



Cellulosic Biomass Systems

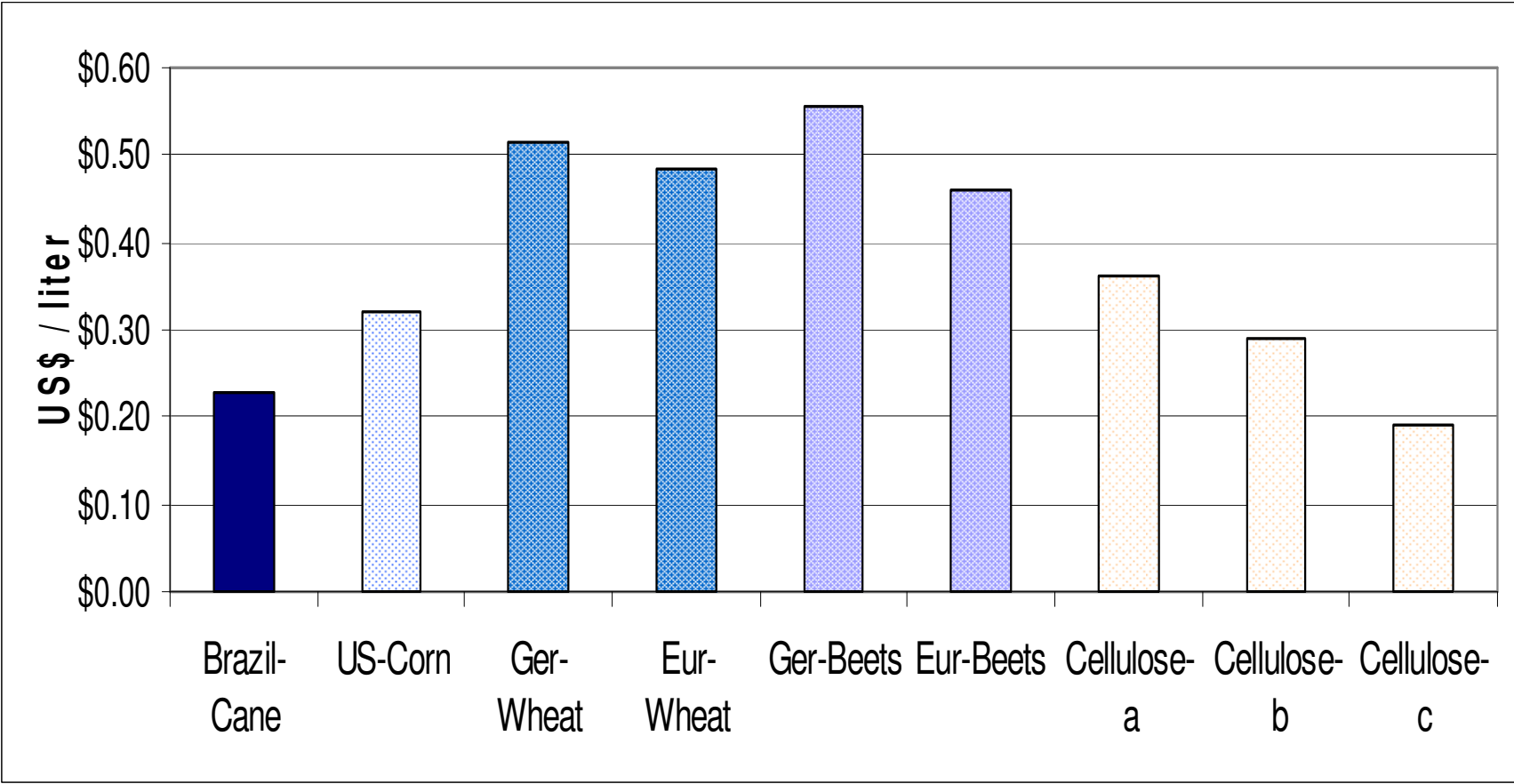
Tom Richard

Penn State University

Mark Laser

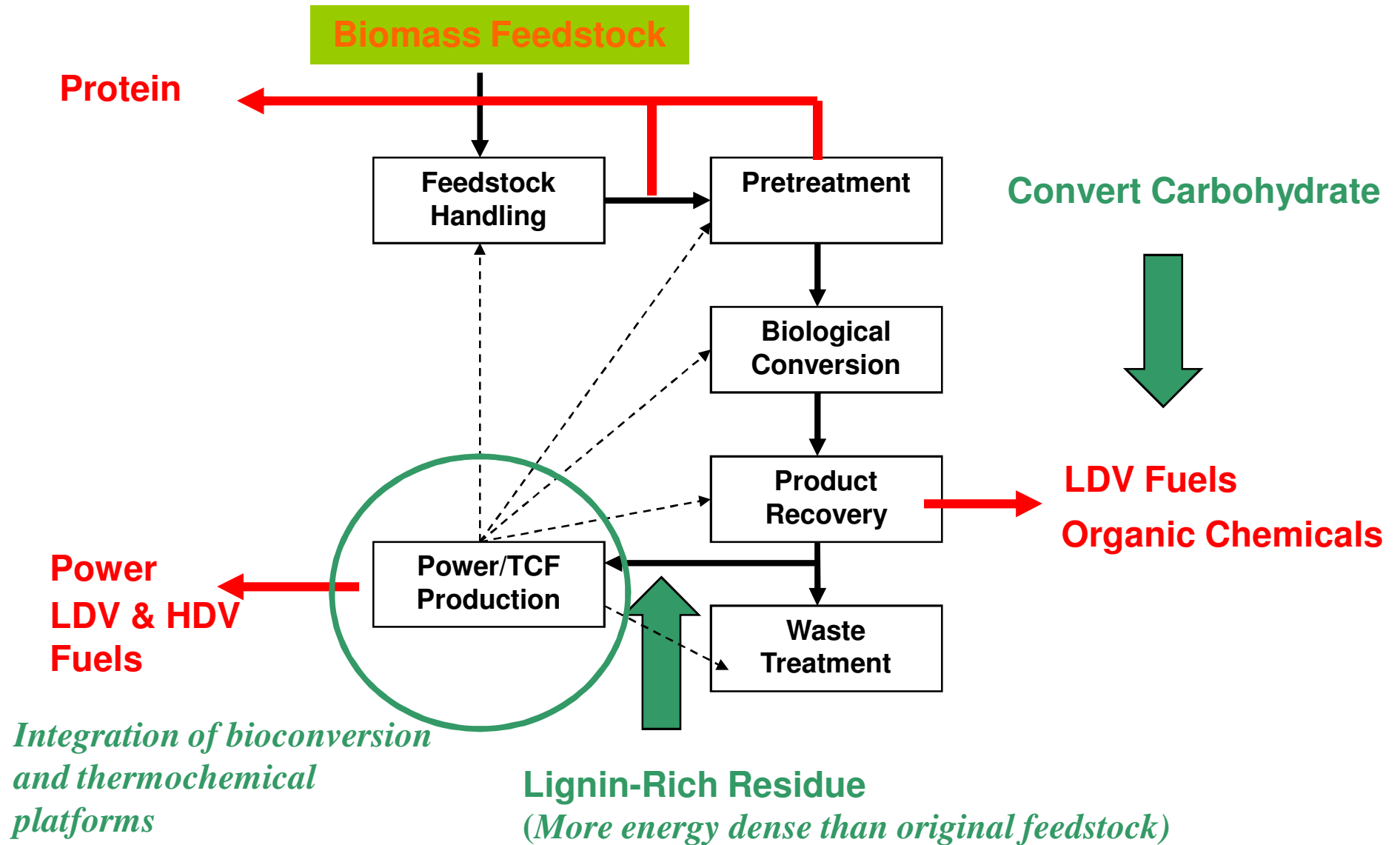
