Algal Scaling

- 1500 bbl/day – amount needed to integrate with refinery
- *25,000 L, 90 m^2 of solar area: 1-3 kg algae/wk (~3 $g/m^2/day$)*

→7700 acres

→110 x 10^6 gallons water/h

2011 Sunrise Ridge Algae

Biofuels: Other Platforms

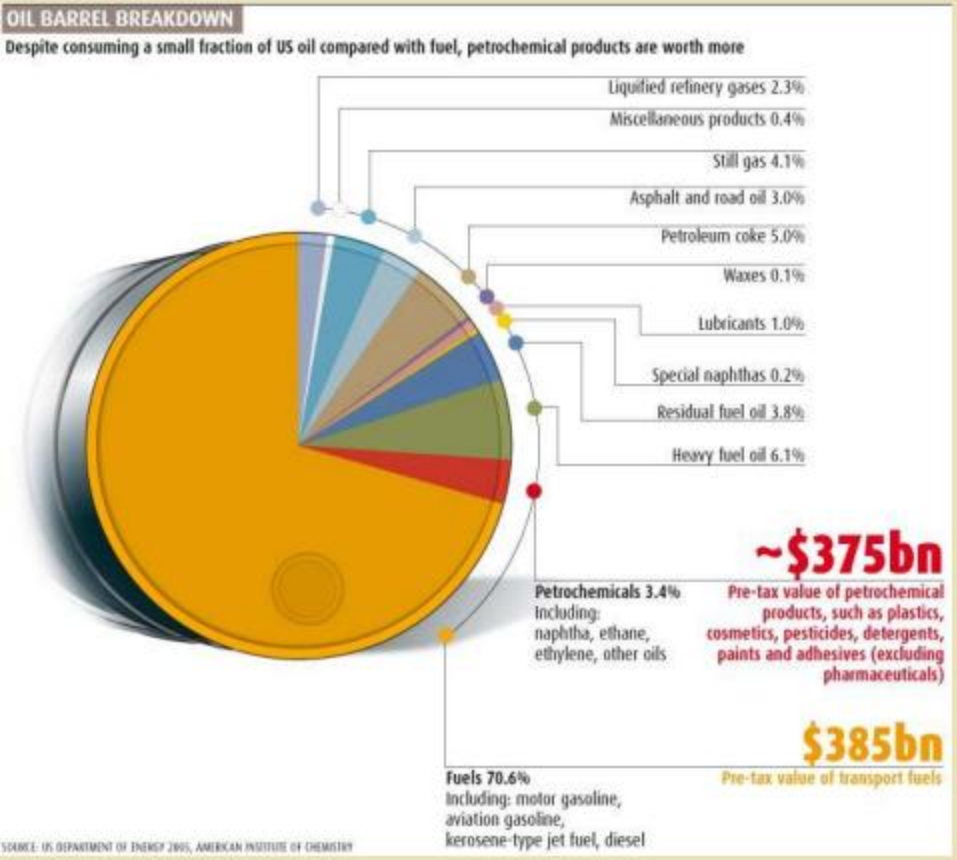
- **Plant oil based routes**
  - Technology for conversion of plant oils such as soybean oil or palm oil well established
  - Conversion technology not capital intensive
  - Costs driven by cost of the plant oil which typically high
  - Soybean oil today is $1200 per tonne, that leads to over $4.00/gallon feedstock component in total cost of biodiesel
  - Raises questions concerning competition for food

Biofuels: Other Platforms

- **Other Fermentation Routes**
  - Synthetic biology used to modify yeast or other organisms to make specific products
  - Similar to fermentation, feedstock is sucrose
  - Cost of Brazilian raw cane sugar gives of order $3 per gallon of diesel hydrocarbon product (rough estimate)
  - Problems with microorganism survival and productivity

- **Catalytic conversion of other plant products**
  - Early stages of development
  - Need to find abundant plant products that are cheap
  - Technology not clear for estimate base

