Evaluation of custom pathways for greenhouse gas calculations

Dr. Alissa Kendall
Assistant Professor
Dept. of Civil & Environmental Engineering
University of California, Davis
amkendall@ucdavis.edu

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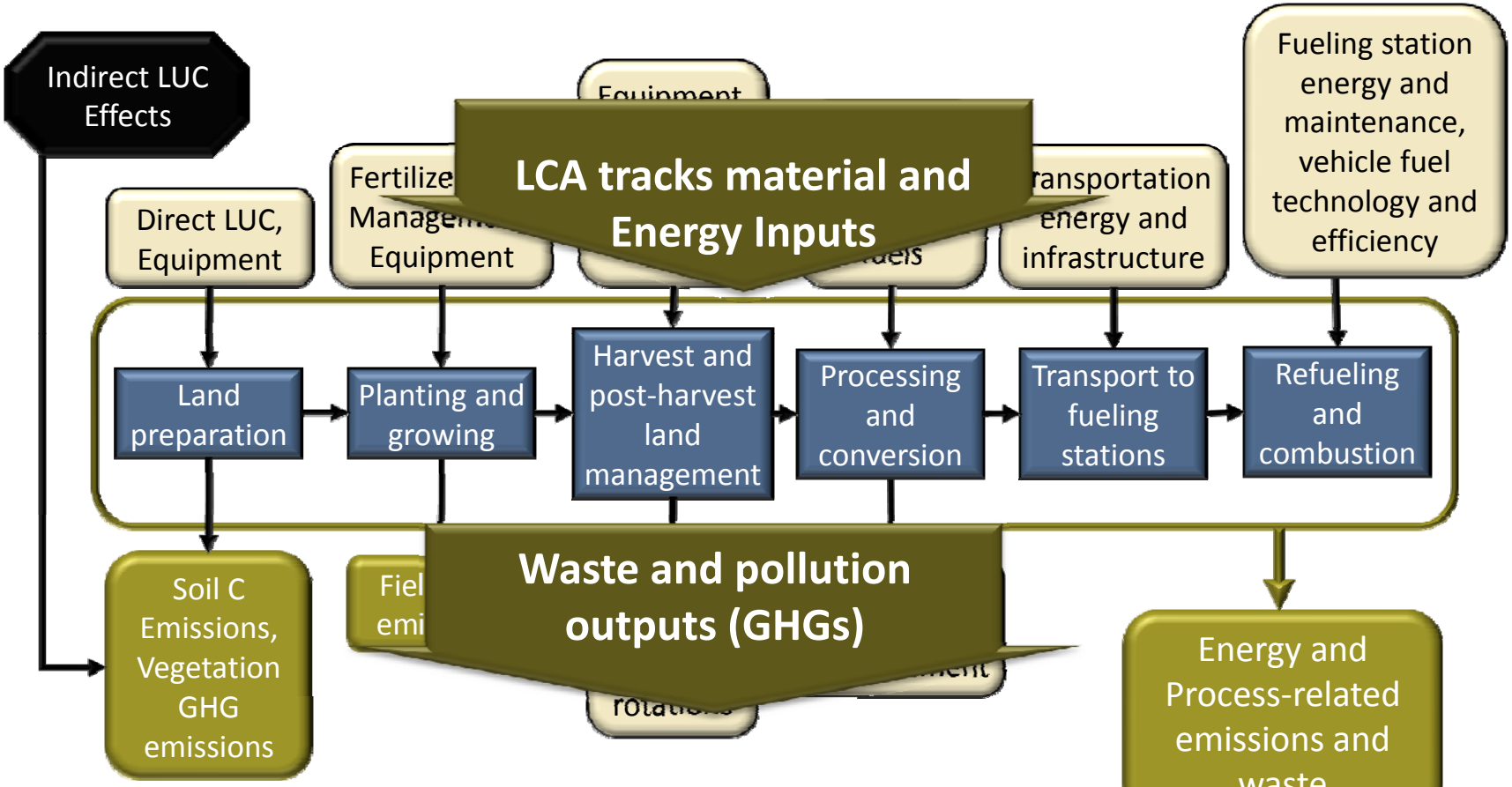
Life cycle greenhouse gas accounting, or carbon footprints

- Carbon intensity or carbon footprint calculations are just a narrow form of life cycle assessment (LCA), where only greenhouse gases (GHGs) are tracked