Dartmouth College

Comparative production costs

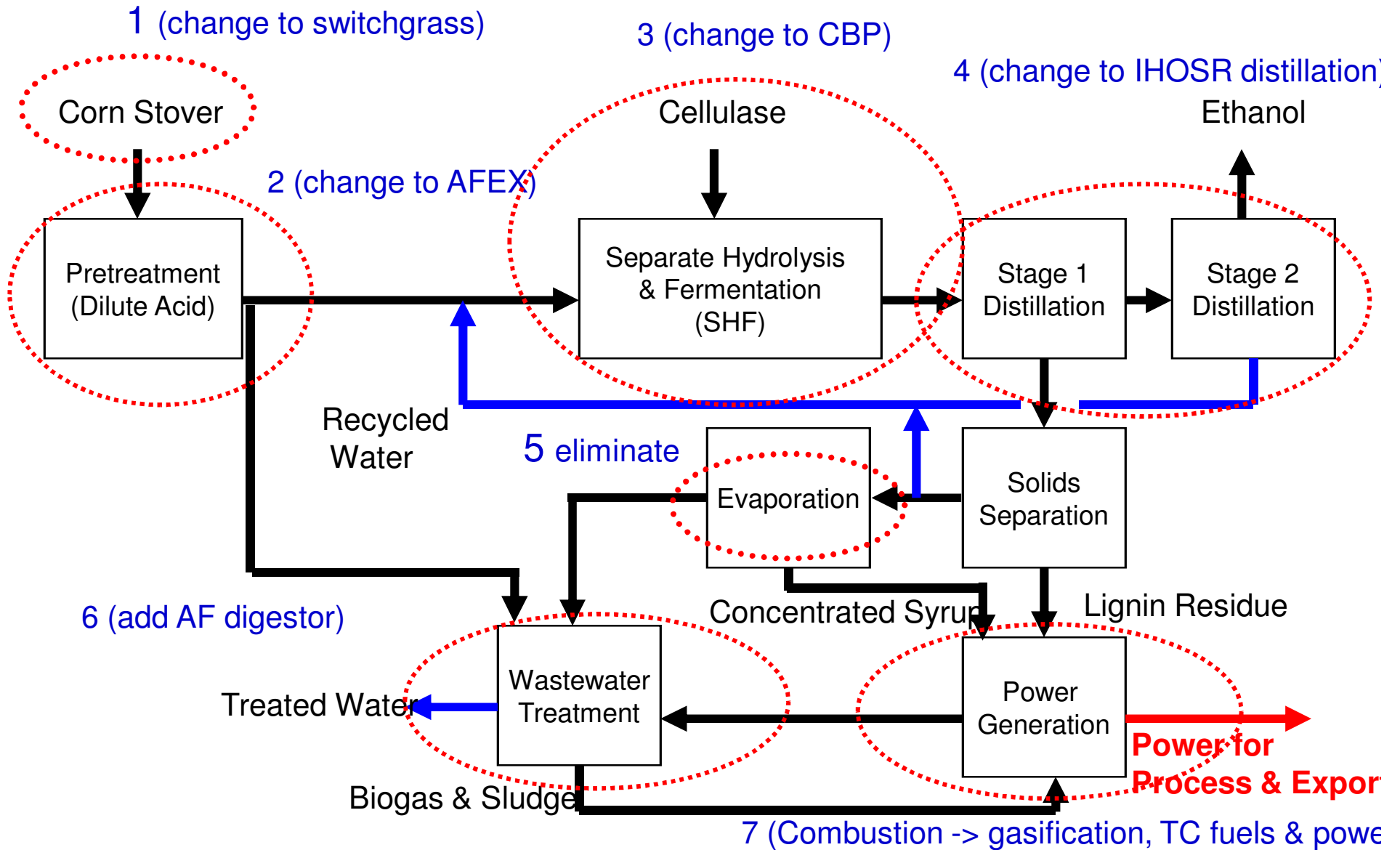


Source: Compiled by Brewer from data in IEA, 2004

