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UC DAVIS PLANT SCIENCES

Prospects for Agricultural Feedstocks for Biofuels in California

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The California ENERGY COMMISSION

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UNIVERSITY OF CALIFORNIA AGRICULTURE AND NATURAL RESOURCES • Cooperative Extension • Agricultural Experiment Station

Biofuels Workshop Topics

- Overview of CA biofuel feedstocks
- Biofuel coproducts, water-use, purpose grown crop locations and ag wastestream feedstocks
- National and state ag policy for biofuel
- Strategy for achieving policy outcomes
- Current status of purpose-grown and ag residues in state

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‘Working’ Biomass Qualifiers

- **Purpose-grown energy crops:** Crops grown as a *commodity* with market standards and an established demand
- **Residues:** Homogenous *by-products* (not-mixed) and utilized periodically as demand goes up and down
- **Wastes:** Heterogeneous *by-products* (mixed) and in sufficient excess supply to require additional costs to remediate

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Distribution of California Biomass

- **Regionally defined**
  - Forestland is rainfed on steep slopes
  - Agriculture is largely irrigated and flat
  - Solid waste is concentrated surrounding urban areas
  - Wastewater can be
    - Food processing residues in the ag production areas or
    - Municipal wastewater in the urban areas
- **Not all biomass is uncommitted**
  - Many woody residues are used in power generation
  - Many of the food processing residues are fed to cattle
  - Bury ~ 20 MBDT/y of biogenic material in Landfills

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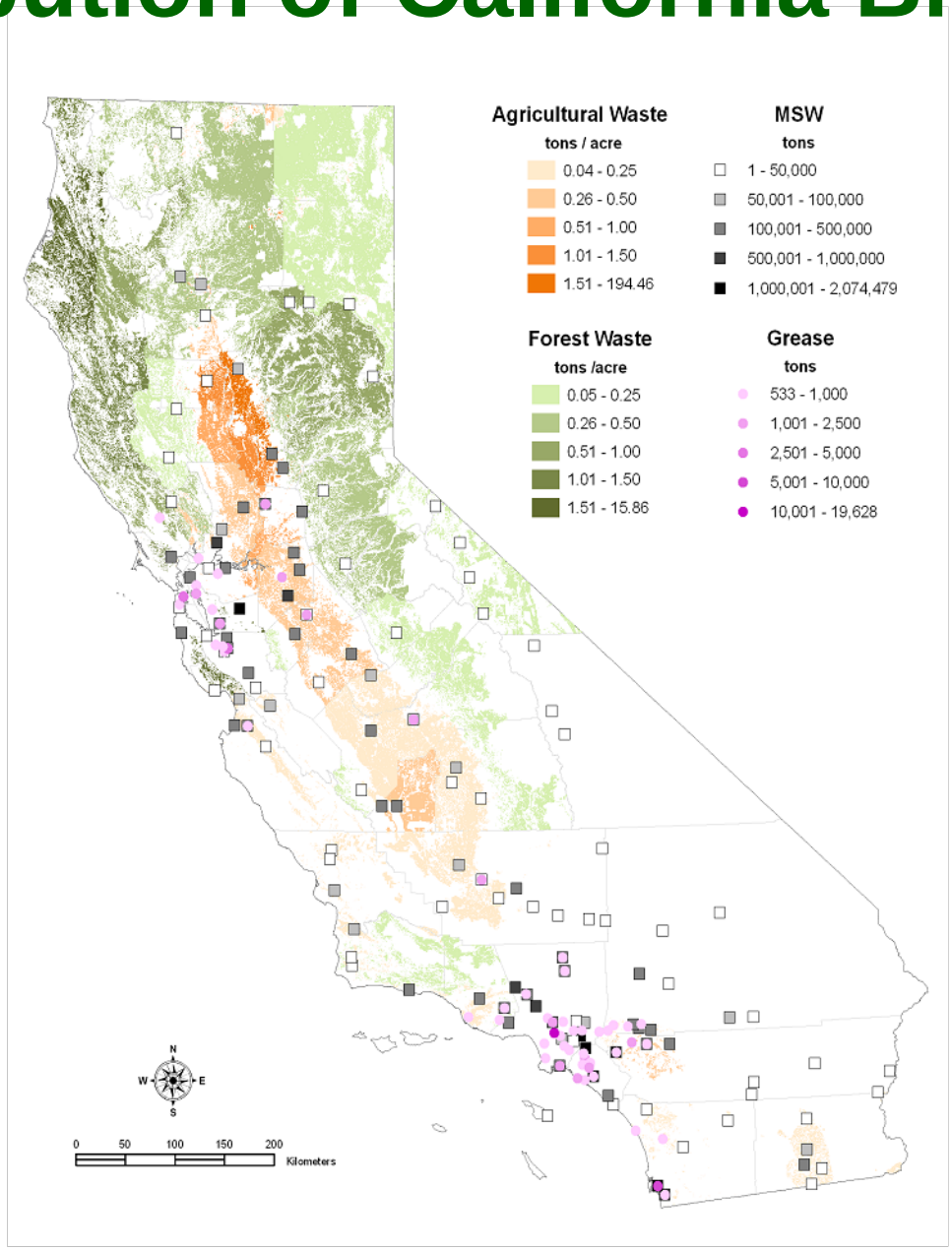
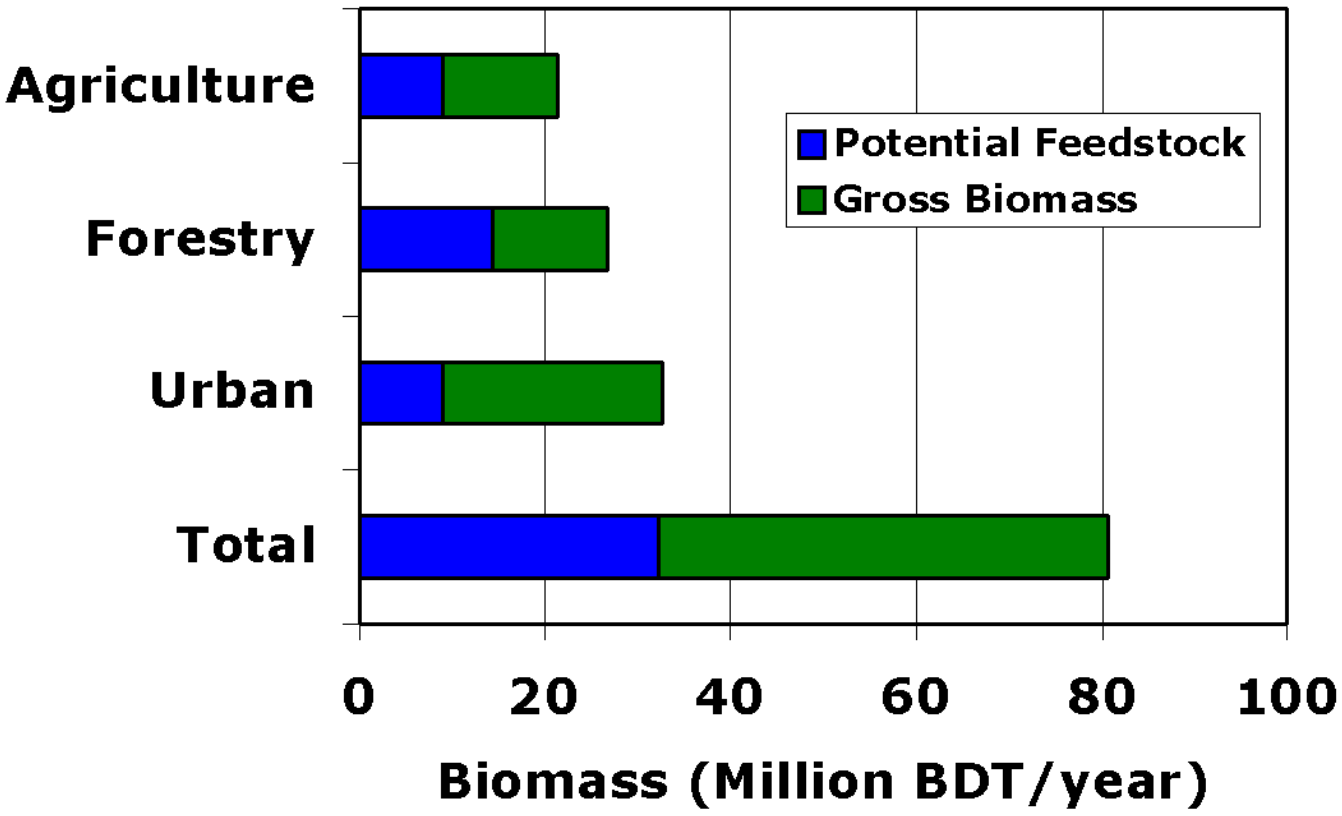
Distribution of California Biomass