A Generic Biofuel Life Cycle for Purpose-Grown Feedstocks



LUC = Land Use Change

Defining the life cycle of a biofuel

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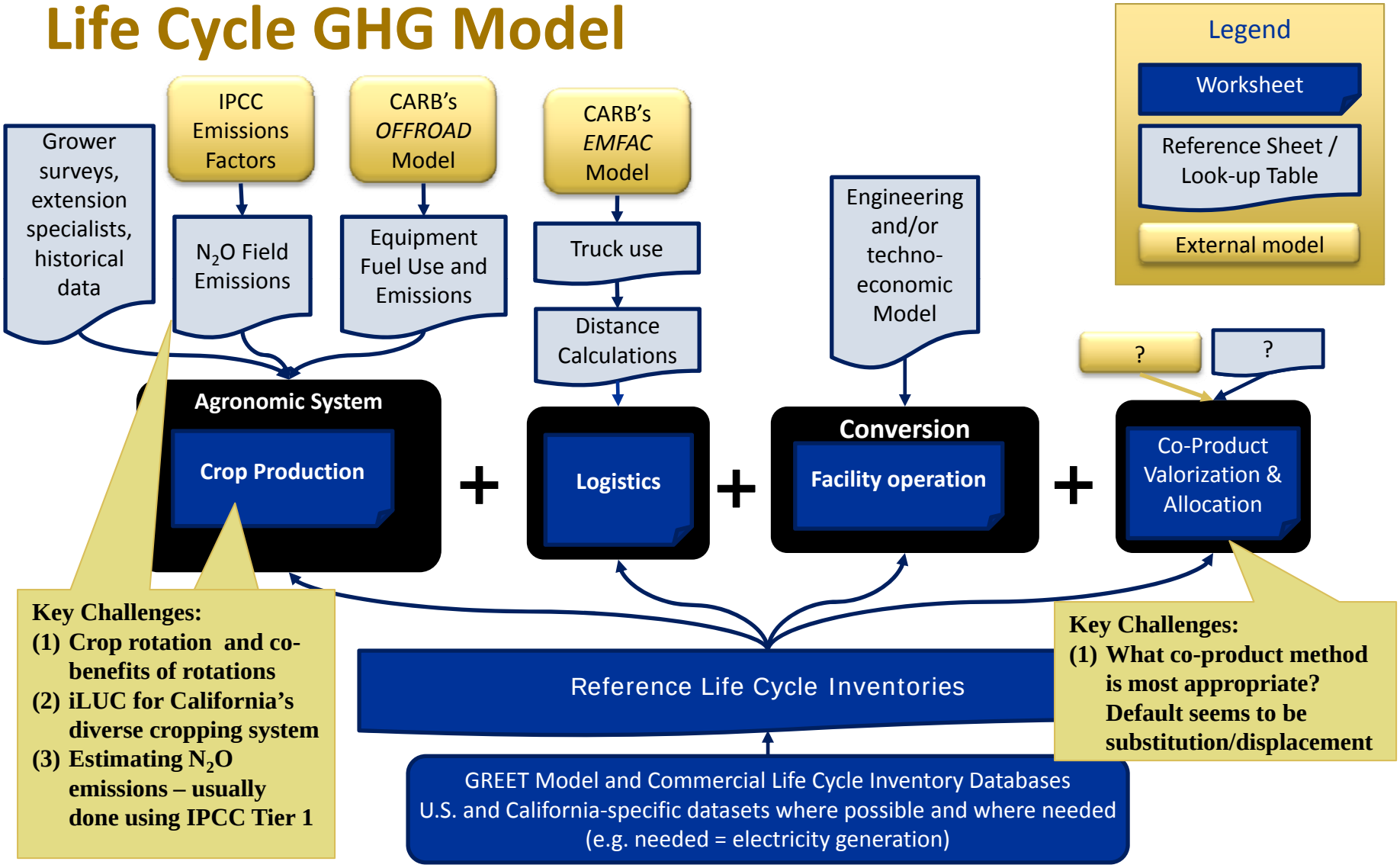
Sources of GHGs

High Confidence

High Uncertainty

- Key sources of GHGs
  - From industrial systems, equipment operation, and transport
    - Diesel combustion for tractors and trucks
    - Production of agrochemicals and other inputs
    - Heat and energy sources for conversion facilities (coal and natural gas combustion)
  - From biogeochemical sources, particularly soil emissions
    - **N_2O emissions from fertilized fields**
    - CO_2 flux from soil (new cultivation methods, direct land use change, etc.)
  - Indirect and consequential effects
    - Indirect LUC, co-product credits

