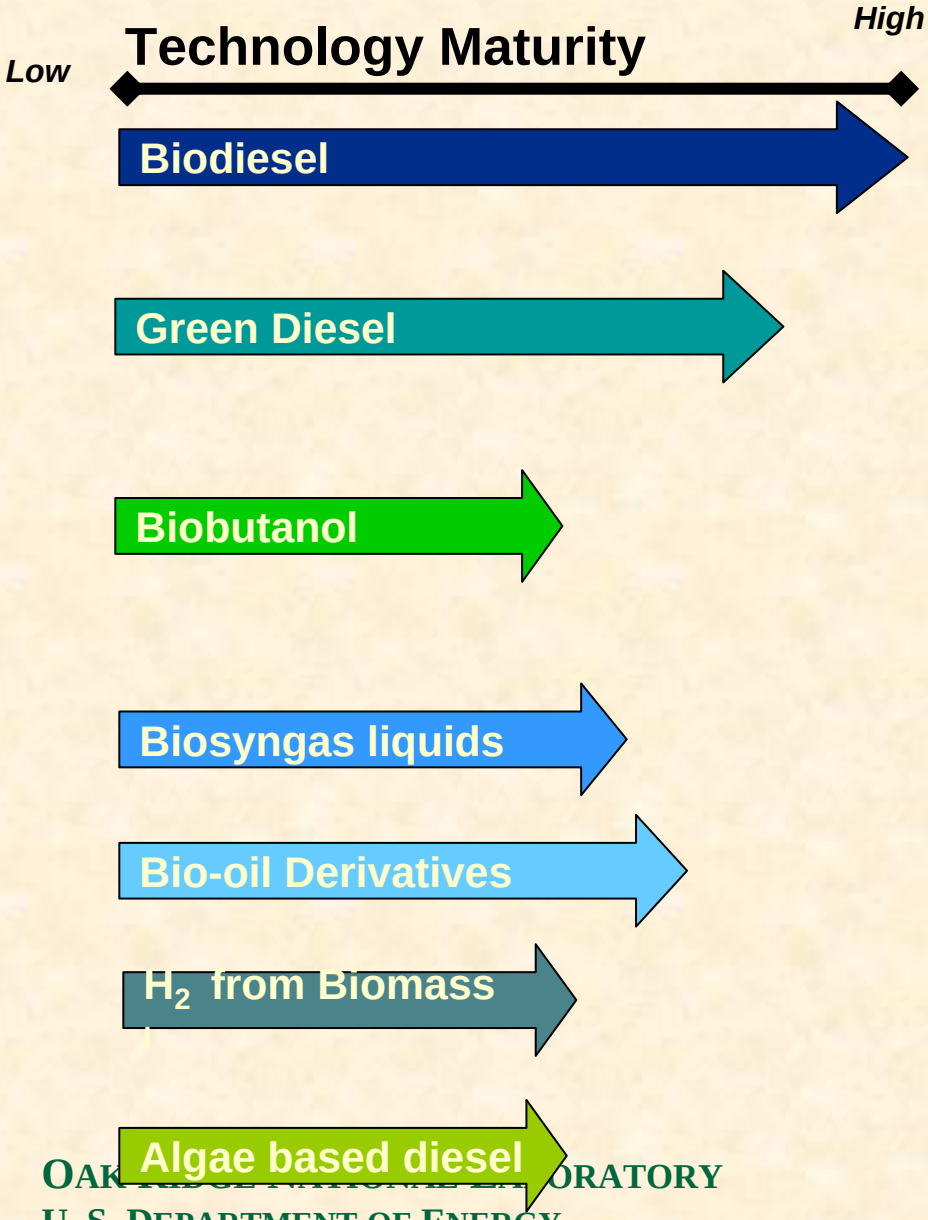
Conversion routes for biomass

Many feedstocks, many conversion options, many products, different economics, energy balances



Source: Carlo N. Hamelinck, "Outlook for Advanced Biofuels," PhD Thesis, Utrecht University, The Netherlands, 2004