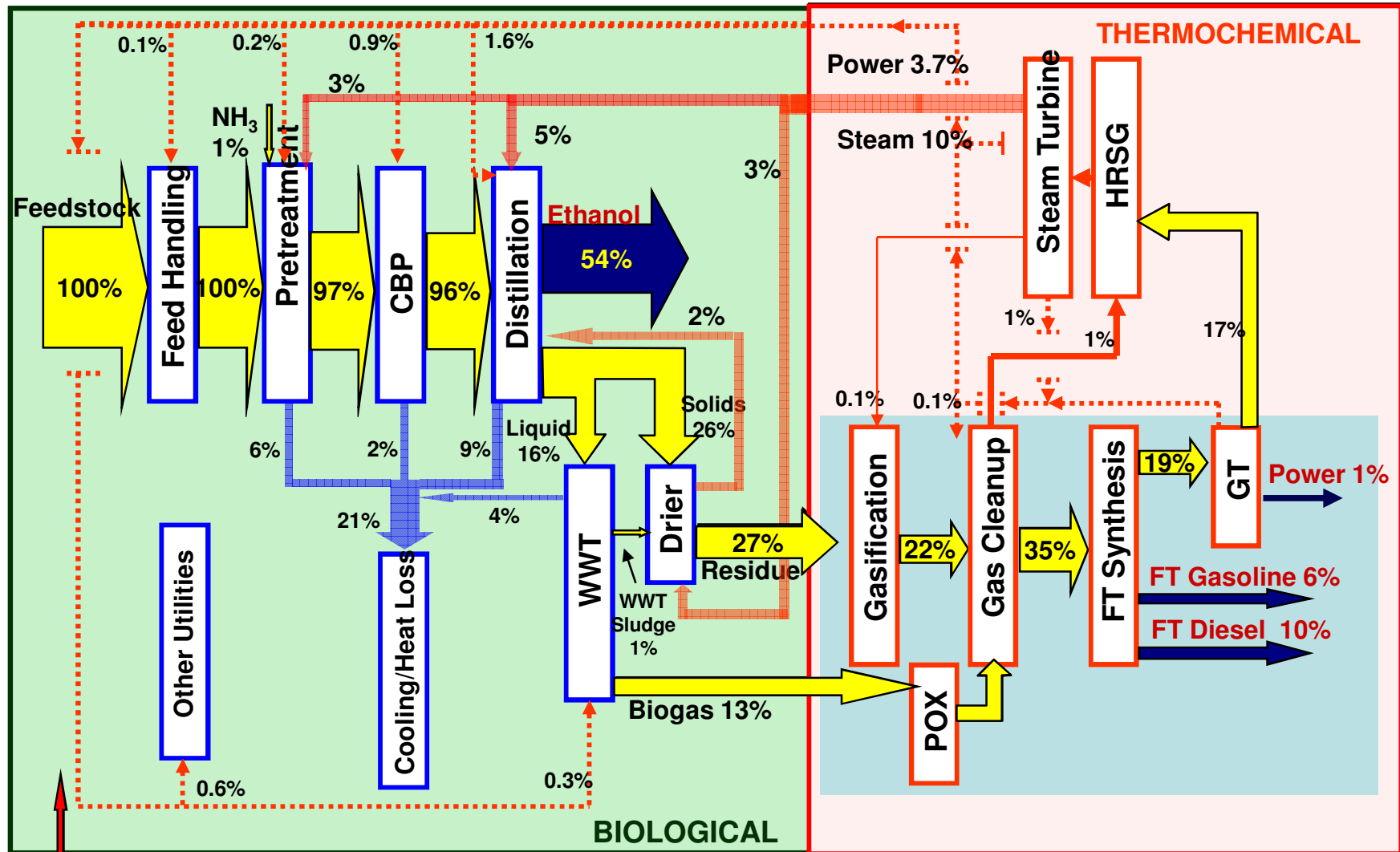
Integrated Biorefineries



Changes from 2002 NREL Design



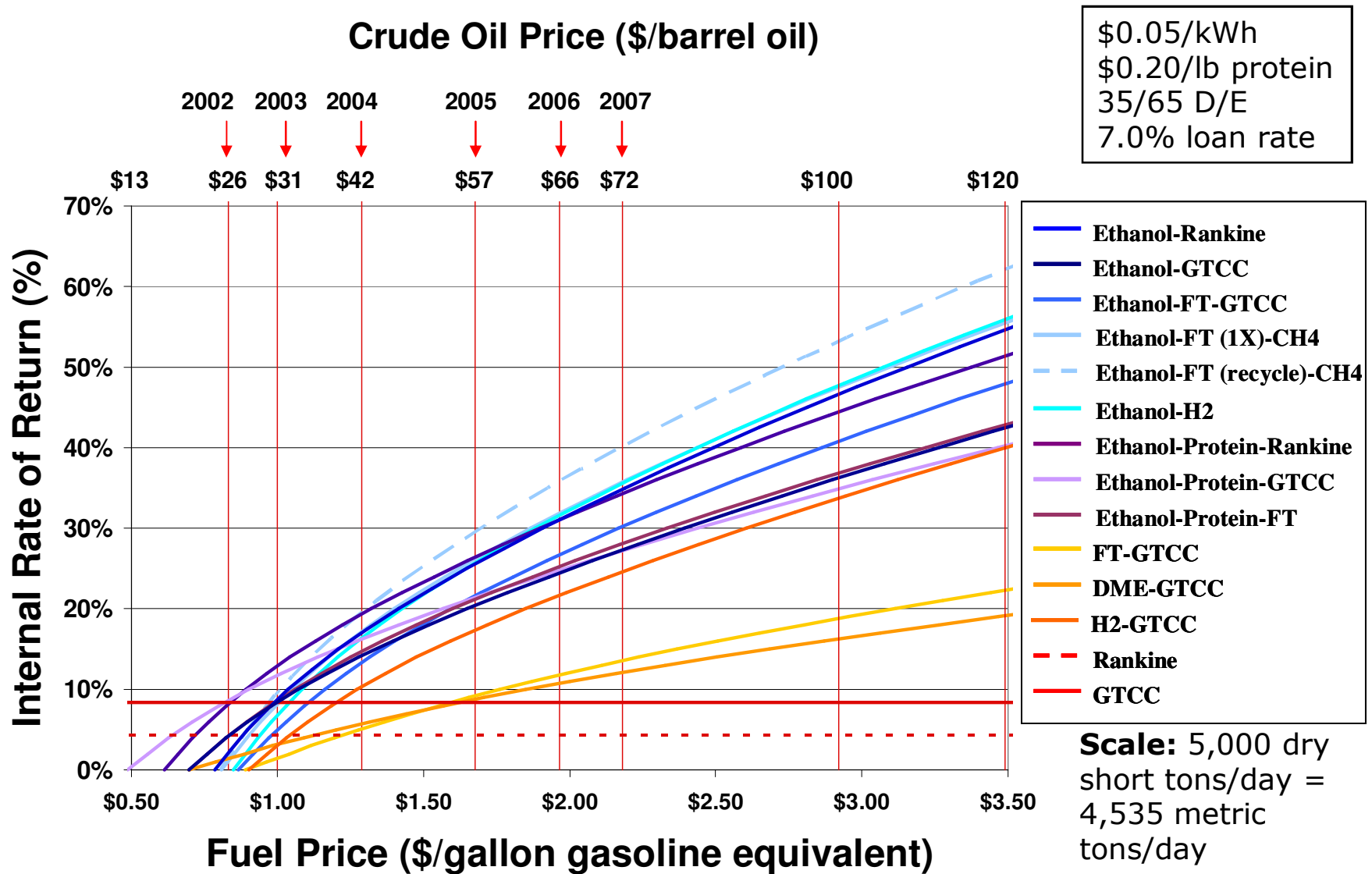
Energy Flows (Example Scenario)