Operational Framework for California Biofuel Life Cycle GHG Model



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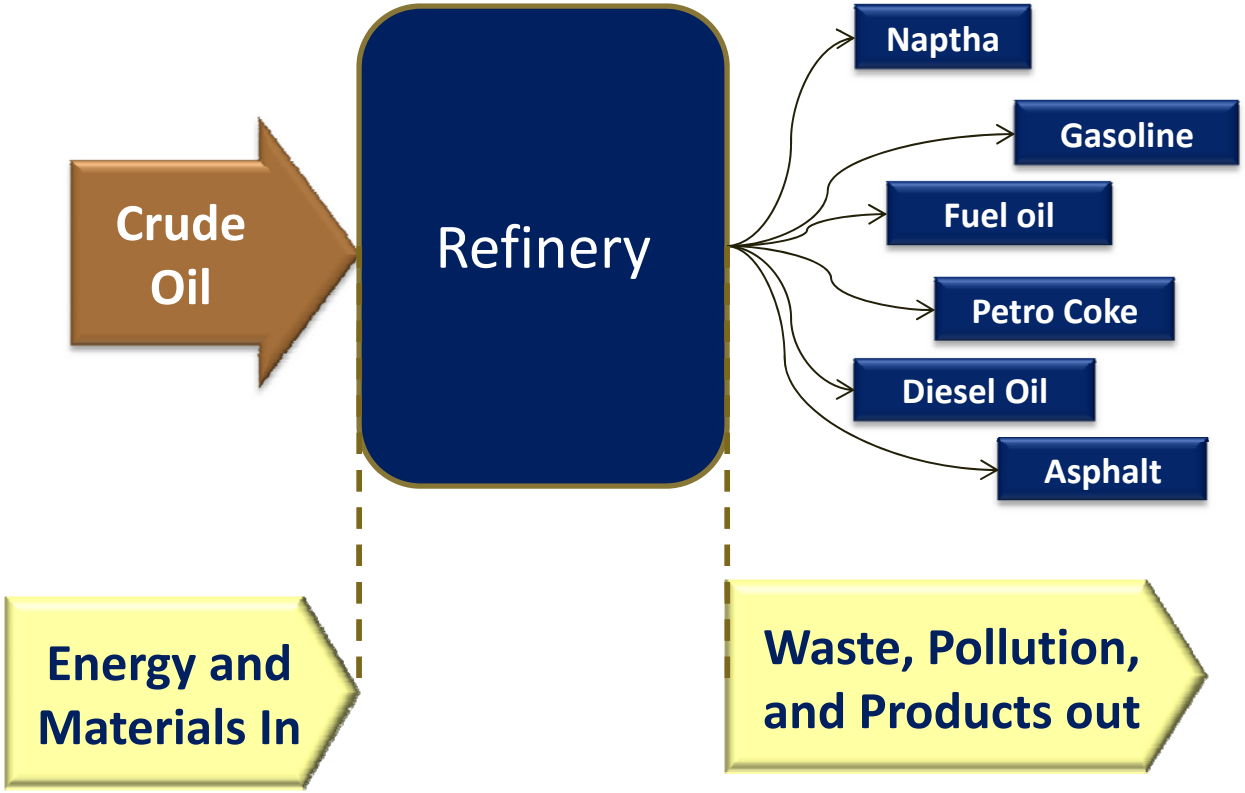
Example: Co-Products from Refineries