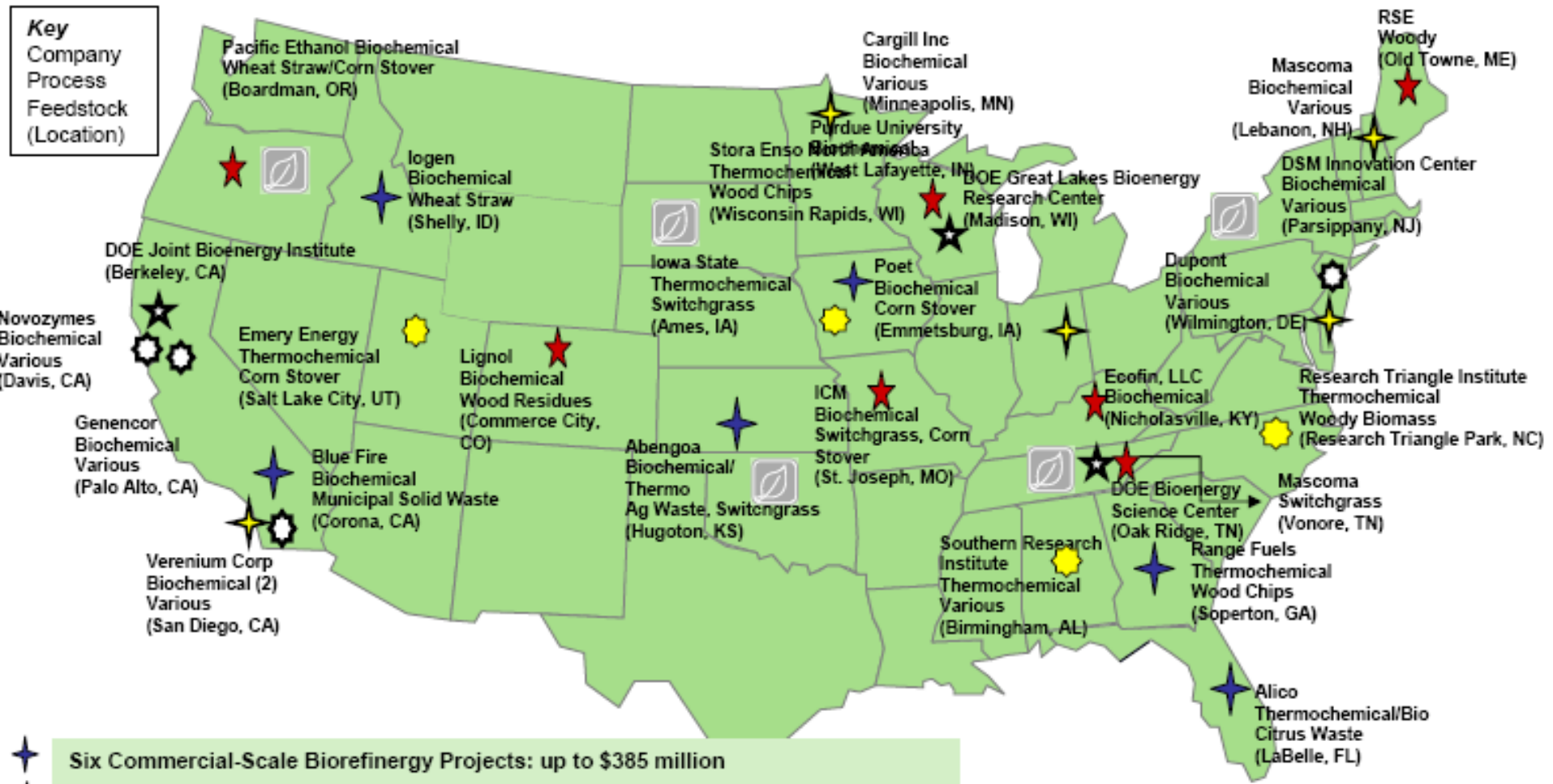
Other Biofuels



	Issues	Prospects
Biodiesel	Supply of oils	Small impact on market
Green Diesel	Supply of bio-oils	Could out compete biodiesel handily
Biobutanol	Immature technology	Better blending than ethanol in gasoline
Biosyngas liquids	Costs, catalysts	Omnivorous for feedstocks
Bio-oil Derivatives	Cleanliness for applications	Good feed to green diesel
H_2 from Biomass	Costs	Best as co-product?
Algae based diesel	Costs, technology	Good in certain regions

Major DOE Biofuels Project Locations

Geographic, Feedstock, and Technology Diversity



- Six Commercial-Scale Biorefinergy Projects: up to $385 million
- Seven Small-Scale (10%) Biorefinery Projects: up to $114 million (first round)
- Three Bioenergy Centers: up to $405 million
- Four Thermochemical Biofuels Projects: up to $7.7 million
- Four Improved Enzyme Projects: up to $33.8 million
- Five Projects for Advanced Ethanol Conversion Organisms: up to $23 million

Regional Partnerships

South Dakota State Univ., Brookings, SD
Cornell University, Ithaca, NY
Univ. of Tennessee, Knoxville, TN
Oklahoma State Univ., Stillwater, OK
Oregon State Univ., Corvallis, OR