California Biomass Resources



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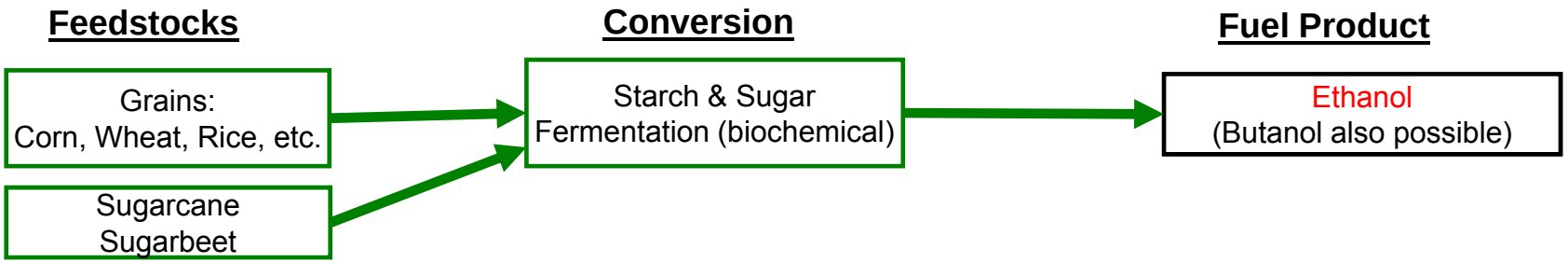
Biofuel Pathways