Co-Product Options

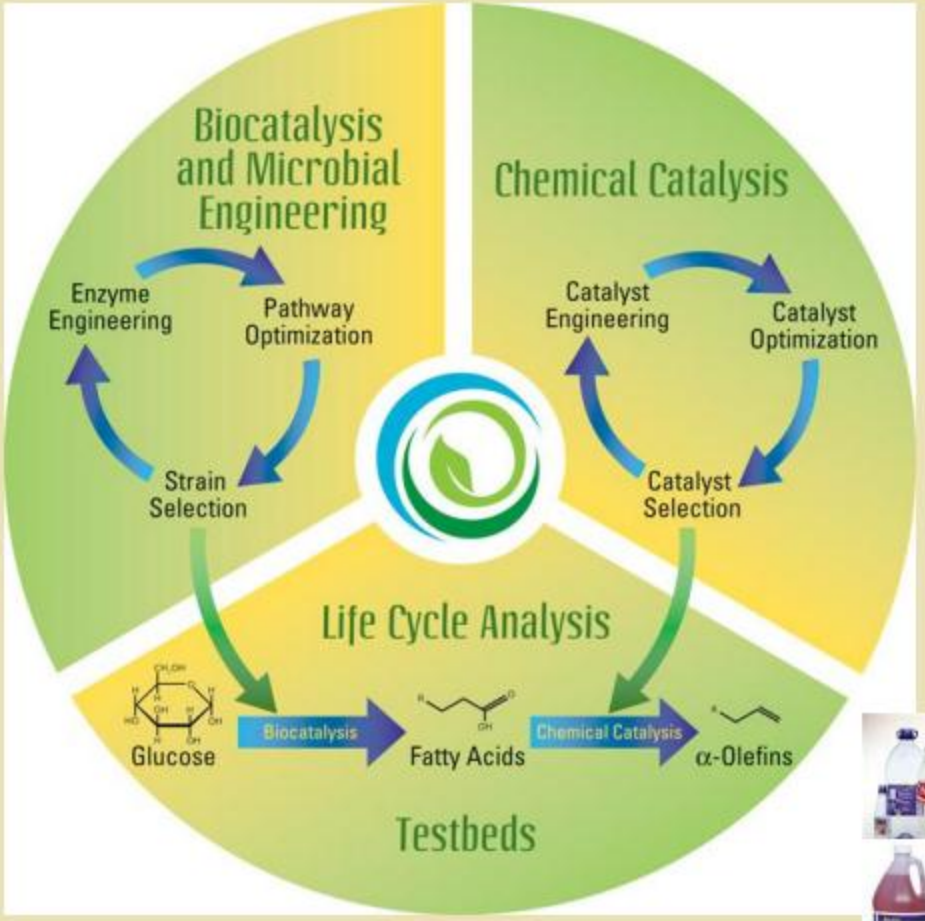


CBiRC

NSF Engineering Research Center for Biorenewable Chemicals

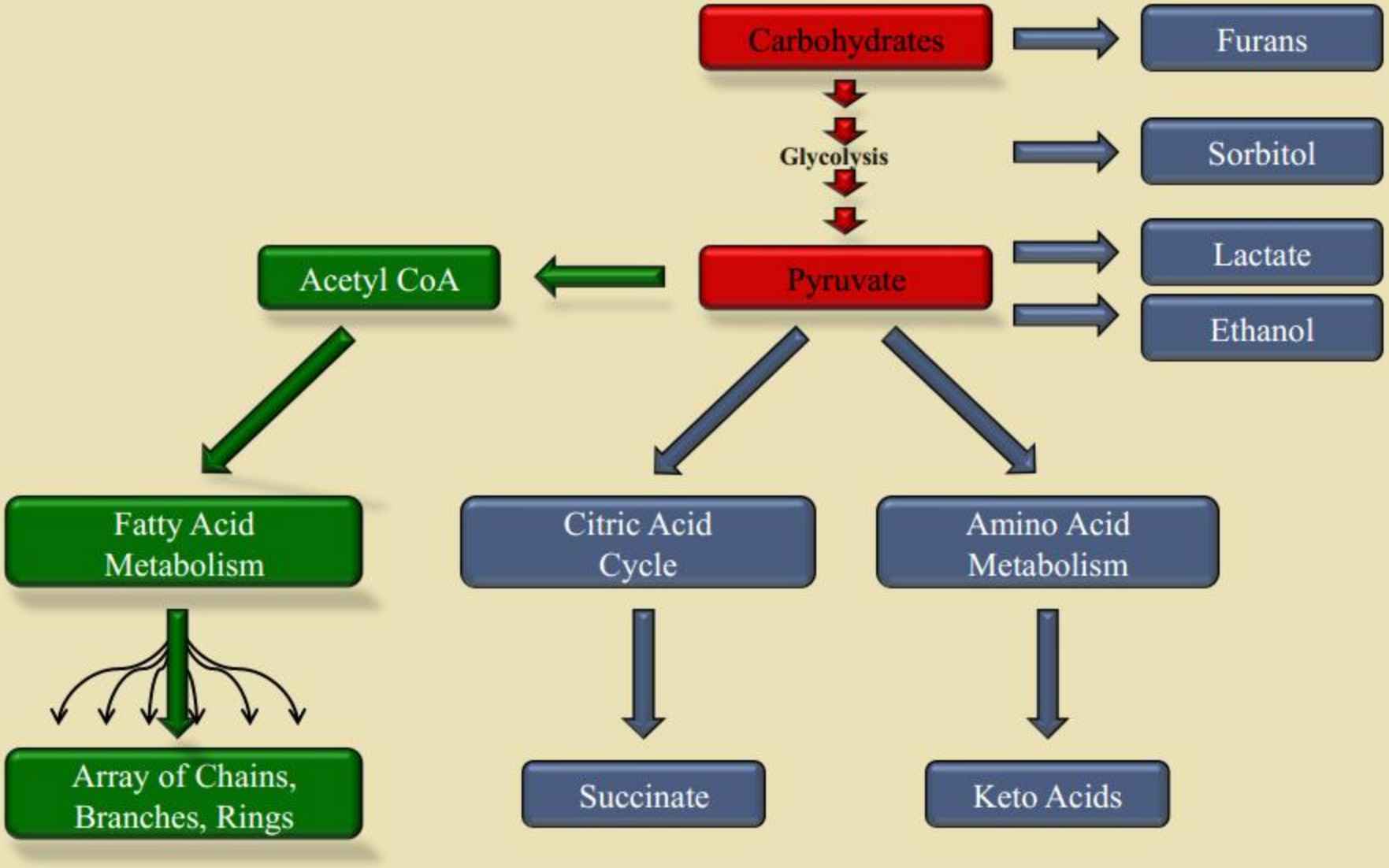
Diverse product framework

Research Overview

