

# Bioenergy in California

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California Biomass Collaborative

Policy Institute for Energy, Environment and the Economy  
June 7, 2013



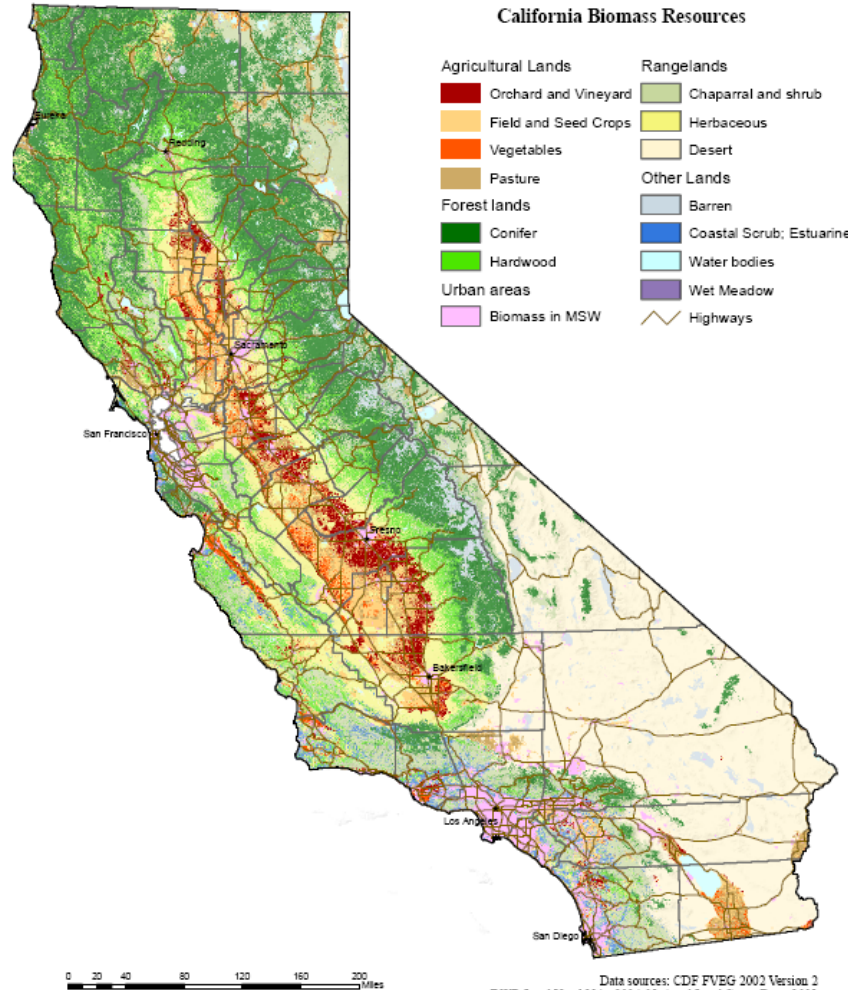
# WHAT IS BIOMASS?

- **Strict definition:**
  - **living (or recently living) plant or animal material**
- **General Federal statute (Energy Policy Act of 2005):**
  - **“Any organic matter that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes and residues, plants (including aquatic plants), grasses, residues, fibers, and animal wastes, municipal wastes, and other waste materials.” Excludes old-growth timber.**
- **Many revisions since, but generally similar – (may exclude material from public lands)**

# DEFINITIONS

- Anaerobic Digestion (AD) – A process by which biomass is sealed in an airtight vessel, which promotes microbial production of methane-rich biogas.
- Billion Cubic Feet (BCF) – Measurement of natural gas or digester gas, when used for natural gas, roughly enough energy to supply 10,000 homes for over one year.
- Landfill Gas (LFG) – Methane-rich gas produced by naturally anaerobic conditions deep in a landfill.
- Wastewater Treatment Plant (WWTP) – Often use anaerobic digesters to help remove organic matter from water, the biogas can be used for heat or power.
- Combined Heat and Power (CHP) – A system which generates electricity and useable heat.

# California Biomass Resources Are Diverse

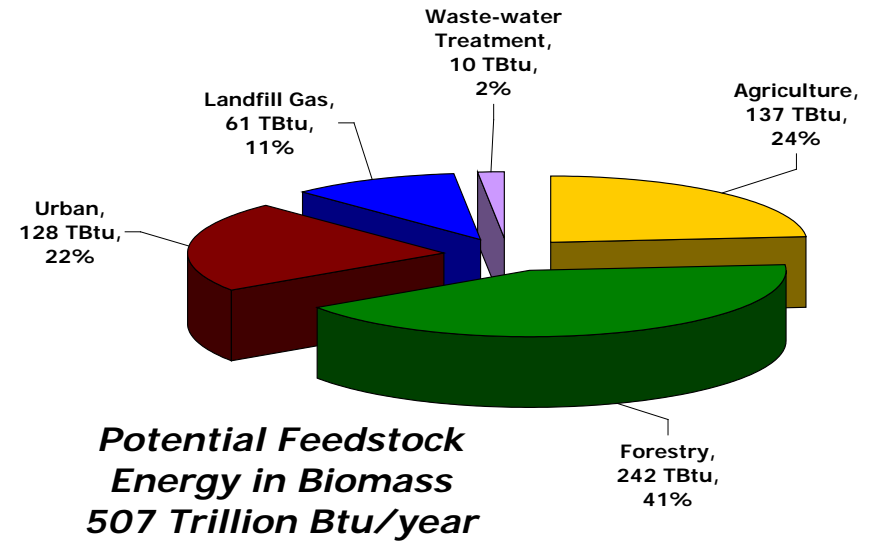
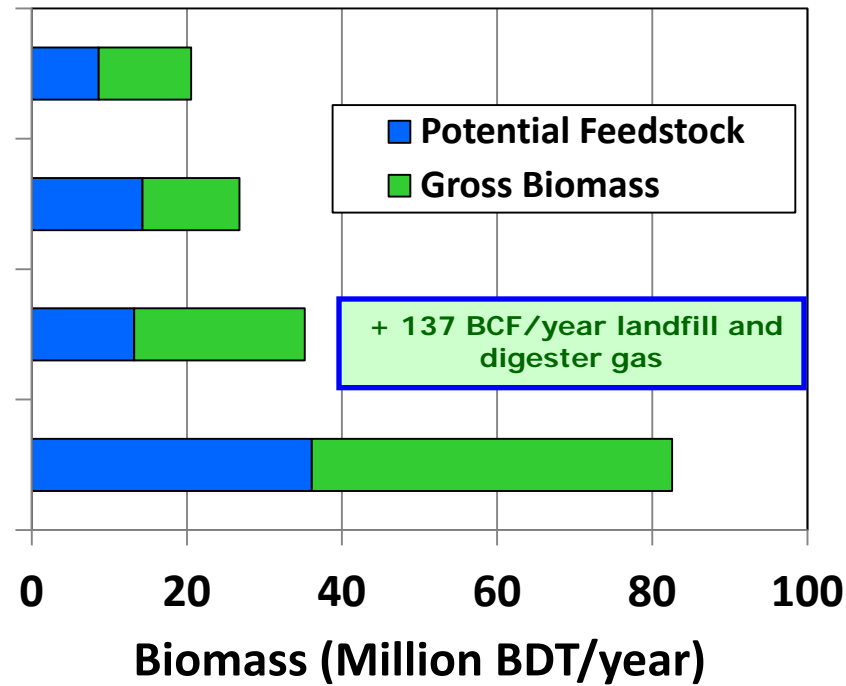


**Agriculture**

**Forestry**

**Urban**

**Total**



# OUR SPEAKERS

## • Rob Williams, P.E.

- Development Engineer, Bio. & Agr. Engineering
- Member of Technical Staff, Biomass Collaborative
- Extensive experience with conversion technologies and bioenergy systems.