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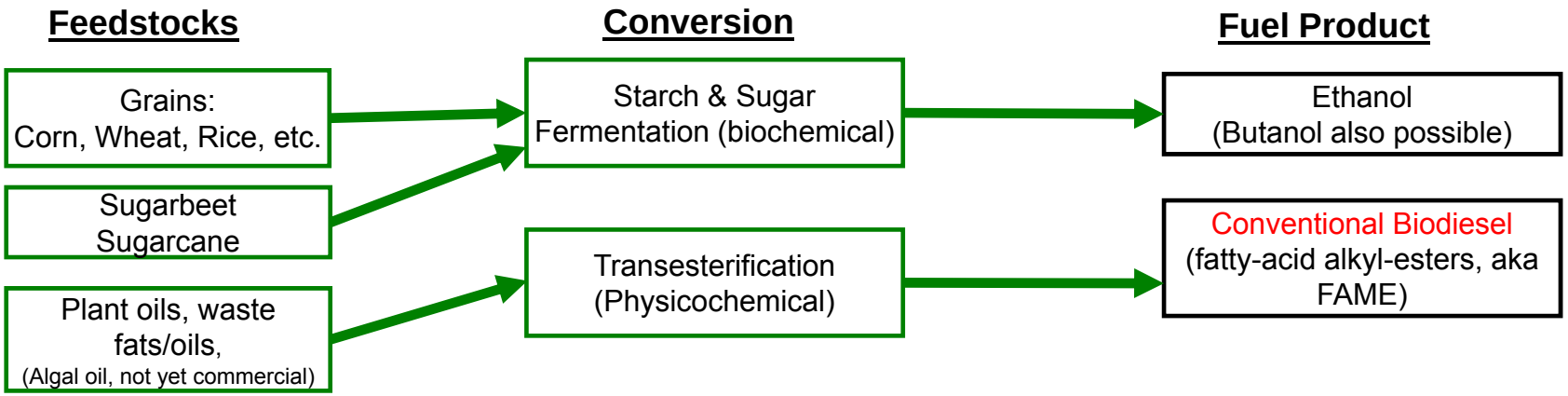

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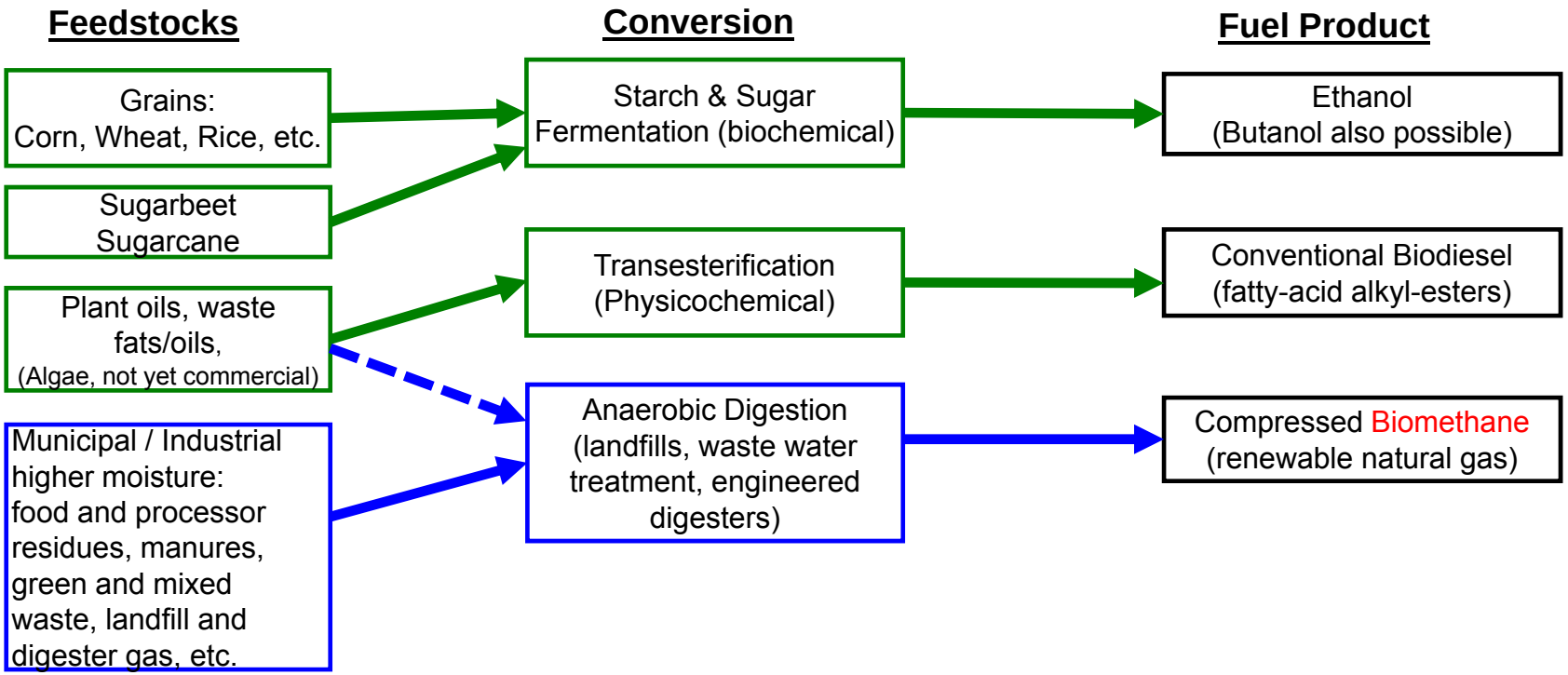

