Mobility Chain Analysis for the RBAEF Project

Lead Team:

Argonne National Laboratory

Other Participating Teams:

Dartmouth College

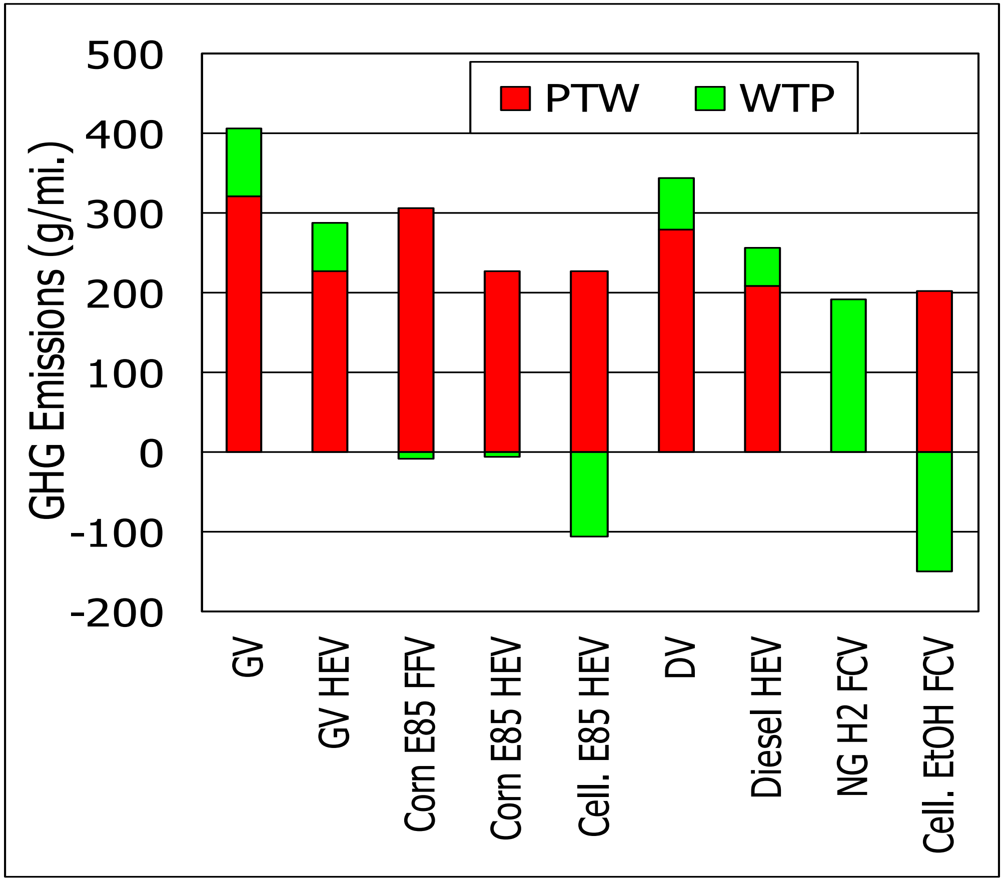
Union of Concerned Scientists

Mobility Chain Analysis Is Needed to Fully Address Energy and Emission Effects

Energy and emission burdens of vehicle/fuel options can occur in well-to-pump or pump-to-wheels stage

Objectives

- **Evaluate the entire chain of feedstock and fuel production and delivery, and conversion of fuel into work in vehicles**
- **Results will include energy use, GHG emissions, and criteria pollutant emissions**



Note: results in the chart are based on prior analyses with ANL GREET and are for demonstration purpose here.