## • Stephen Kaffka PhD

- Cornell University MS & PhD in Agronomy
- Extension Specialist – Department of Plant Sciences
- Director of Biomass Collaborative
- Extensive experience with potential energy crops



# Bioenergy in California

## Part 2:

**How is biomass transformed to energy and bio-products?**  
**What state policies affect/regulate the use of biomass in California?**  
**What are the prospects for increased use of biomass in California?**

*Policy Institute for Energy, Environment and the Economy*  
*June 7, 2013*

**Part 1: May 17, 2013.**

**What is biomass? How much is there in California? Is it being used? Could more be used? How will this come about?**



**CALIFORNIA**  
**BIOMASS COLLABORATIVE**

## **Themes/Questions for Part 2: Biomass Energy in California**

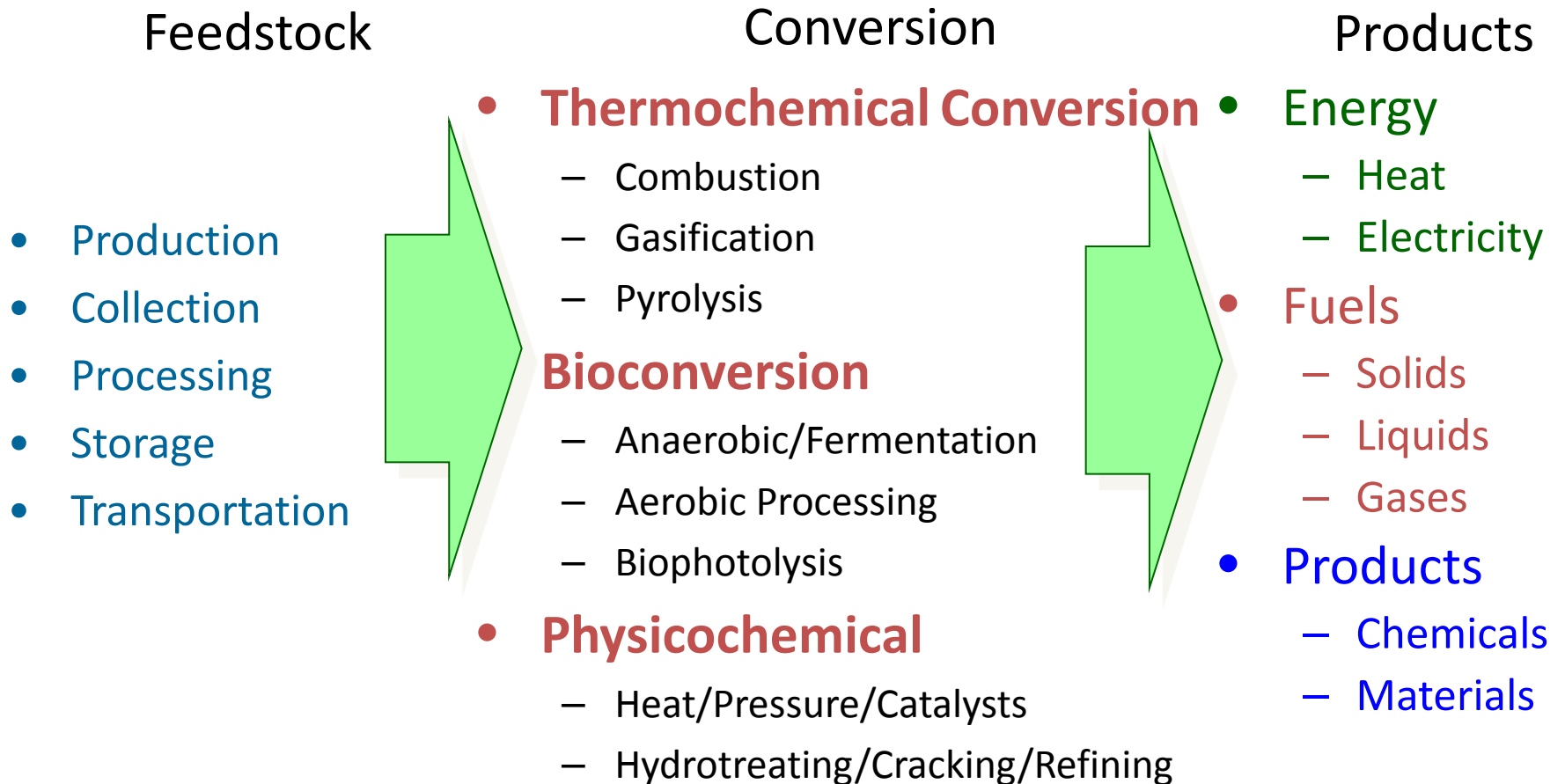
- **How is biomass transformed to energy and bio-products?**
- **What state policies affect/regulate the use of biomass in California?**
- **What are the prospects for increased use of biomass in California?**

# WHAT IS BIOENERGY

- **Heat**
- **Biopower (electricity)**
- **Biofuels**
  - **Solid Fuels**
    - Wood pellets or cubes for heating or cofiring
    - Torrefied biomass (for cofiring at coal facilities)
    - Char/charcoal for cooking
  - **Gaseous Fuels**
    - biogas,
    - biomethane,
    - compressed biomethane (like CNG),
    - Renewable synthetic natural gas (RSNG)
  - **Liquid Fuels**
    - Ethanol (conventional starch/sugar derived, or from lignocellulosic processes)
    - Methanol
    - Butanol
    - Biodiesel (from vegetable or waste oils. Specifically: fatty-acid-methyl-ester (FAME))
    - Renewable diesel and gasoline (e.g., “drop-in” fuels or hydrocarbons, biomass-to-liquid (BTL), Fischer Tropsch liquids, etc.)



# Principal Biomass Conversion Pathways



# Thermal Pathways

(Combustion, Gasification, Pyrolysis)

- Characterized by high temperature and high rates of conversion,
- Ability to convert essentially all of the biomass feedstock (cellulose, hemicellulose & lignin)
- Drier feedstocks preferred



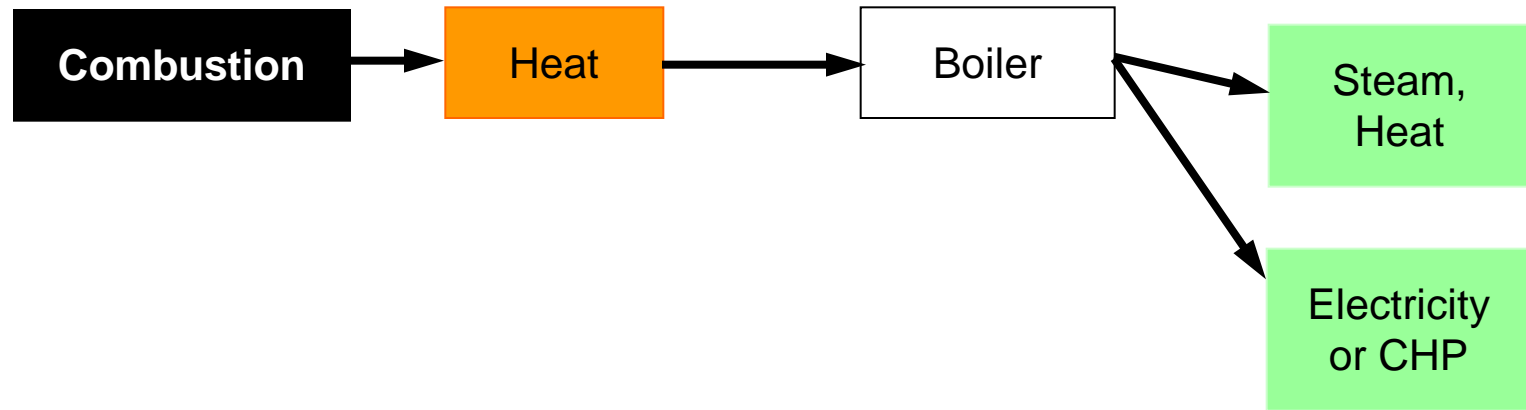
# Biochemical Pathways

(Aerobic [i.e., composting], Anaerobic Digestion, Anaerobic Fermentation [ethanol])