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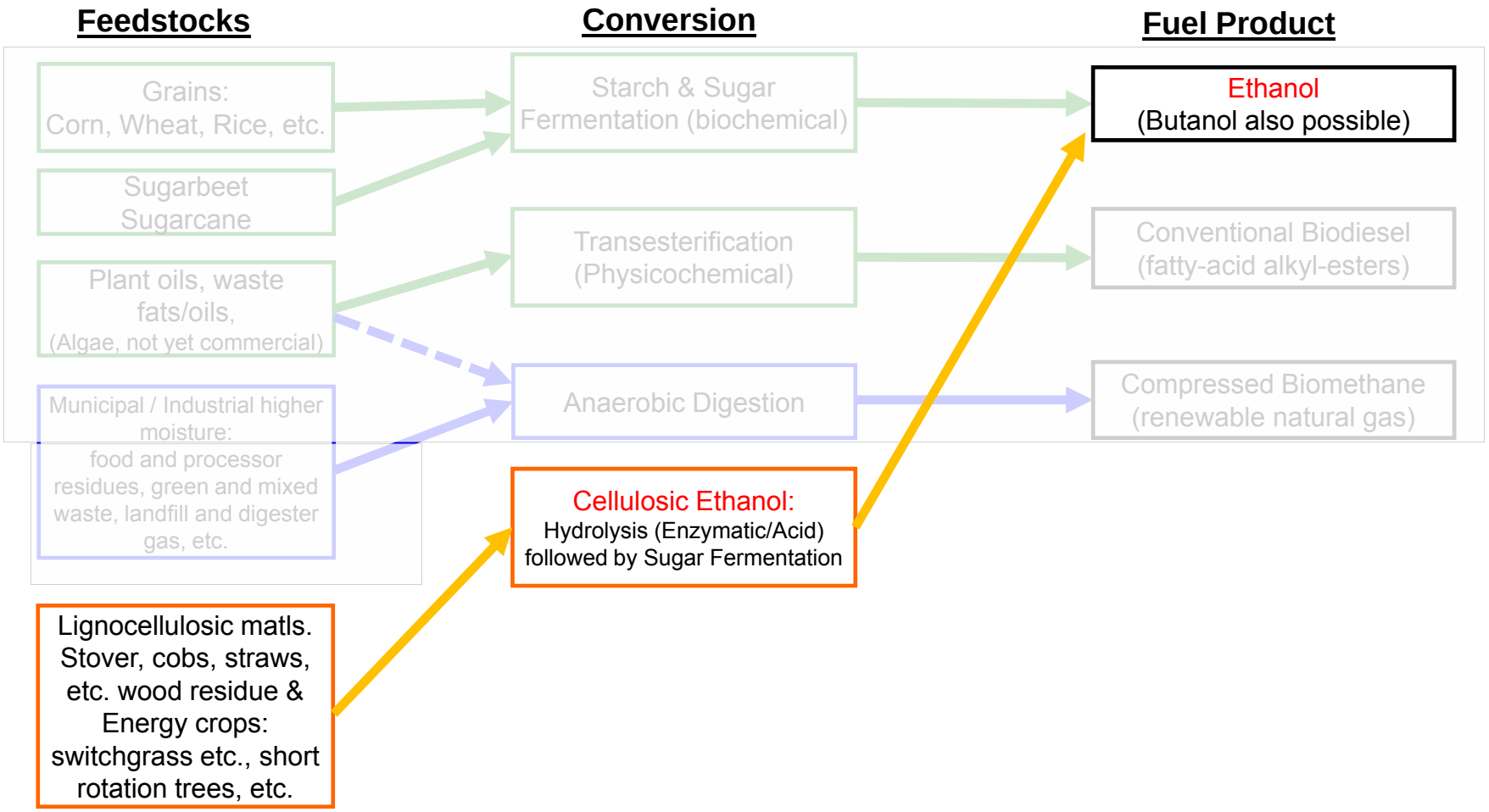