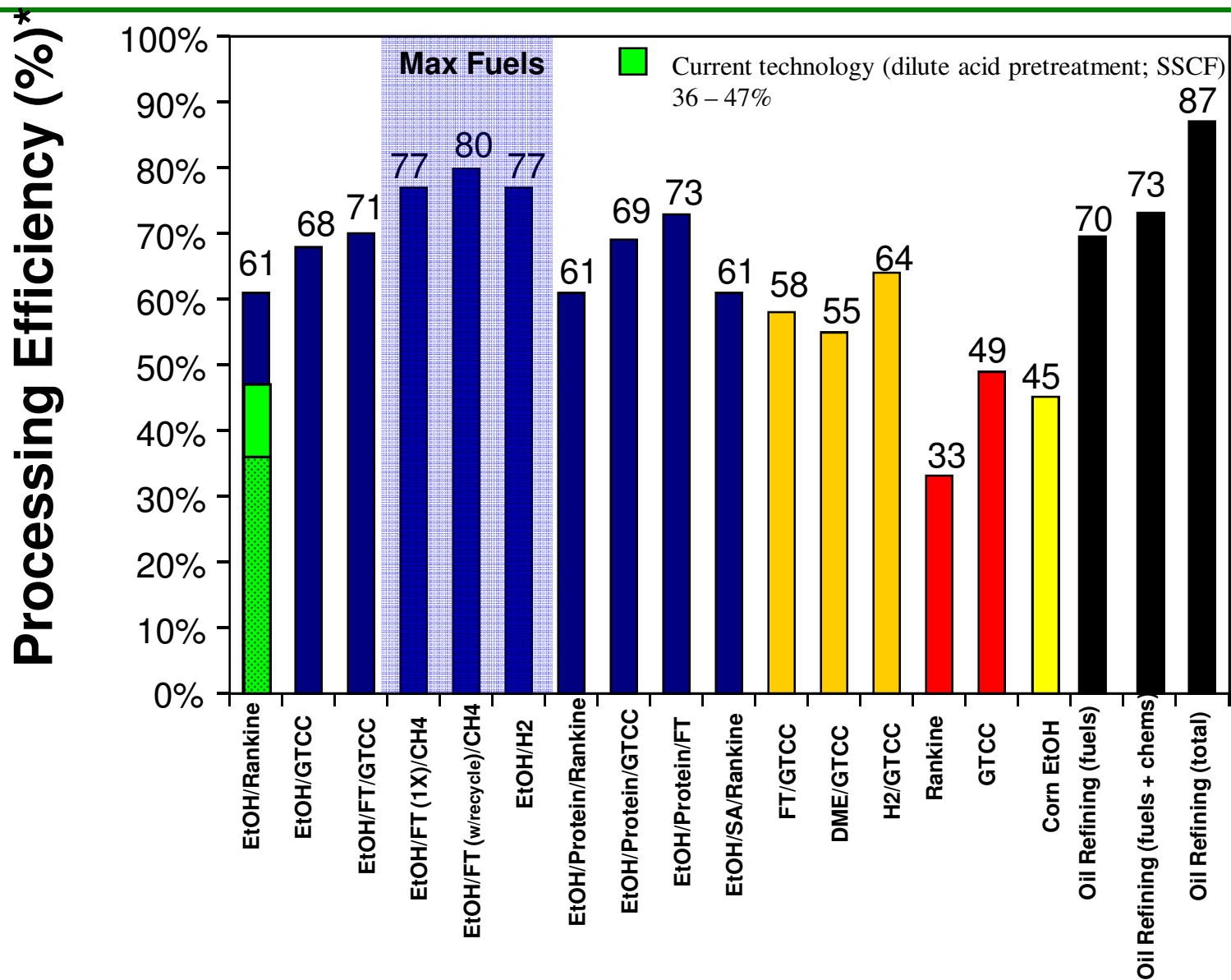
Ag Inputs (Farming, feedstock transport) ~ 7 %

Energy out/Ag inputs in:

Process Economics

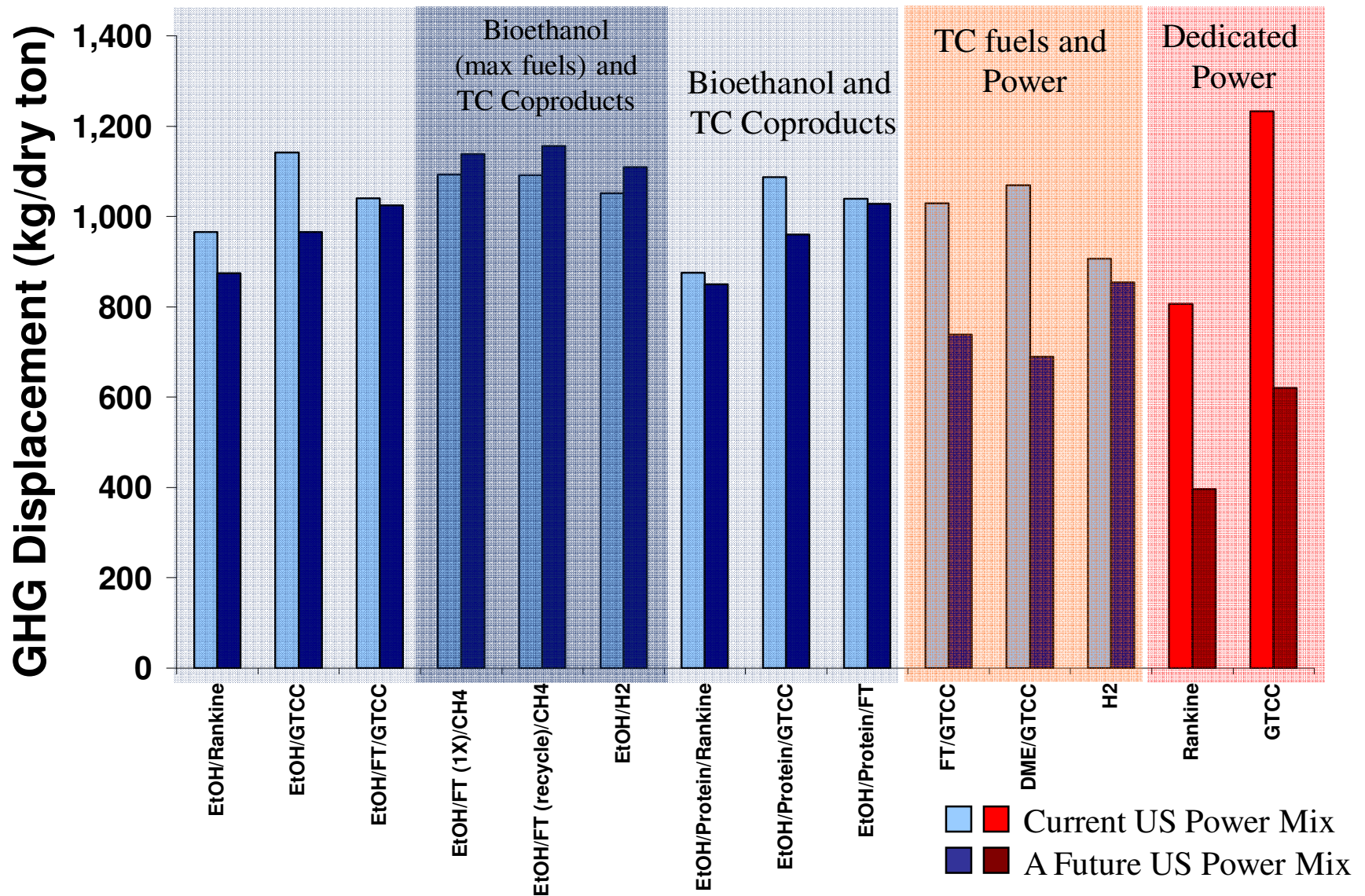


Processing Efficiencies

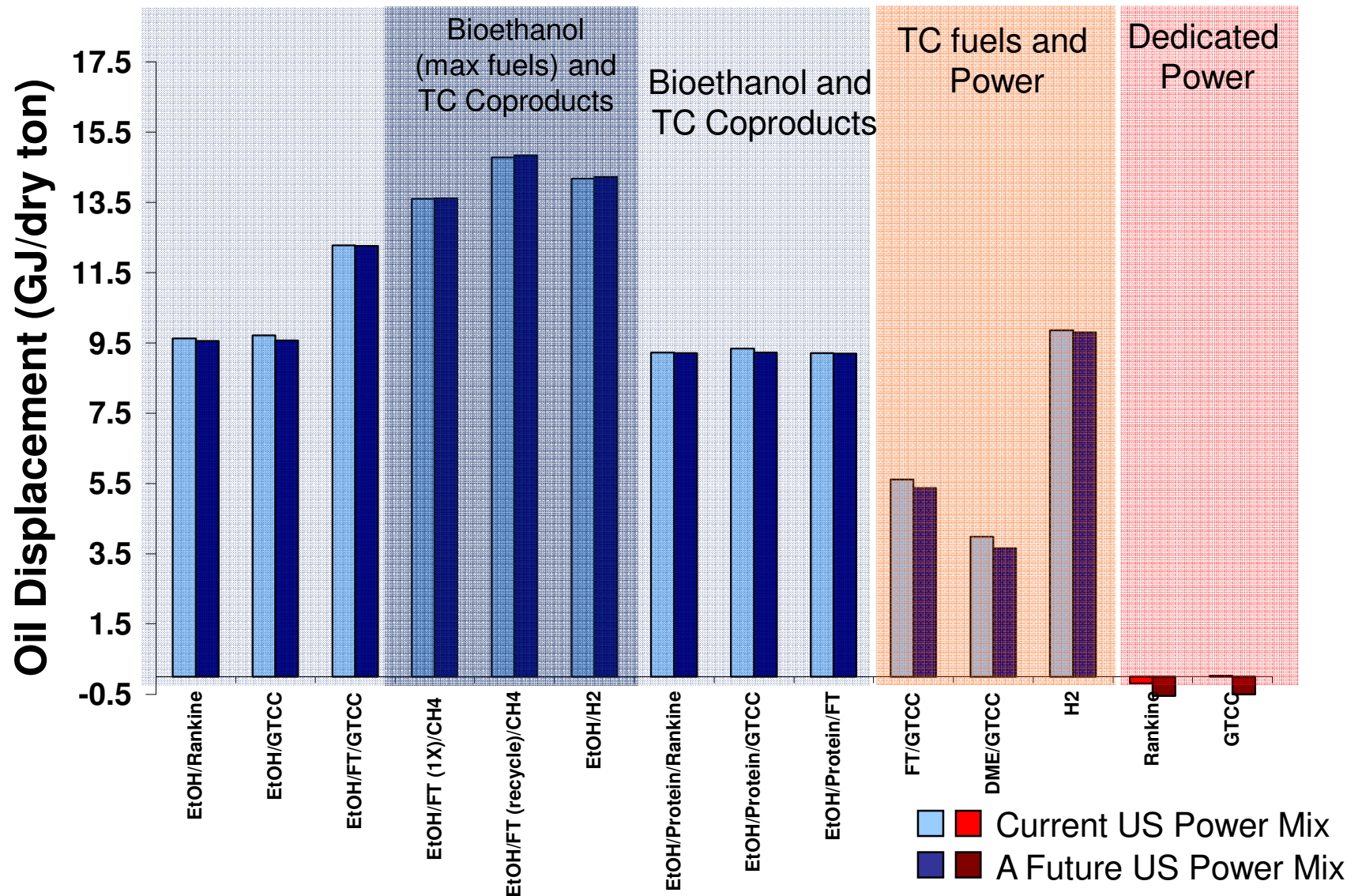


*Defined as energy out/(feedstock + external processing energy); % feedstock LHV basis