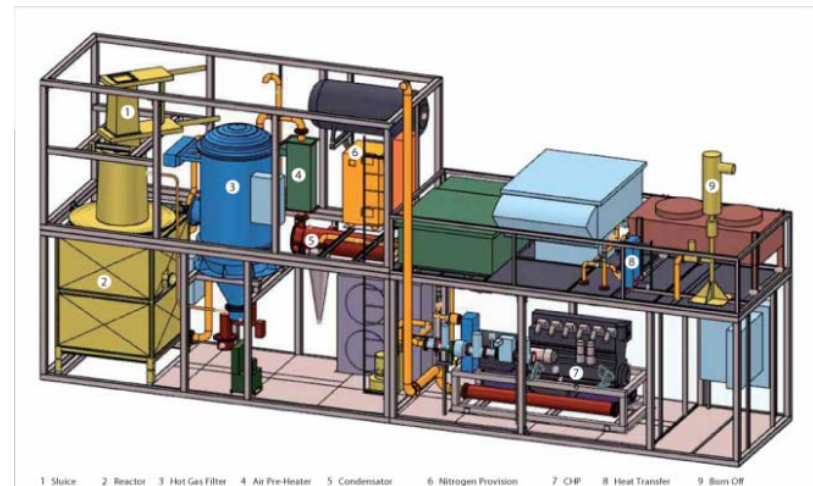
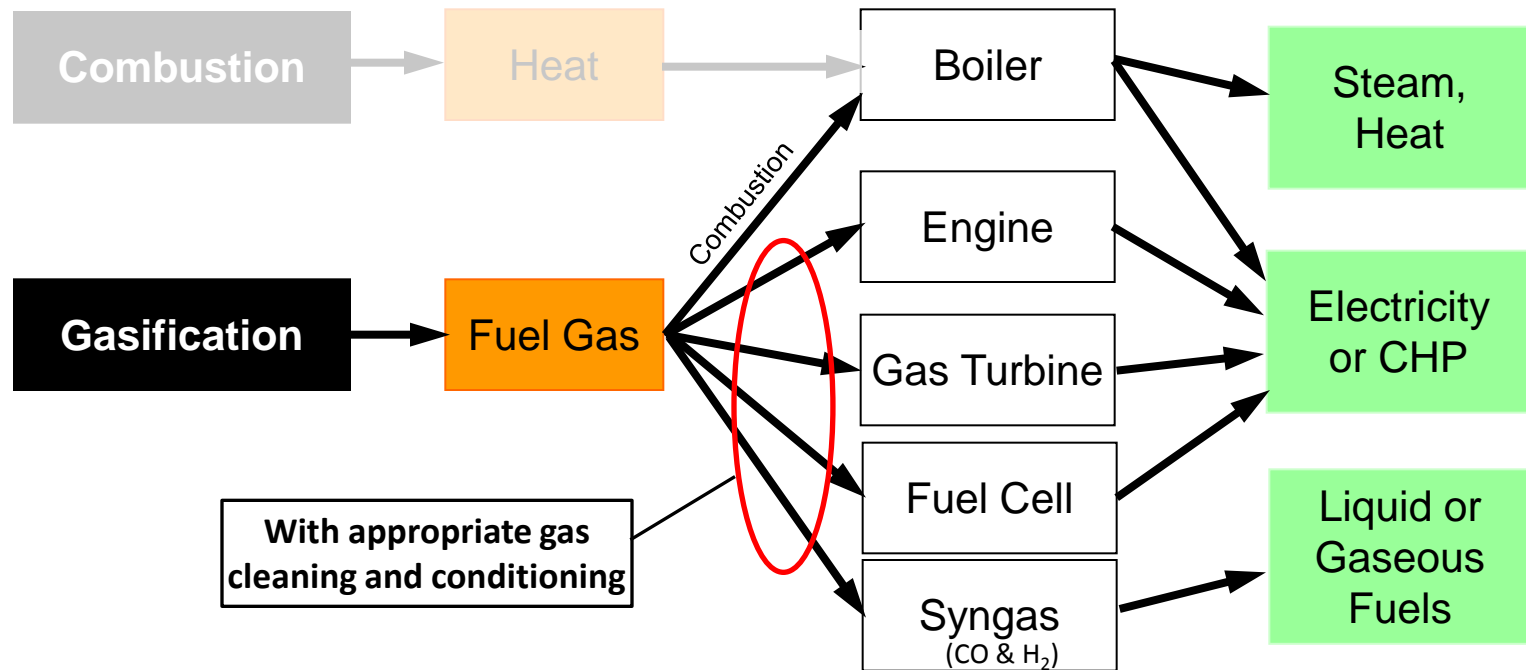
- Characterized by lower temperature and lower rates,
- Starch and sugar feedstocks (corn, grains, sugar beets, sugar cane ) :  
Conventional fuel ethanol
- Lignocellulosic biomass (Woody biomass, Straws, stovers, non food materials) : Advanced fuel ethanol / biofuel pathways
  - The “lignin” portion of lignocellulosic biomass is not available to bio-conversion (the lignin energy can be recovered by thermal means)
- Food and green wastes, fats, oils, greases
- Generally higher moisture  
materials preferred  
(or moisture is added)