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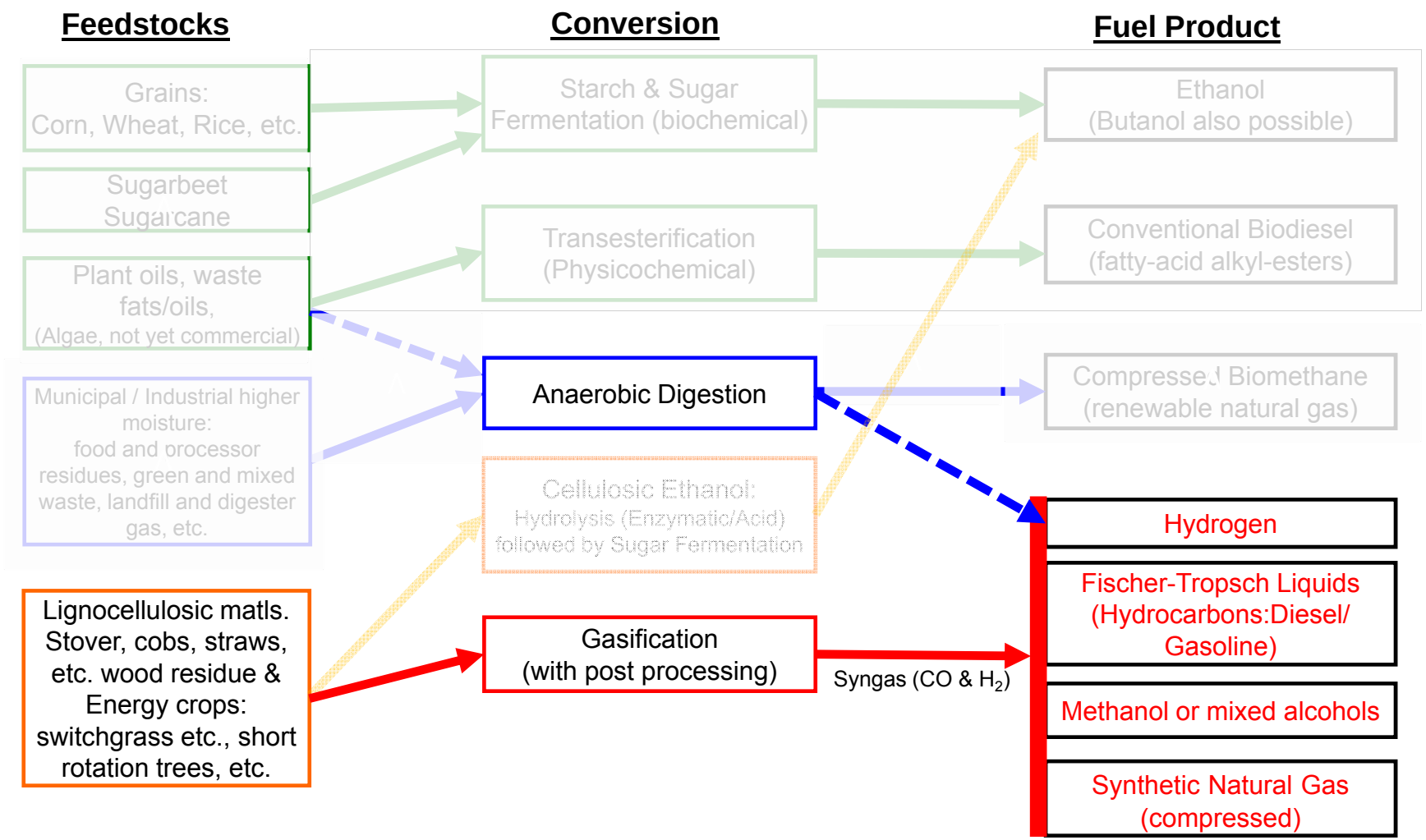

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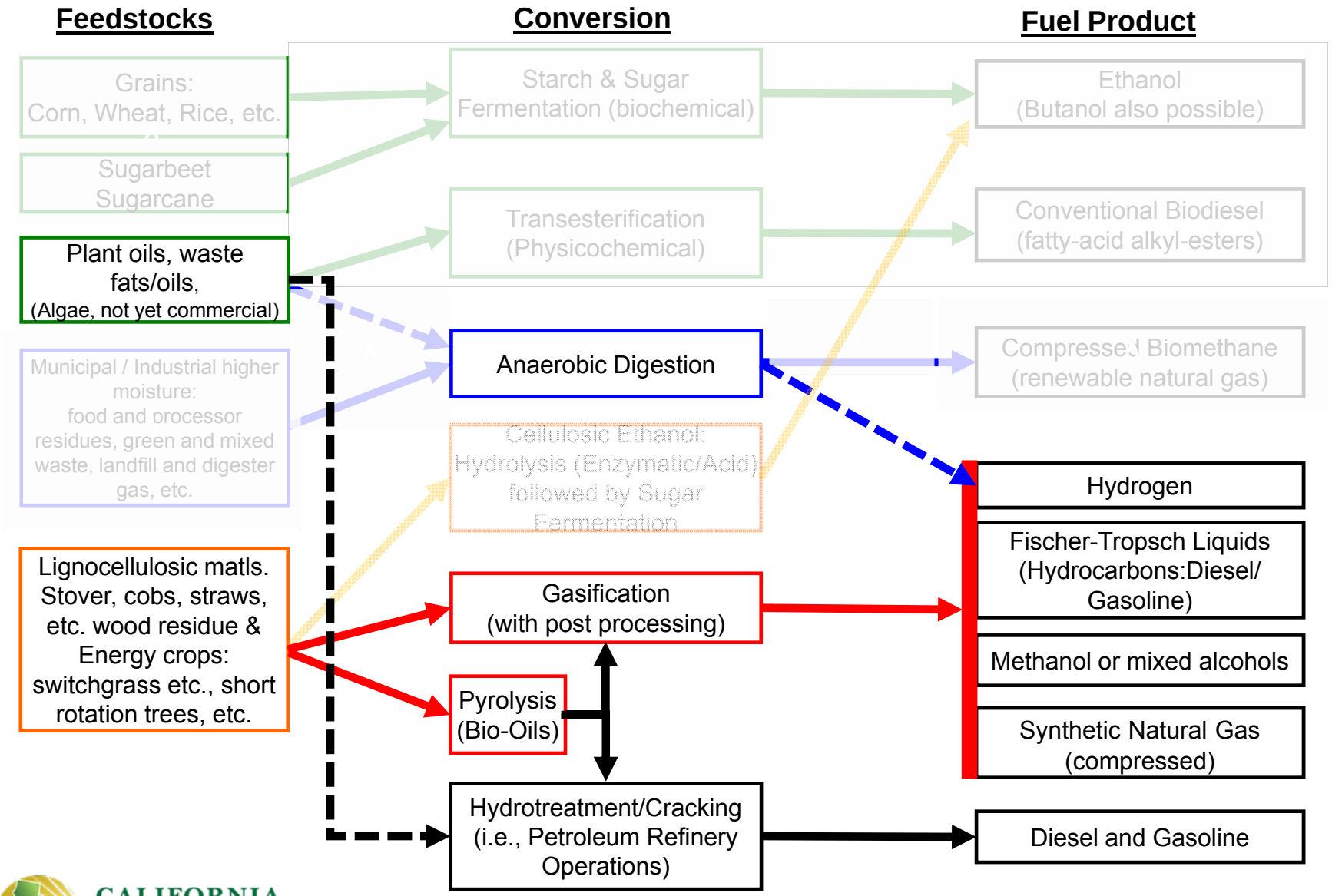