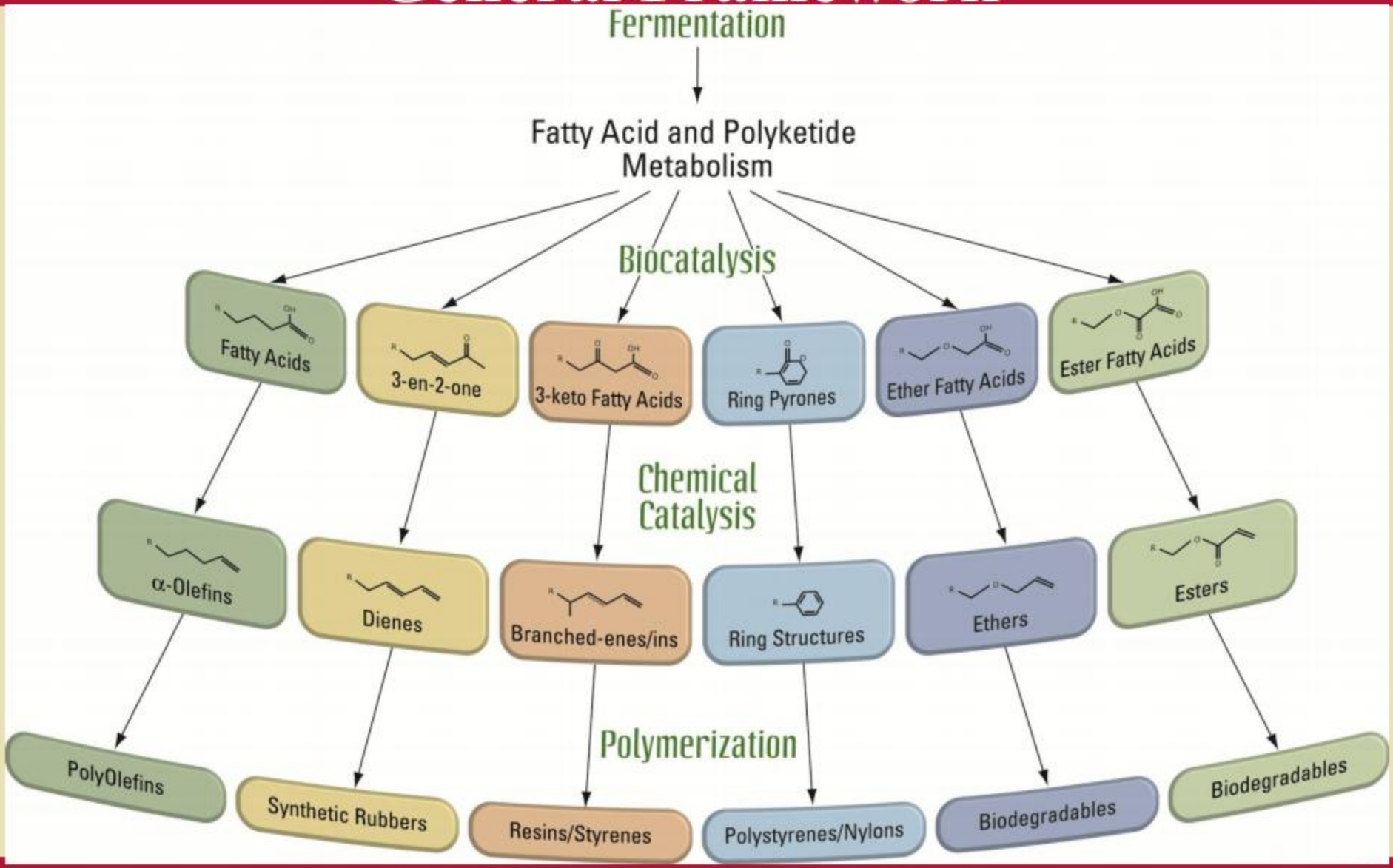


Renewable Carbon → **Biorenewable Chemicals**

Pathways to Biorenewables



General Framework



Fast Pyrolysis

Corn stover
(~1.5 GJ m^{-3})

~500°C

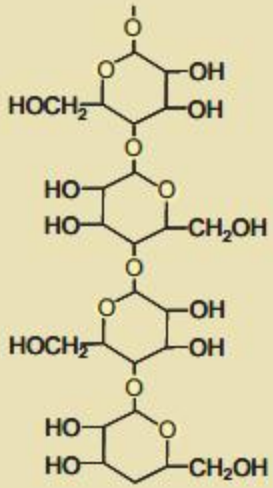