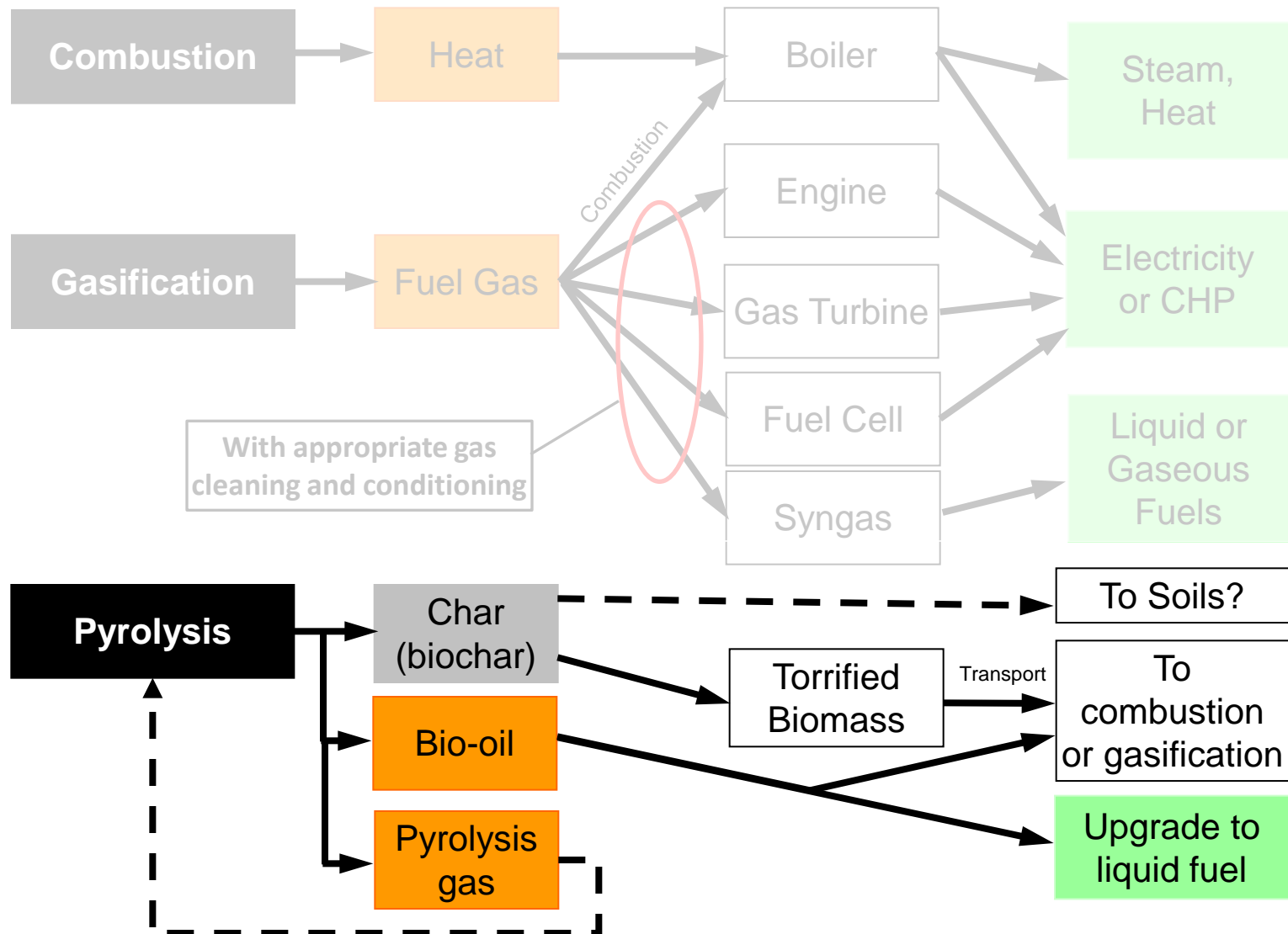
# Basic Thermochemical Pathways



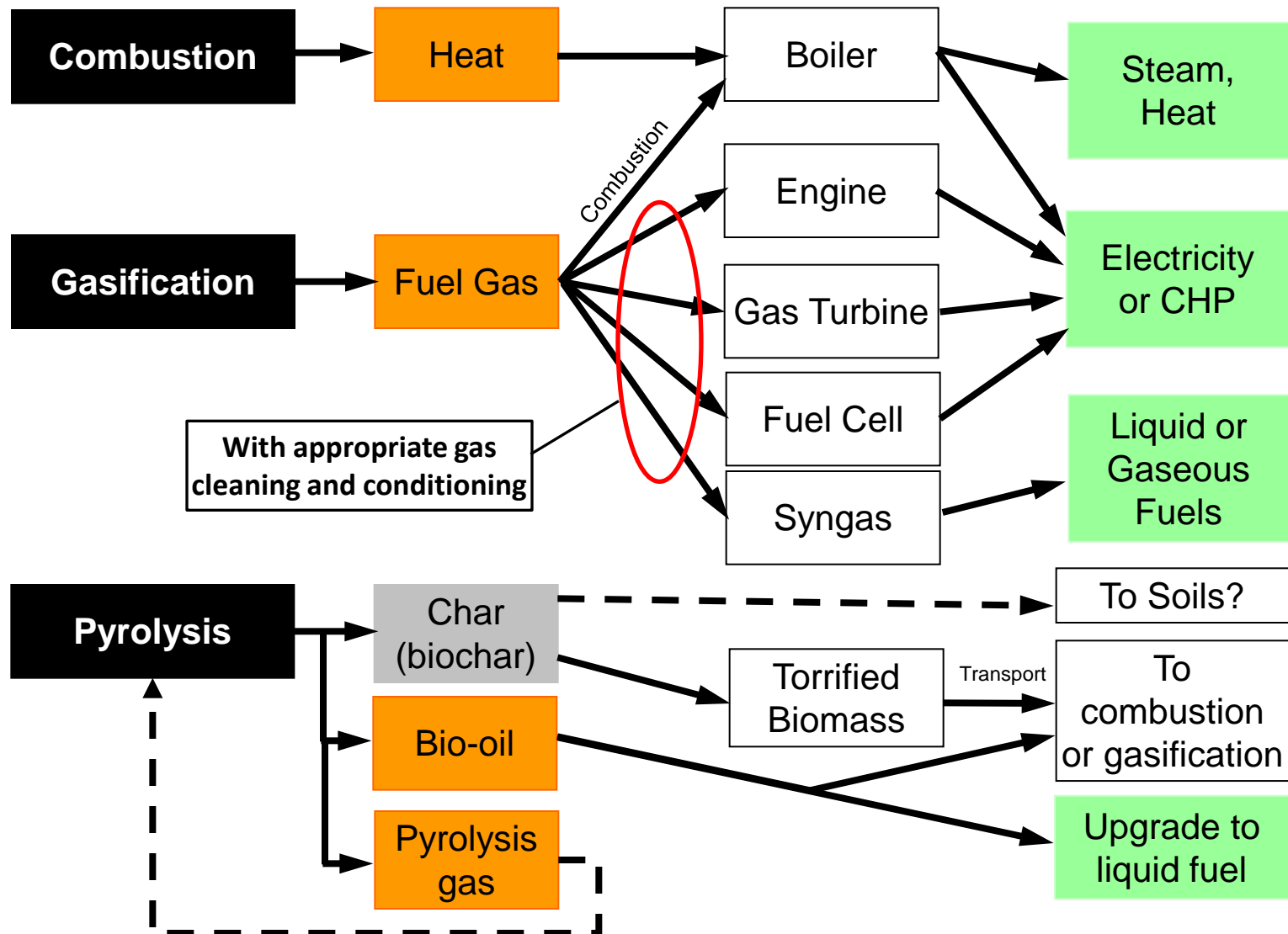
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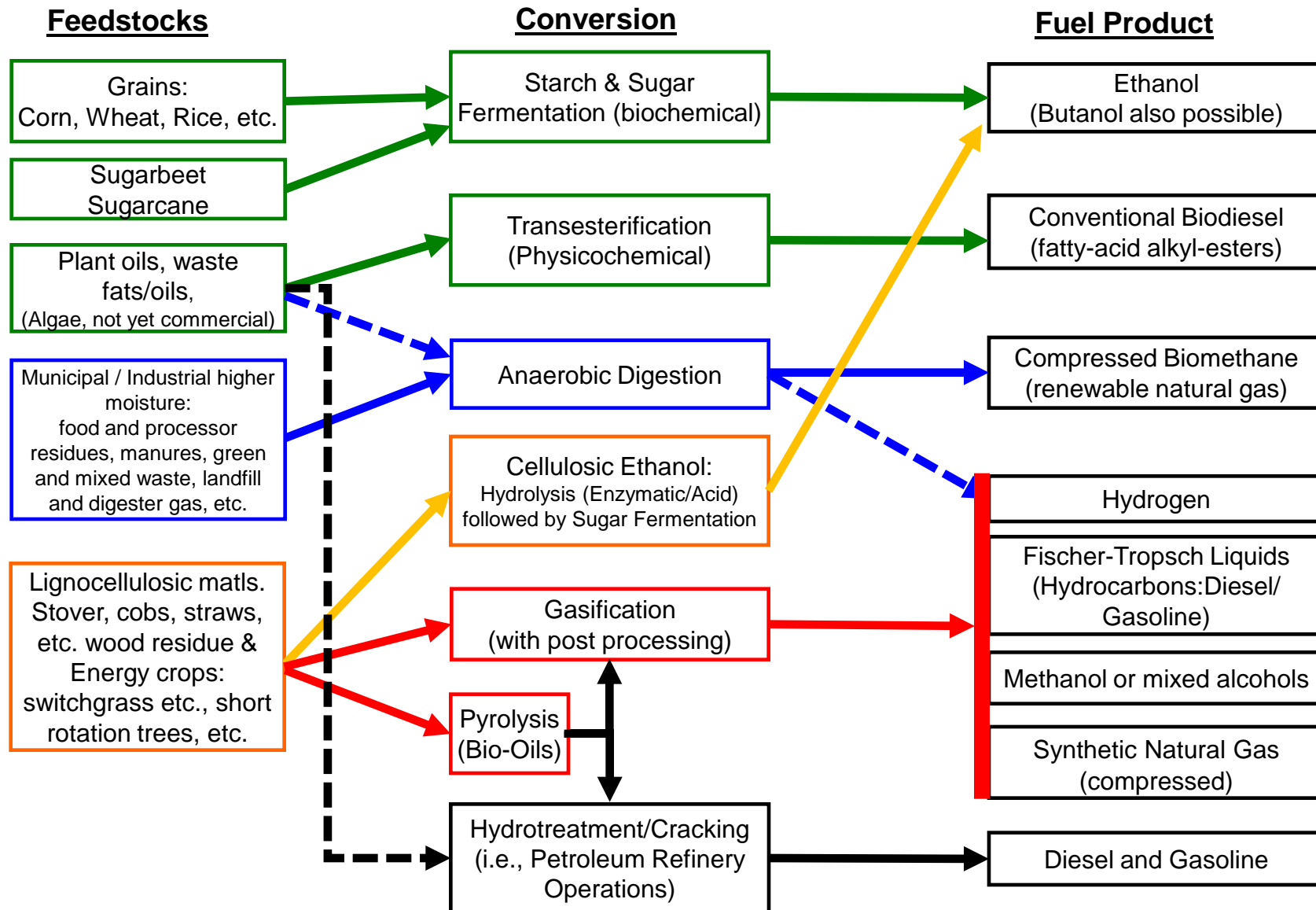
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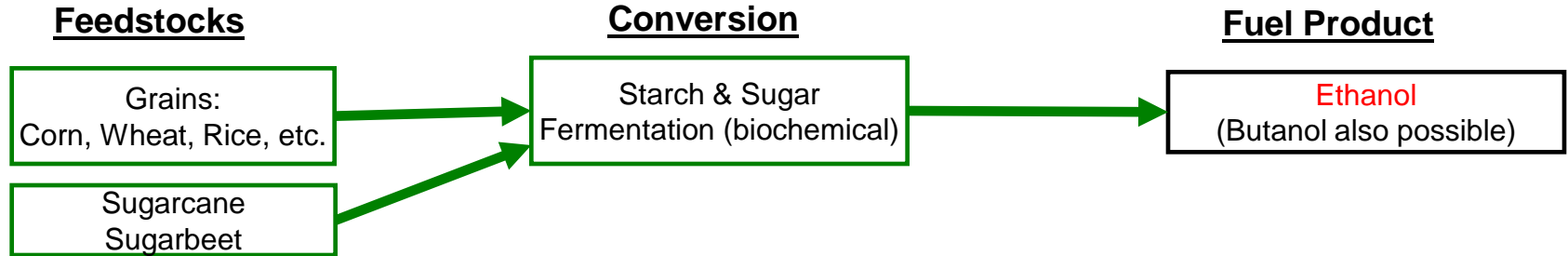