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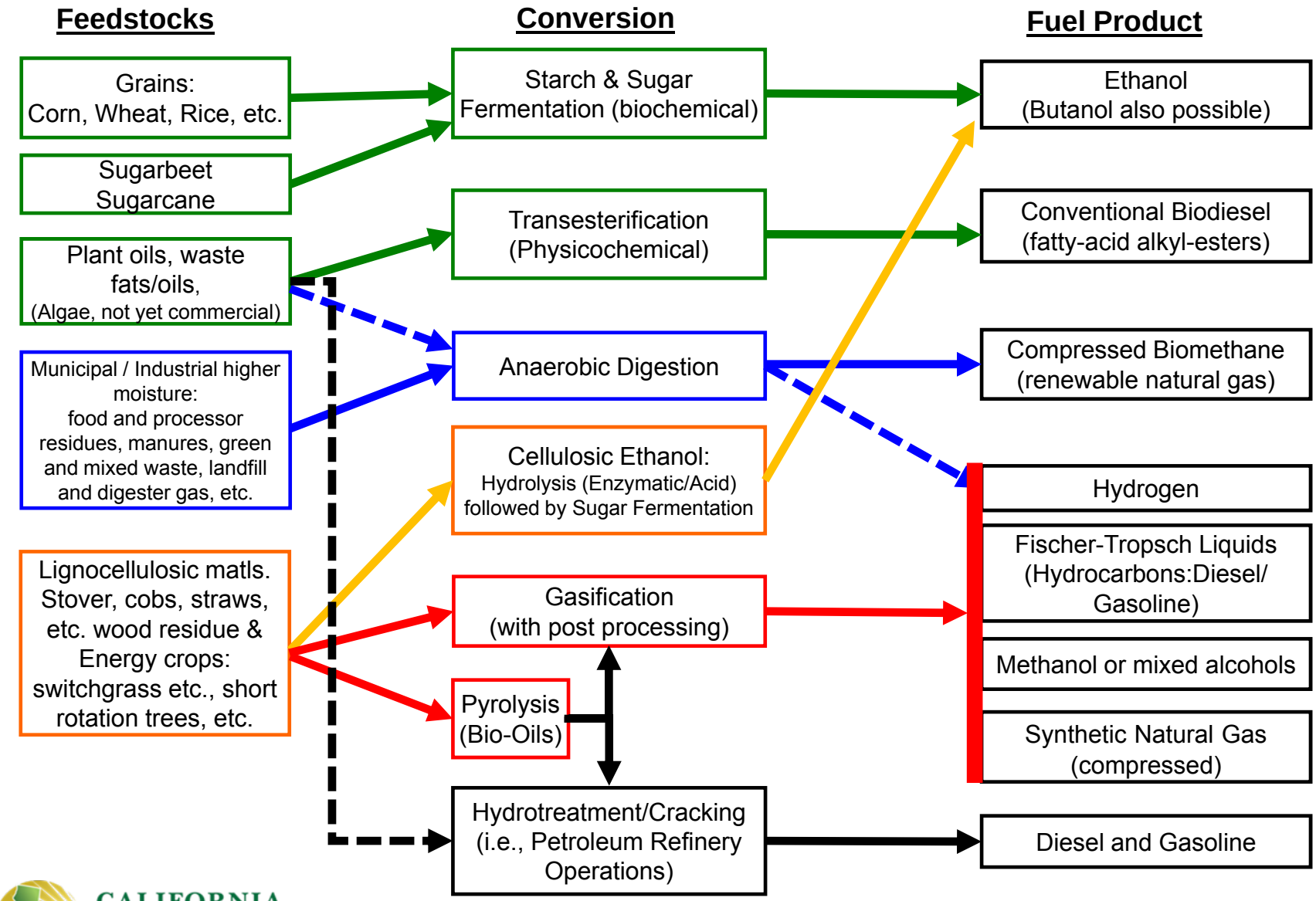

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National Crop Production Models Capture a Different California

- Existing national agricultural models, REAP, POLYSYS, GTAP, FASOM, are being used to predict future production of biofuels based on conventional feed-valued crops.
- Local models based on California resources and production more accurately reflect the potential for biomass production from CA cropping systems.