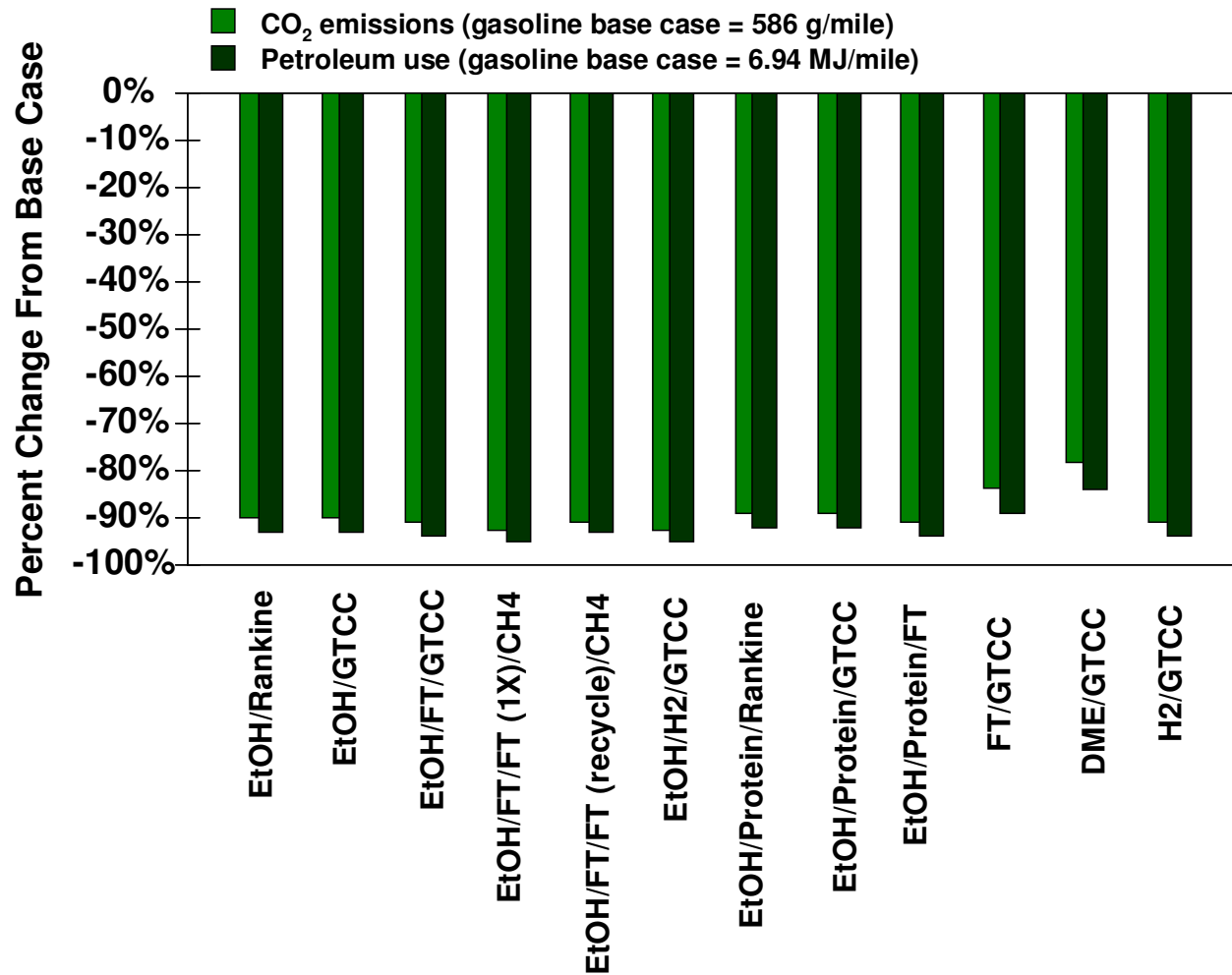
Comparative GHG Displacement



Comparative Oil Displacement

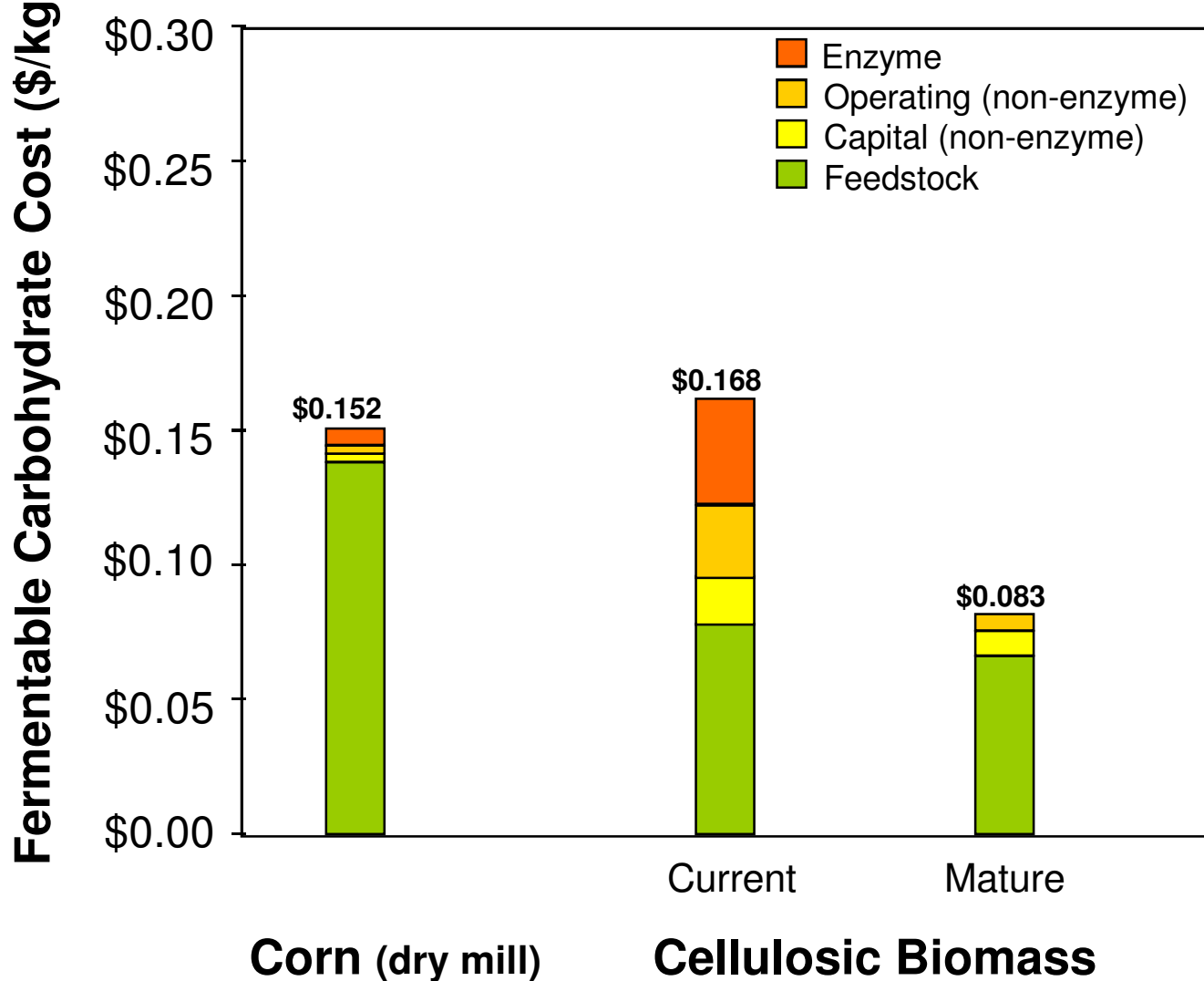