# Biofuel Pathways



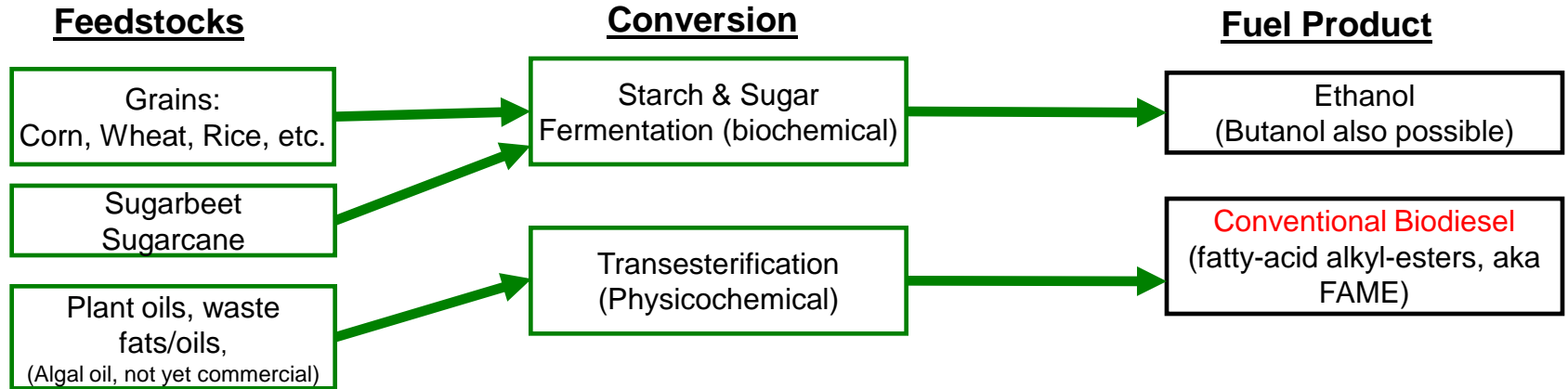


# “Conventional” Biofuel Pathways

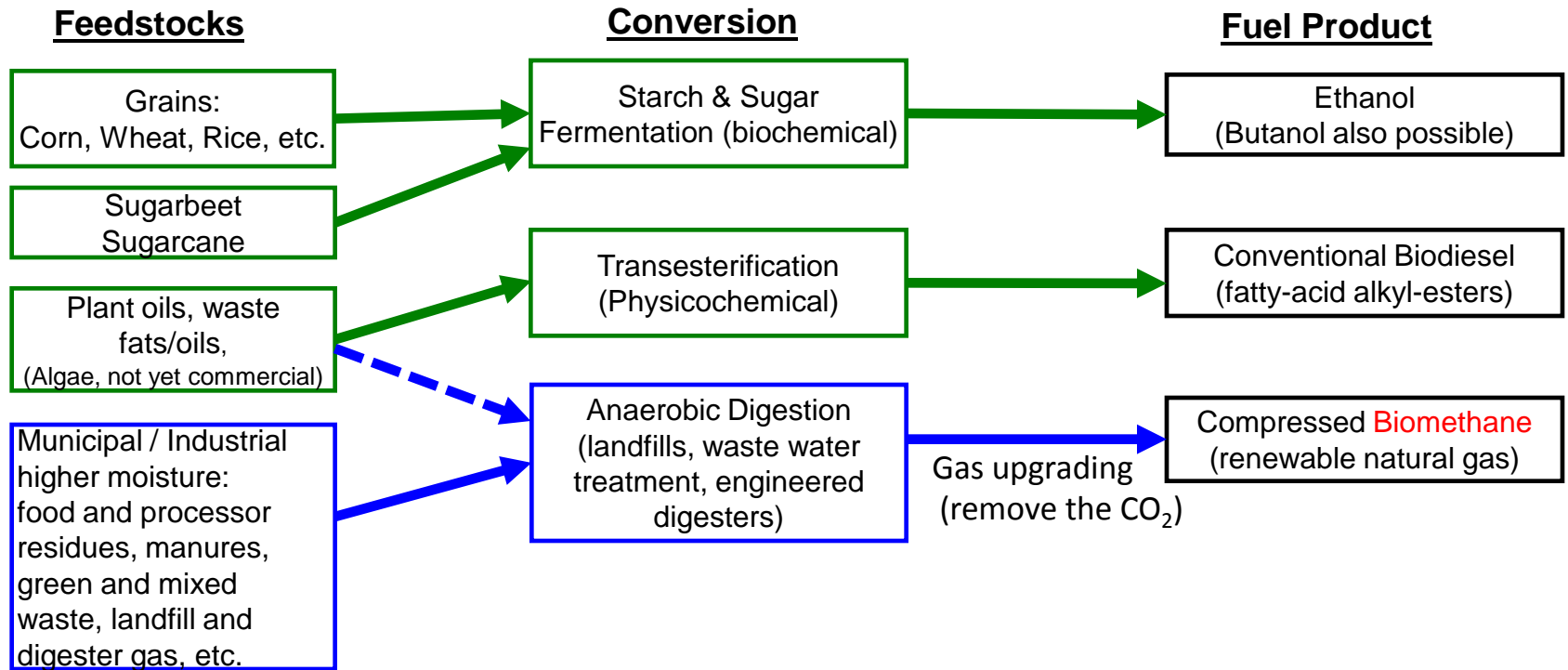


Starch and sugar fermentation to ethanol is the conventional (and currently commercial) route.

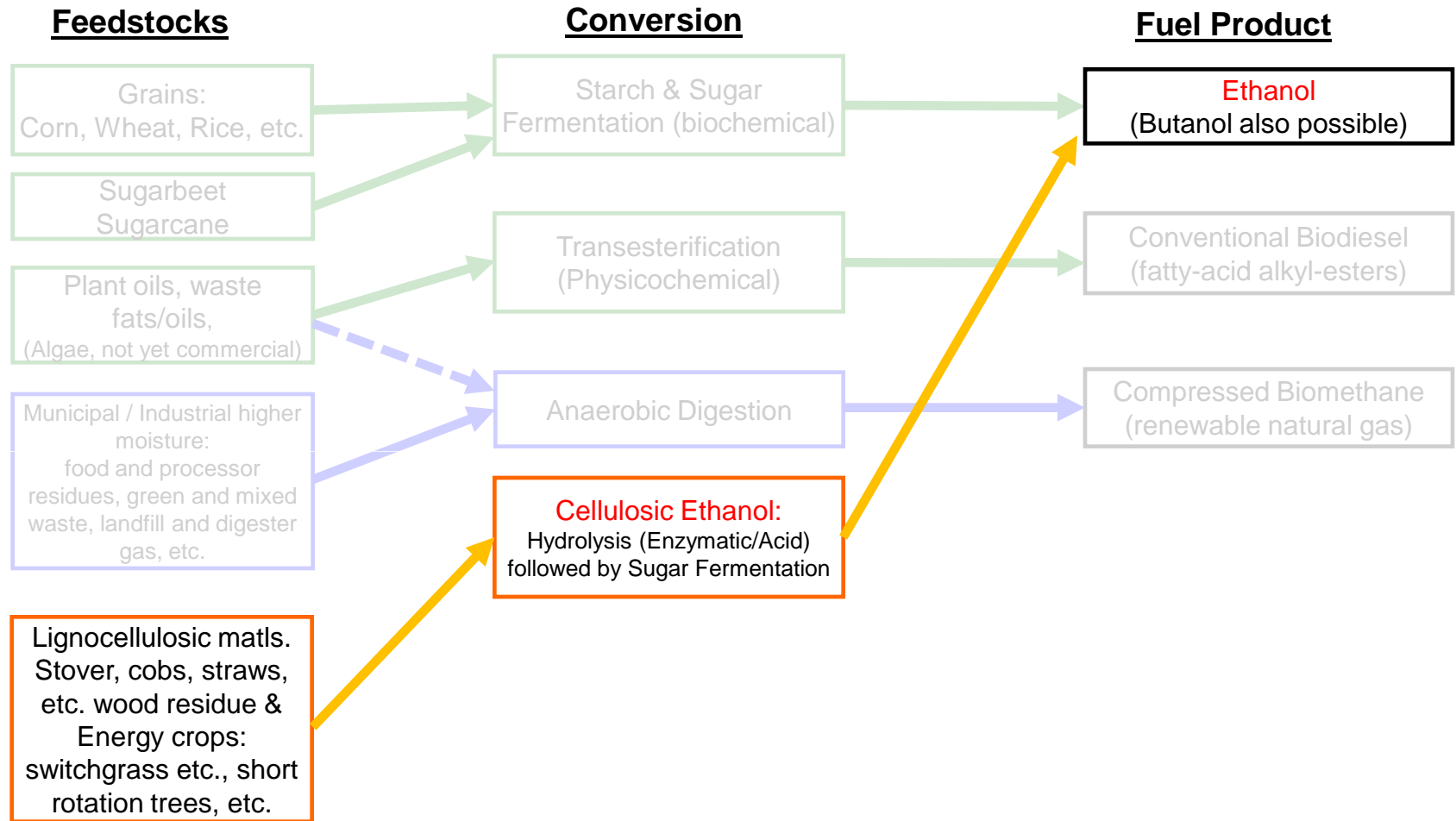
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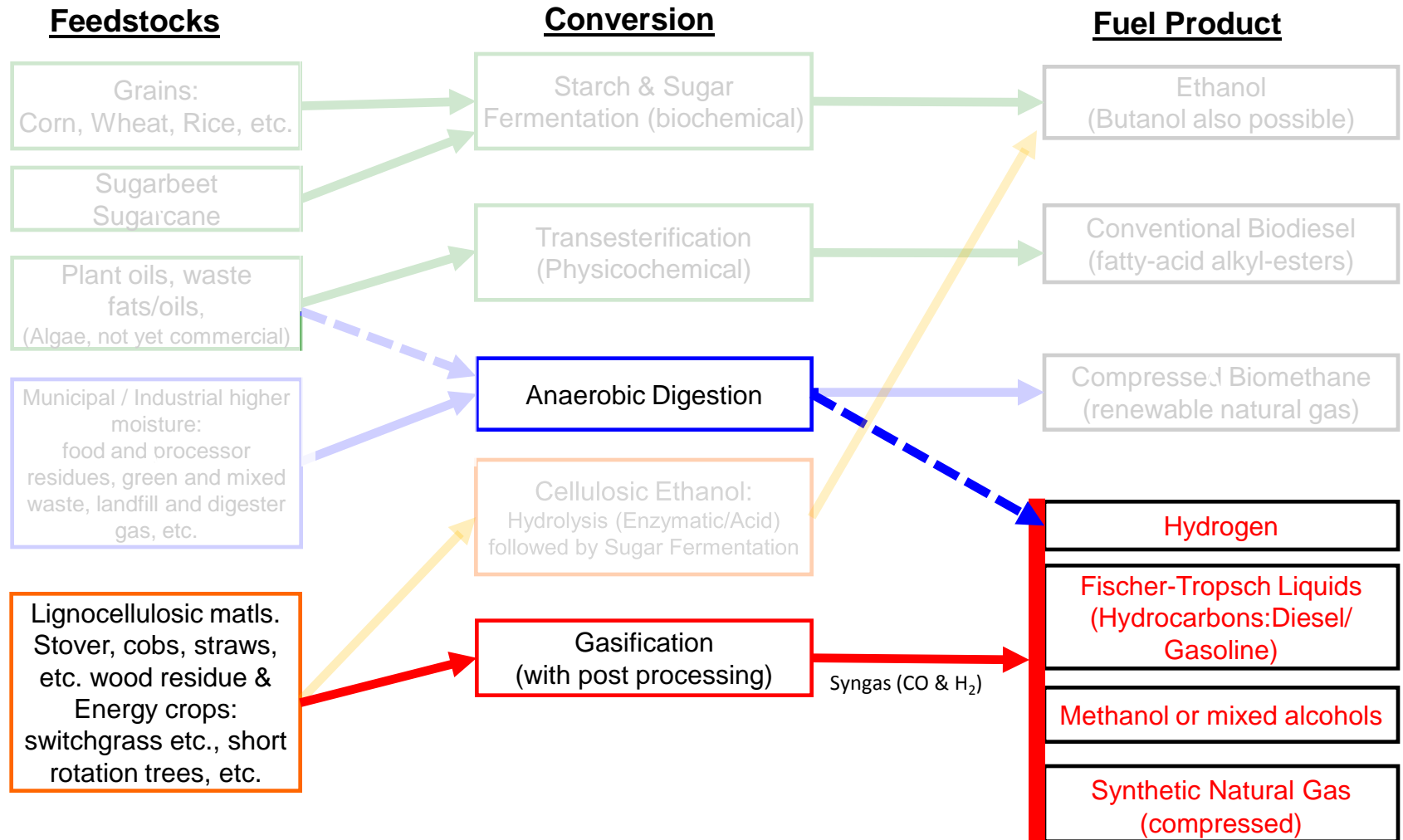
# “Advanced”\* Biofuel Pathways