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High Valued Food Crops and Ornamentals Dominate CA Ag

	California $1,000		Average of Next 4 States* $1,000	Times Greater CA> Ave. 4
Food-plant	**$16,490,102**	**>>**	**$200,105**	**82.4**
Food-animal	$10,793,300	>	$8,805,667	1.2
Feed	$2,408,398	<	$7,812,354	0.3
Fiber	$409,272	>	$315,692	1.3
Ornamentals	**$3,725,194**	**>**	**$401,071**	**9.3**
Other	$58,798	>	$28,690	2.0
Total Value	$33,885,064	>	$17,563,578	

* Next 4 states are Texas, Iowa, Nebraska, and Illinois

Ag model of the rest of the US

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Purpose grown energy crops will replace lowest-value crops first, subject to resource constraints

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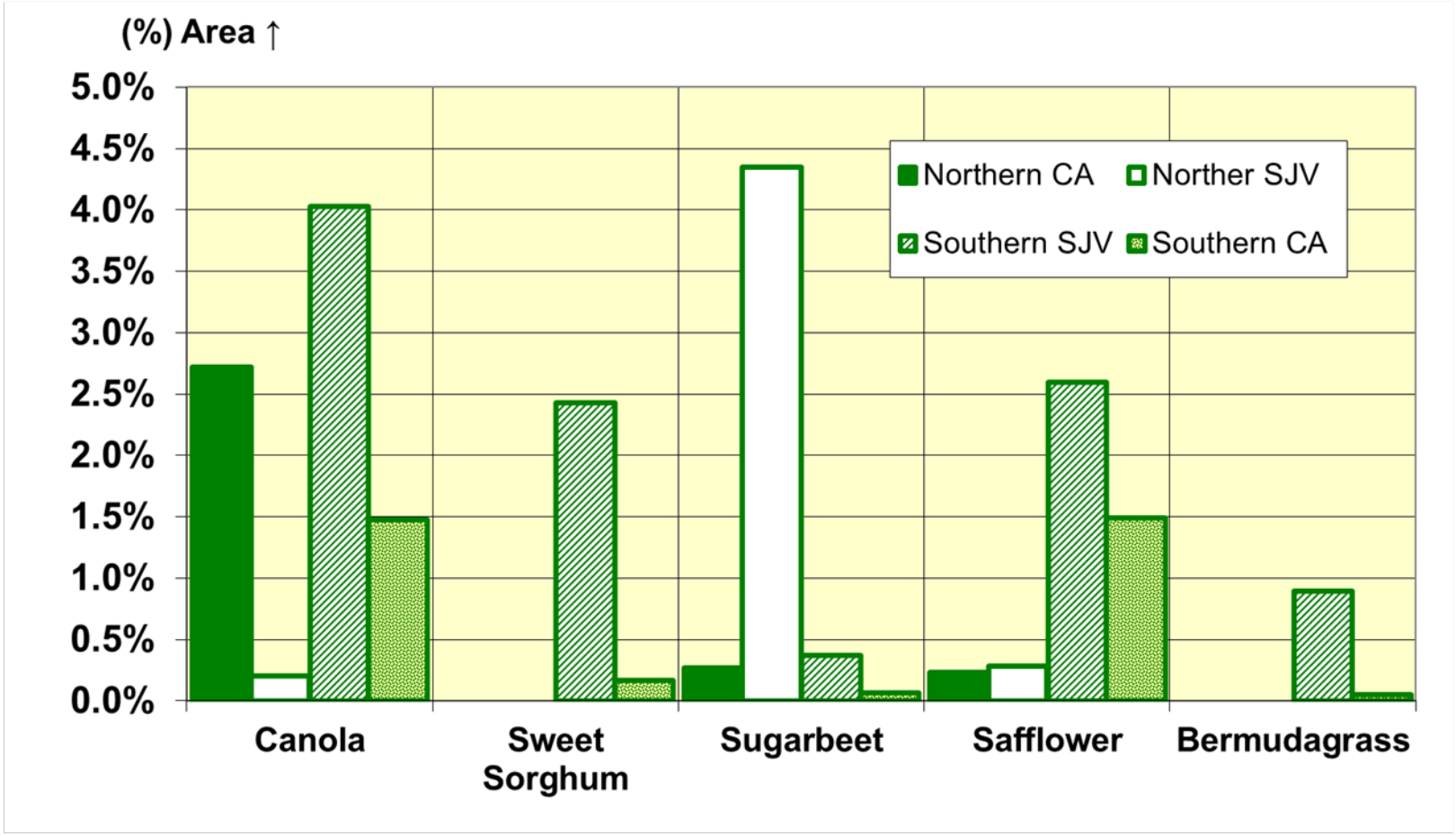
Energy Crop Adoption is Region Specific for $20/acre Profit Level