Comparative Oil Use and GHG Emissions



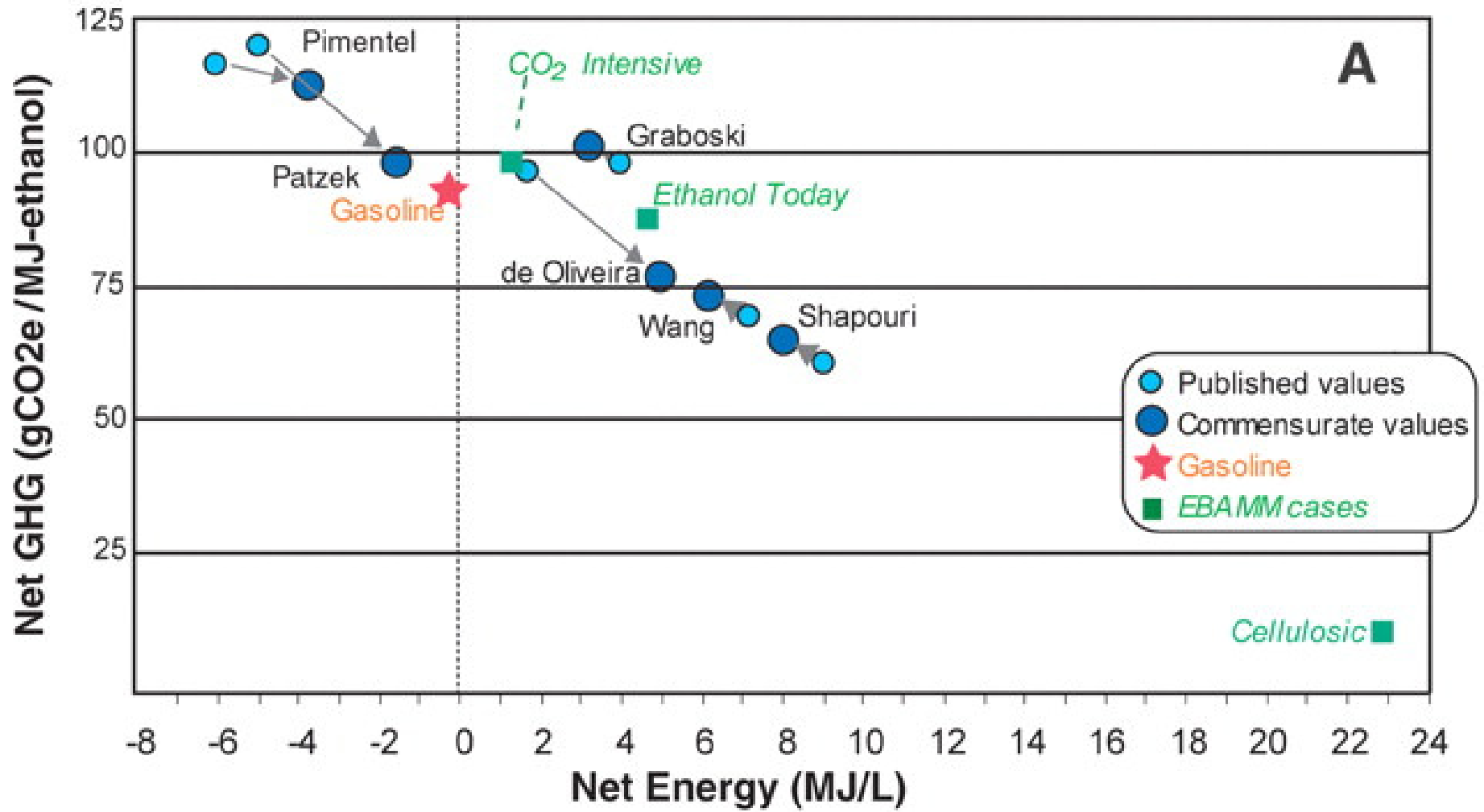
Scenarios involving bioprocessing: > 90% reduction relative to status quo