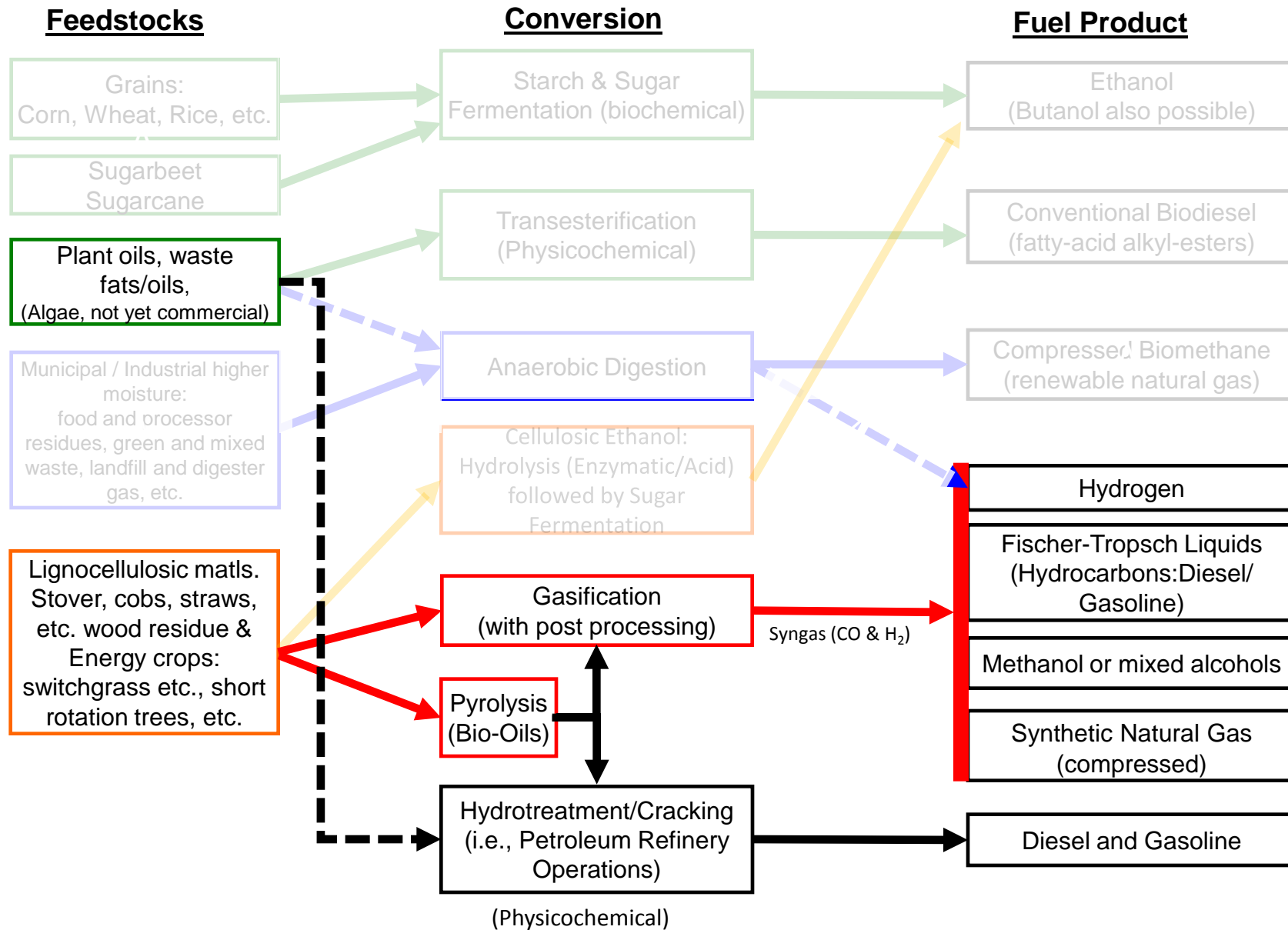
\*Sometimes called second and third generation biofuels

- Second Generation = derived from lignocellulosic feedstocks
- Third Generation often refers to algae feedstocks