Gas
(~6 MJ kg^{-1})

+

Bio-oil
(~22 GJ m^{-3})

+

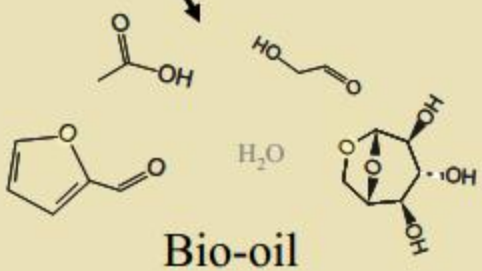
Biochar
(~21 MJ kg^{-1})



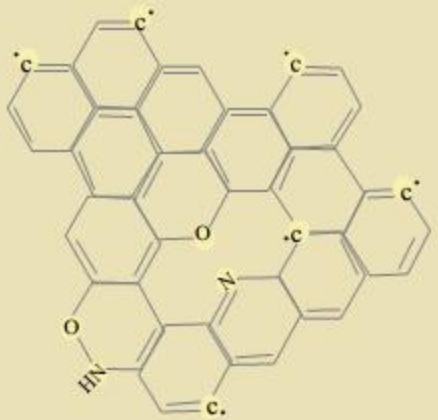
Cellulose

Gas

H_2, CO, CH_4, CO_2



Bio-oil



Biochar