Economic Drivers: Biological Processing of Lignocellulose



Laser and Lynd, 2007

Net energy and net greenhouse gases for gasoline, six studies, and three cases



A. E. Farrell et al., Science 311, 506 -508 (2006)

www.bioenergy.psu.edu

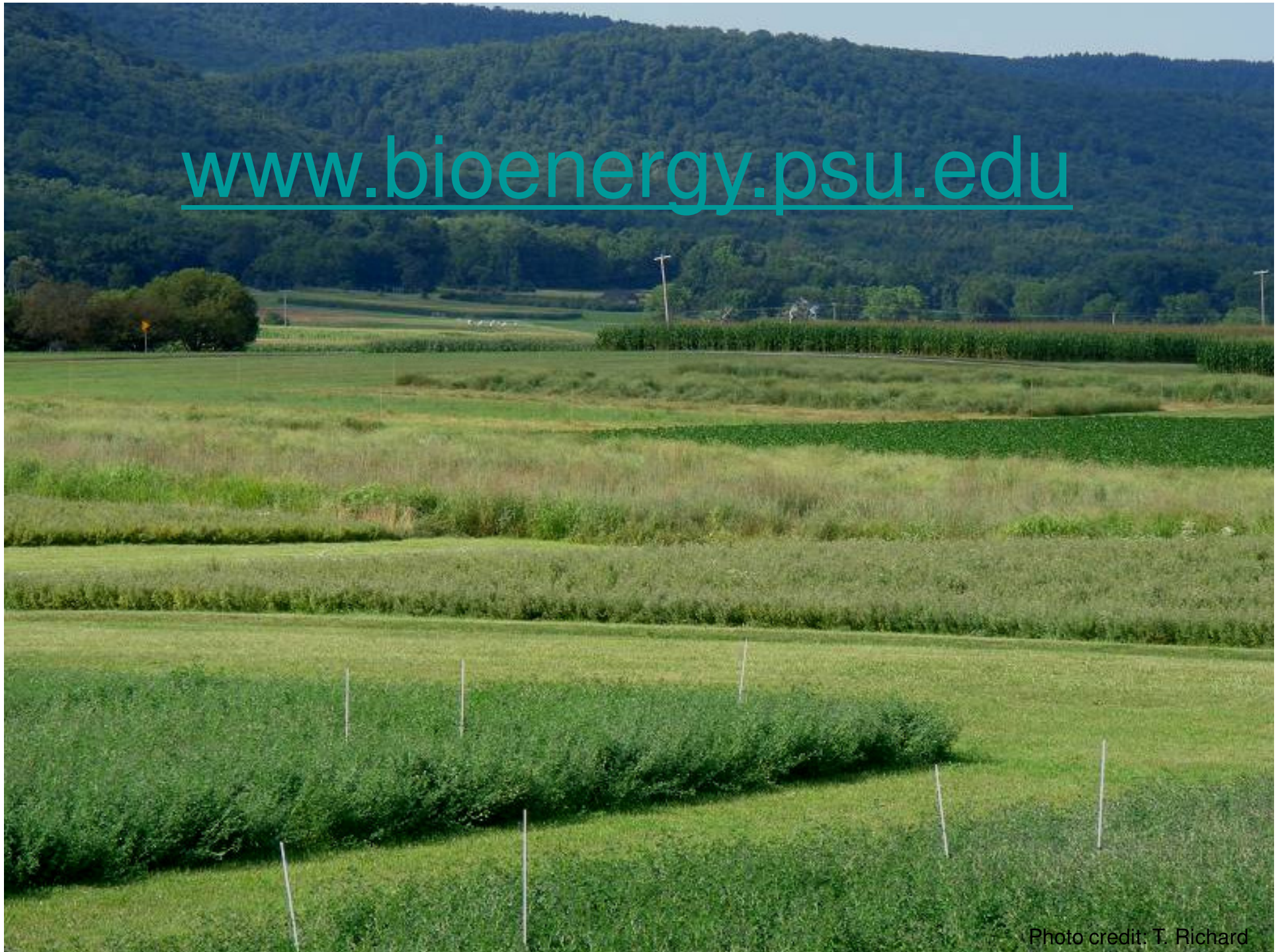


Photo credit: T. Richard