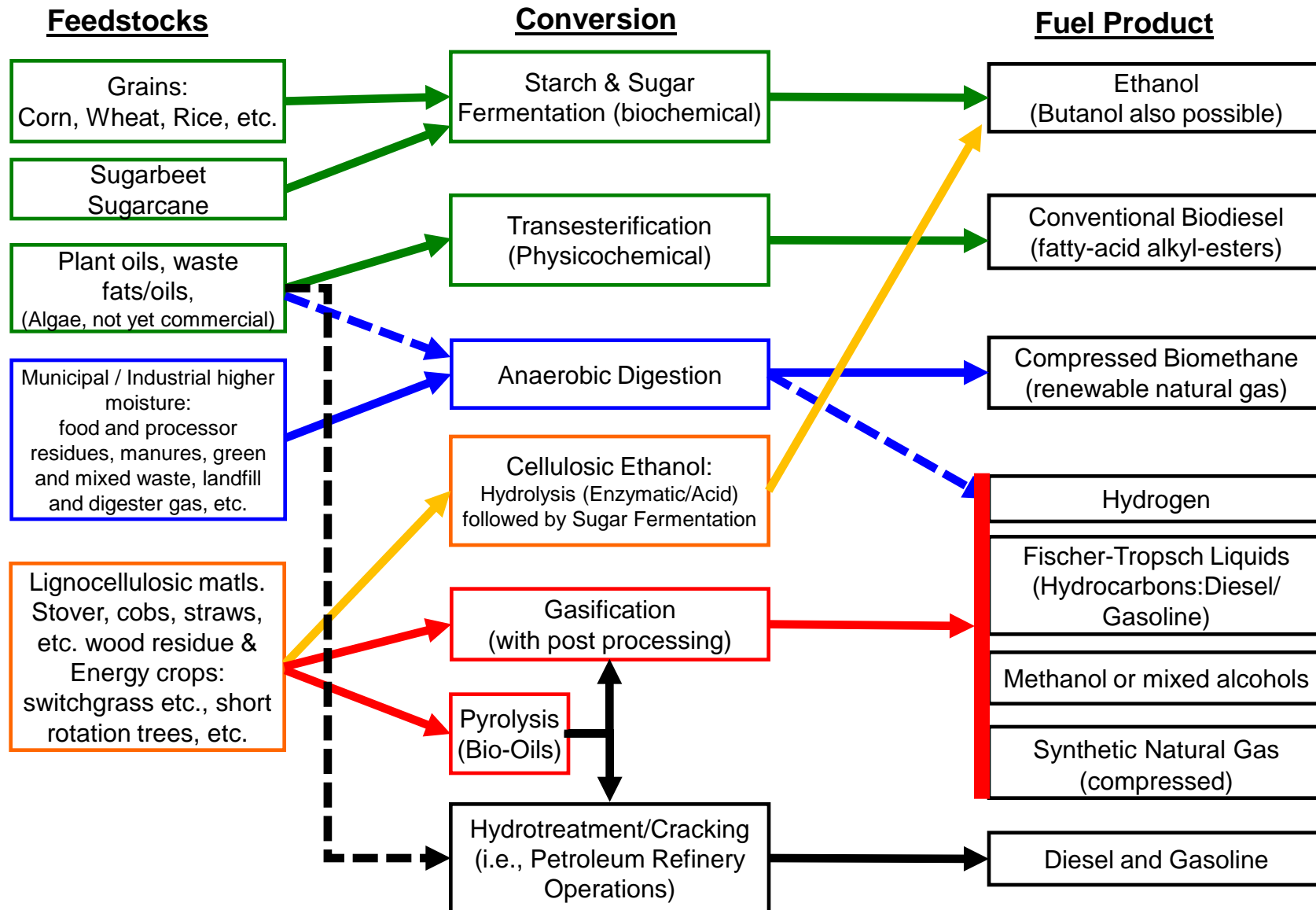
# “Advanced”\* Biofuel Pathways



# Biofuel Pathways



# Biofuel Pathways



## Themes/Questions for Part 2: Biomass Energy in California

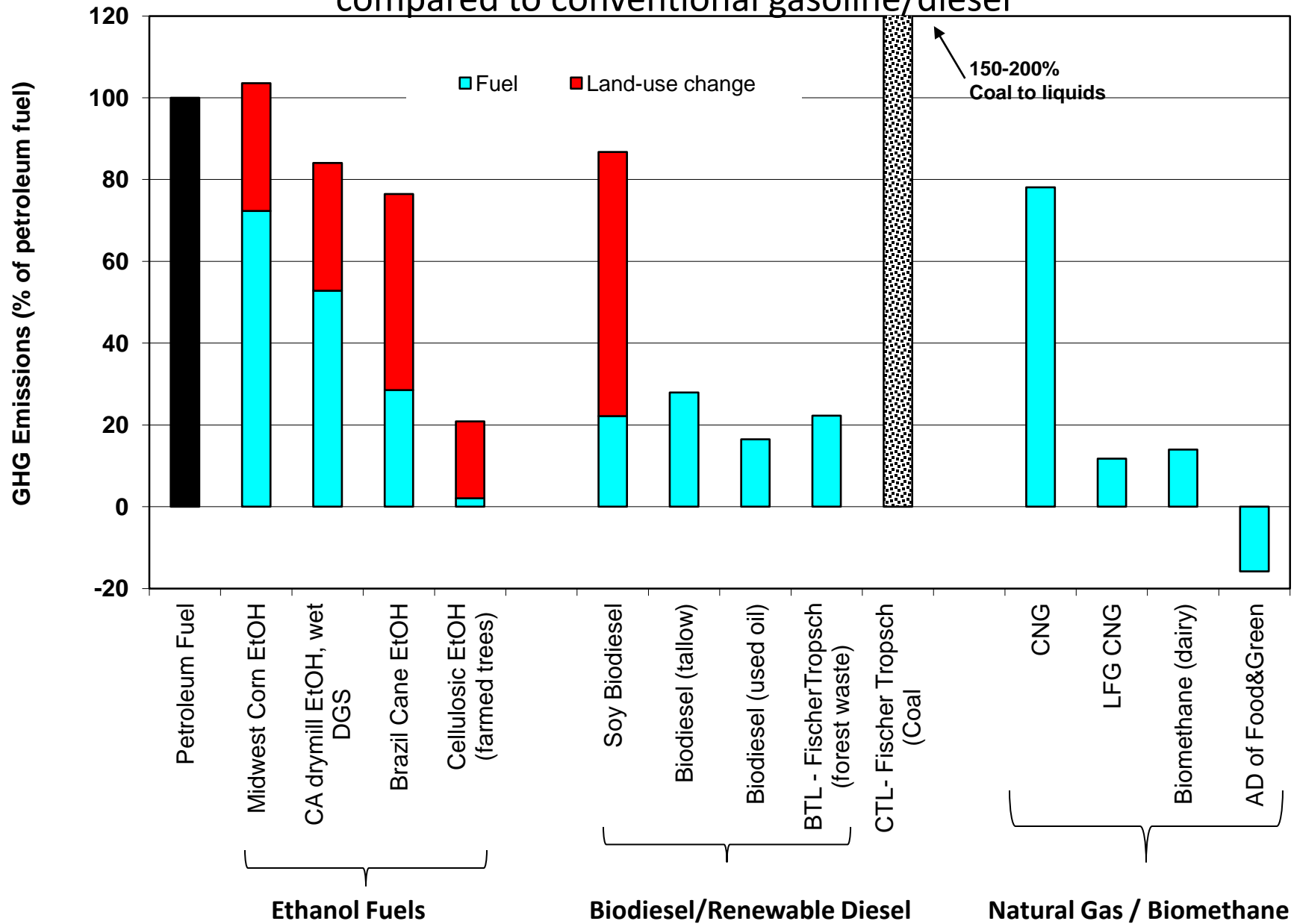
- How is biomass transformed to energy and bio-products?
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- What are the prospects for increased use of biomass in California?



# Policies related to Bioenergy in California

- **Governor Brown's Clean Energy Jobs Plan**
  - 20 GW new renewable generation by 2020 (12 GW distr. gen., 8 GW large scale ≥ 20MW)
- **AB 32 (Global Warming Solutions Act)**
  - Generally CO<sub>2</sub> emissions from biomass energy and fuels are exempt from cap and trade reporting
  - Scoping Plan: Waste Management Sector Workshop on June 18, 2013 (CalEPA building)  
( <http://www.calrecycle.ca.gov/Actions/PublicNoticeDetail.aspx?id=986&aiid=900> )
- **Low Carbon Fuel Standard (LCFS)**
  - Reduce carbon intensity of transportation fuel by 10% by 2020
  - Biofuels/bioenergy could play important part

# Relative Greenhouse Gas Emissions of Alt. Fuels compared to conventional gasoline/diesel



California Air Resources Board – LCFS various reports- see: <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>

# Policies related to Bioenergy in California

- **2012 Bioenergy Action Plan**
  - Goals and recommendations of a state agency working group
- **Electric Program Investment Charge (EPIC) -20% set aside for bioenergy in technology demonstration area**
- **SB 1122 (Rubio, 2012) → CPUC to direct electrical corporations (IOUs) to procure 250 MW (cumulative) of new small biopower ( $\leq 3$  MW) in a separate IOU feed-in tariff program. Allocated by resource type:**
  - 110 MW for biogas from wastewater treatment, municipal organic waste diversion, food processing, and codigestion
  - 90 MW for dairy and other agricultural bioenergy
  - 50 MW for bioenergy using byproducts of sustainable forest management
  - CPUC workshop May 2 reviewed consultant report on small scale bioenergy resource potential and costs