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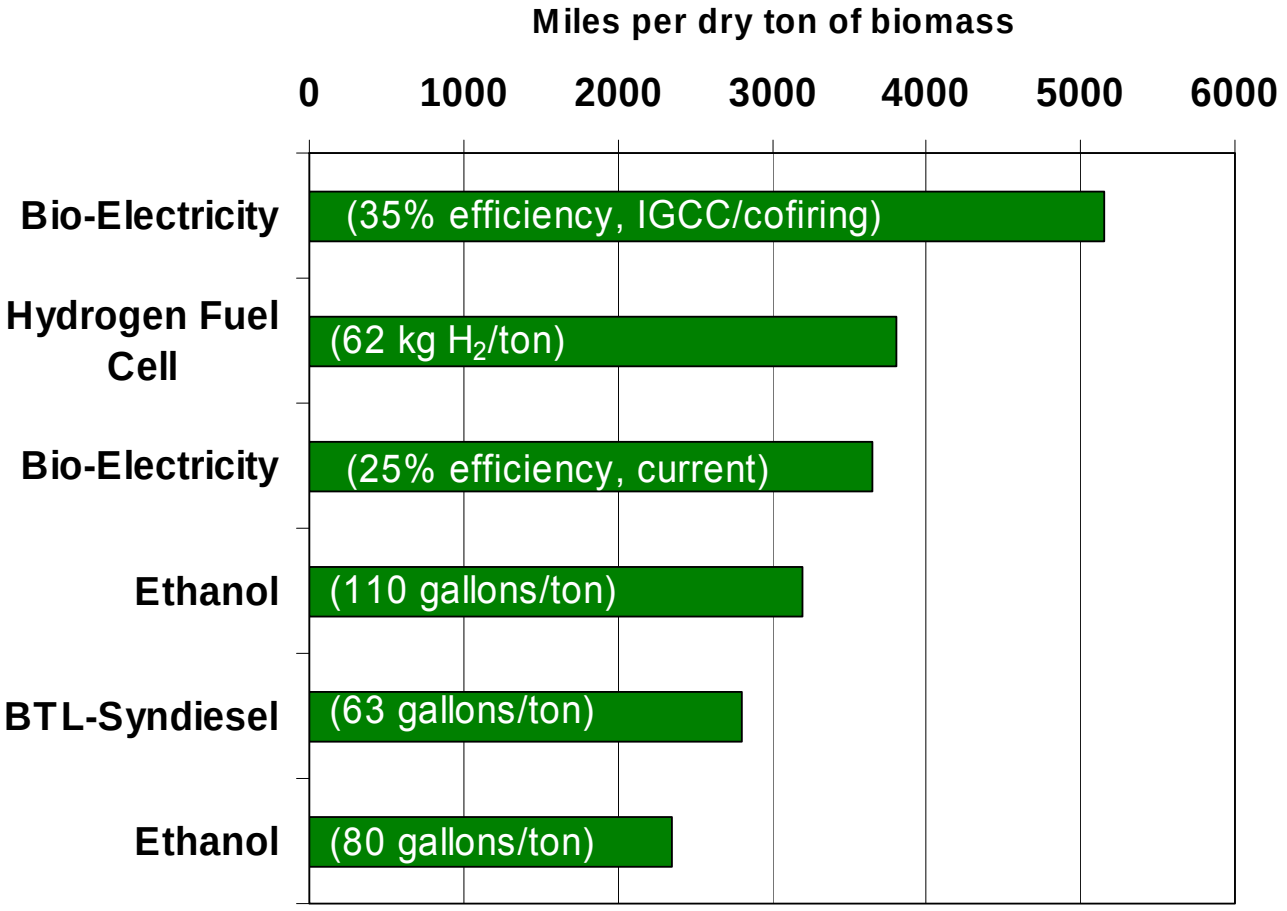
Miles Per Dry Ton Biomass (lignocellulosic)



Based on hybrid vehicle with 44 miles per gallon fuel economy on gasoline, 260 Wh/mile battery (source: B. Epstein, E2). Electricity includes generating efficiency, transmission, distribution, and battery charging losses. Ethanol, BTL-Syndiesel, and H_2 include fuel distribution transport energy.

Source: B.M. Jenkins

GHG Life Cycle Impacts Do Not Capture California Systems Well

- ***Attributional*** LCA calculates GHG emissions directly for cradle-to-end use pathway based on inputs, yields, and transportation.
- ***Consequential*** LCA assesses the global economic landscape
  - EPA: FASOM + FAPRI → ILUC
  - ARB: GREET + GTAP → ILUC
- Purpose-grown energy crops fall through the cracks for lack of a historical presence in data

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Comparison of US and CA Carbon Policies

- **California's LCFS** mandates reductions in the *Carbon Intensity* of Fuels but does not specify which types of fuels or how much must be used.
- The **Federal EISA (2007)** and the **RFS2** mandate the use of biofuels, mandate minimum *Carbon Intensities*, and mandate the amounts of fuels to use.
- These different laws are not harmonized so fuel providers in theory must meet both. It is unclear how they will do so.

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Prospects for Ag Feedstocks for Biofuels in California

- Success of Ag biofuel feedstock development is contingent on many things
  - The region of the state (land/urban, rain/irrigation)
  - Category (purpose-grown, residue, or waste)
  - Cost and efficiency of conversion technology
  - Stability in biomass and carbon policies
- There are many investment risks and environmental concerns
- Successful policies will build on known biomass benefits to mitigate additional oversight and lower cost of investment

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