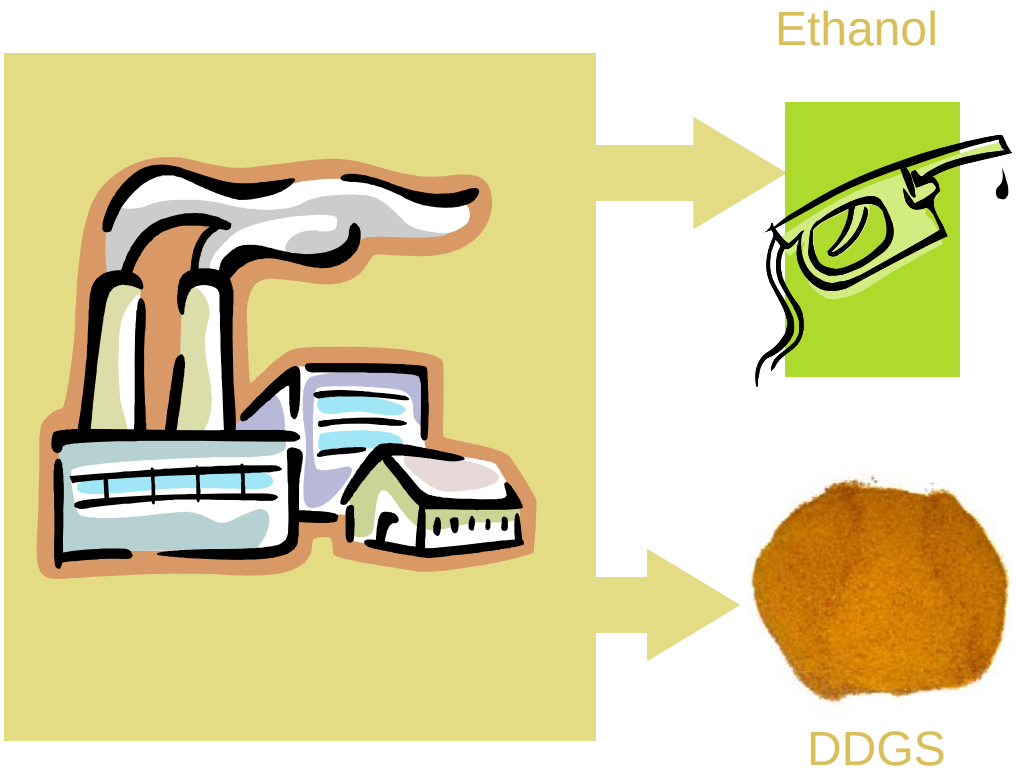
- Co-products are products produced together from a process or system



We have to assign inputs and outputs from the LCI to each product – but how? ***Based on $$, mass, MJ?***

Example: Co-Products from Corn Ethanol

- For ethanol the main co-product is dry distiller's grains (DDG) or and DDG with solubles (DDGS)



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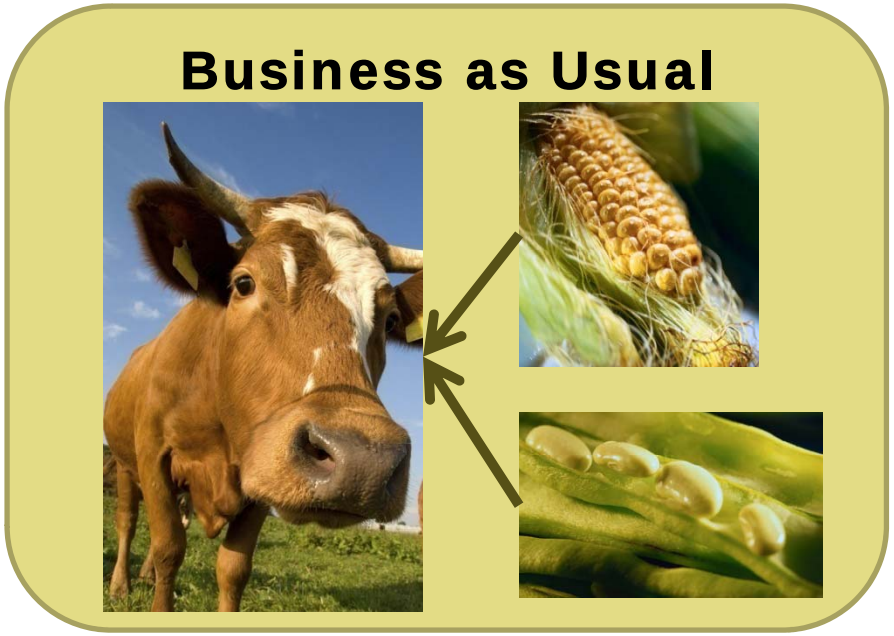
Corn Ethanol : Co-product "credits" (a consequential approach to co-products)

- Since co-products have some value to them and displace some other product in the market, a "credit" to the primary product (ethanol) should be assigned
- The cattle feed market isn't static, and especially in California, is not made up of just corn and soy…



Concluding Thoughts

- We can do a good job:
  - Modeling industrial systems and tailoring them to California conditions
  - We can do a good job estimating inputs, yield, etc. for California cropping systems
- We know that there are significant uncertainties in:
  - Estimating field emissions
  - Consequential effects of biofuel feedstock production in California (e.g. iLUC)
  - How co-products might be used and what GHG 'credit' or allocation they should be assigned

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Questions?