# Policies related to Bioenergy in California

## Biomethane Related:

- **AB 2196 (Chesbro, 2012)**
  - Clarifies RPS eligibility for biomethane delivered by pipeline and essentially re-certifies pipeline biomethane as RPS eligible
- **AB 1900 (Gatto, 2012)**
  - Directs state agencies to develop health and safety standards and test protocols for biomethane injection into pipelines. Addresses pipeline access issue for landfill gas which is currently not allowed by major pipeline operators (in California)
  - Requires CPUC to adopt standards by Dec 31, 2013 for biomethane injected into the common carrier pipeline that:
    - (1) protects public health
    - (2) ensures pipeline integrity and safety
    - CPUC Rulemaking 13-02-008
  - ARB proposed health based standards for constituents of concern in biomethane May 15, 2013
    - ARB also provided recommendations on monitoring, testing, reporting, and recordkeeping requirement

# Policies related to Biopower in California

## Solid Waste / MSW:

- **AB 323 (Chesbro) : Phase-out diversion credit for greenwaste used as alternate daily cover (ADC) by 2020**
  - Appropriations suspense file 5/24/2013
- **AB 1126 (Gordon) : Defines “MSW Conversion” as beneficial use of low moisture waste (i.e., < 25% moisture ) where it supplements or replaces fossil fuel.**
  - Stipulates no diversion credit for material converted
  - Is silent on RPS eligibility
  - Caps facility size at 500 tons per day (landfills don’t have this universal size restriction)
  - MSW Conversion excluded from Recycling Definition
  - Not clear if fossil fuel supplementation/replacement must occur at the facility
    - Does displacement of fossil electricity or fuels elsewhere count (i.e., fuel product that displaces petroleum fuel)?
  - Can the material be dried to 25% using waste process heat??
  - Passed out of Assembly 78 -0

## Themes/Questions for Part 2: Biomass Energy in California

- How is biomass transformed to energy and bio-products?
- What state policies affect/regulate the use of biomass in California?
- **What are the prospects for increased use of biomass in California?**

# What are the prospects for increased use of biomass in California?

- Large potential
- Biopower is relatively expensive
  - Existing solid fuel bioenergy fleet operating on very thin margins
  - Small biopower
    - Emissions issues for many biogas systems in South Coast and San Joaquin Valley Air Districts
    - There is concern that the 250 MW biopower IOU feed-in tariff program (SB 1122) won't yield economic prices and will be undersubscribed
    - Many of the targeted small biopower systems not yet commercial in California
- Biofuels
  - Conventional in-state ethanol facilities are affected by national/international economic trends and federal as well as state policies
  - Advanced biofuels proposed for California are still developmental, but several are promising and could develop in the near term..

# Societal Benefits / Ancillary Services from Bioenergy

- There are perceived societal benefits or services that accrue from use of biomass residues and possibly purpose grown crops for energy and fuels
  - Ecosystem benefits
    - Reduced forest fire severity and improved forest health
      - Improved air and water quality
      - Possibly reduced fire suppression costs
  - Diverts material from landfill
  - Rural jobs and other economic development
  - Locally sourced or distributed renewable energy



# Societal Benefits / Ancillary Services from Bioenergy

- Can these (perceived) societal benefits be monetized to improve bioenergy economics?
  - What are they worth?
  - Difficult to determine
  - Not all agree they exist (or could be a cost?)
- If a value can be determined, who should pay, who can pay?
  - Energy users (rate payers, vehicle owners)?
  - Taxpayers?
  - Segments of society that directly benefit?
  - Other?

# Ongoing Issue with Solid Waste Policy

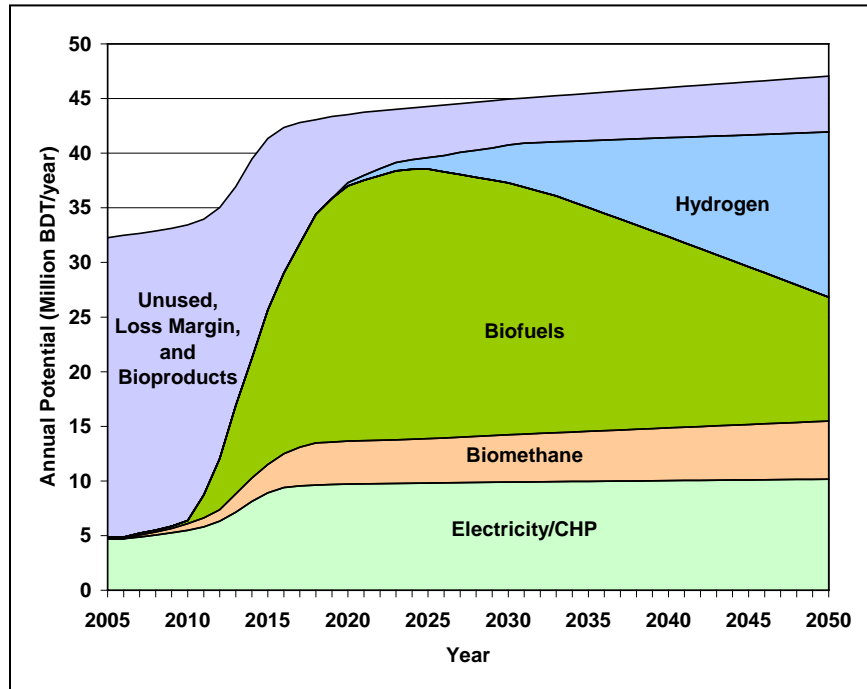
- Transformation (solid waste combustion with energy recovery):
  - Three facilities in the state circa 1980's
  - Limited diversion credit
  - No RPS eligibility for the biogenic fraction\*
  - No RPS eligibility for a new transformation facility
  - Effectively the same as landfilling per policy
- Must use “gasification” to be RPS eligible
  - Problematic statutory definition for gasification
    - No air “emissions, including greenhouse gases”
  - Disagreement on interpretation of definition for real projects – developers have withdrawn from California
- Policy basis for proscribing technology (rather than performance standards) is not clear (possibly out of date)
  - “Highest and Best Use” of MSW residuals equates energy recovery with landfilling in California

\* The Covanta-Stanislaus facility has RPS status per statute (even for fossil components of feedstock). The facilities in Long Beach and Commerce do not.

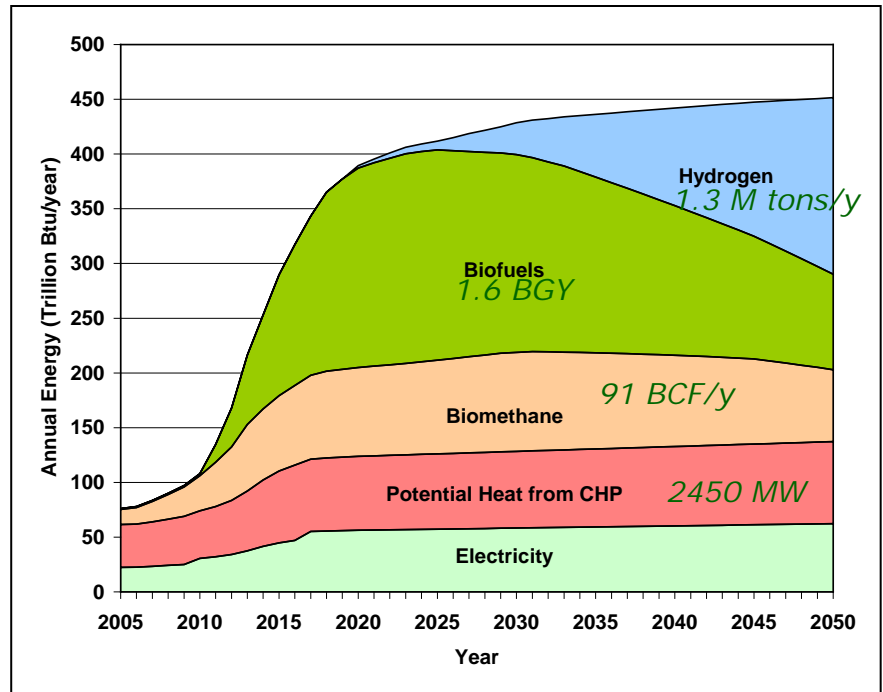
# California has a large bioenergy potential

## Currently:

- 5.8 TWh of in-state biopower production
  - (17% of in-state renewable power and 2% of full California power mix [ $\sim 290$  GWh/y])
- 1.5 billion gallons per year fuel ethanol consumed in California (10% of gasoline - - E10)
  - Approximately 170 million gallons/year instate ethanol production (11% of demand)
- $\sim 26$  million gallons/year of biodiesel currently produced in state  
(Midwest soy and waste oils)



Resource Potential



One Energy Scenario

# Path Forward

- Better economics
  - Monetize the societal benefits (if any)
    - Would help Biopower
    - LCFS is one way this adds value to biofuels
- Technology development
- Congruent policy

# For more information:

- California Biomass Collaborative
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