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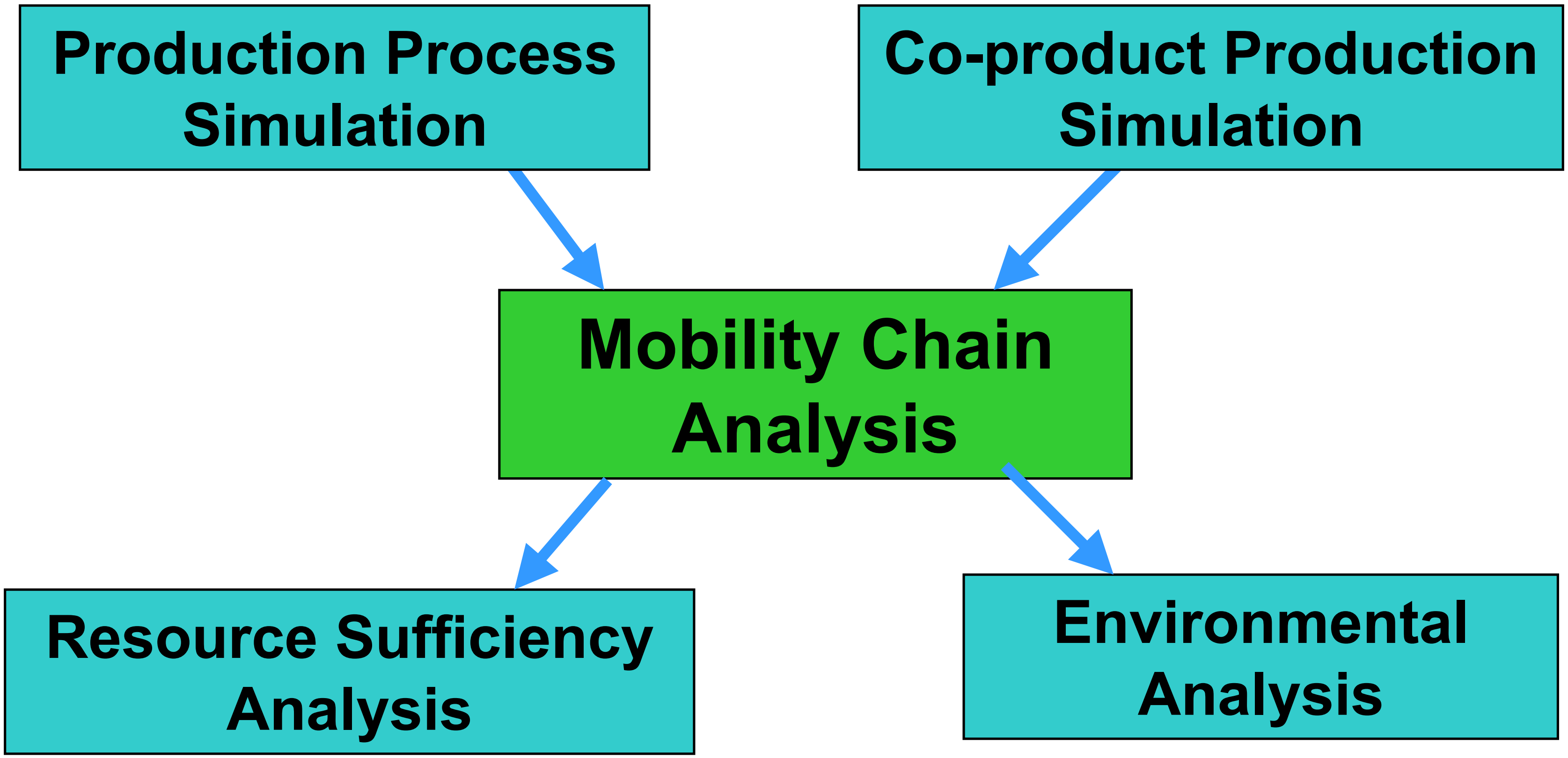
Mobility Chain Analysis Is An Integral Part of the RBAEF Project



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Rationale for Selecting Vehicle/Fuel Options for This Project

- High-priority options
  - Based on likely applications and high interests (especially in bio-fuels)
  - Both light vehicles and heavy vehicles are included
  - Heavy vehicles account for ~22% vehicle fuel use and grow fast
- Low-priority options
  - Primarily to put high-priority options into broad perspective with competing alternatives
  - Will be subject to further down selection on the basis of overall energy effects
- The selection is by no mean exhaustive; resource and time constraints dictated the selection

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Vehicle/Fuel Options Selected for Mobility Chain Analysis

		High Priority (full analysis)	Low Priority (subject to further down selection)
Light-Duty Vehicle	ICE	1. Gasoline (current)	1. Gasoline (advanced) 2. Corn EtOH (advanced) 3. Cell. EtOH (advanced) 4. Diesel (advanced) 5. FTD and DME (for CI engine)
	HEV[a]	2. Gasoline 3. Cell. EtOH	6. Diesel 7. FTD and DME (for CI engine)
	FCV[b]	4. Bio-G.H_2	8. NG G.H_2 9. MeOH (direct?) 10. Cell. EtOH (off board) 11. Gasoline (on board) 12. Cell. EtOH (on board) 13. MeOH (on board)
Heavy-Duty Vehicle	ICE	5. Diesel (current) 6. FTD or DME	14. FTD or DME (depending on what selected in high-priority options)
	HEV[a]		15. Diesel 16. FTD and DME
	FCV[b]		17. Bio-G.H_2

Notes: a) Hybrid electric vehicles are powered by an internal combustion engine;
b) Fuel-cell vehicles will be determined for hybridization or not.

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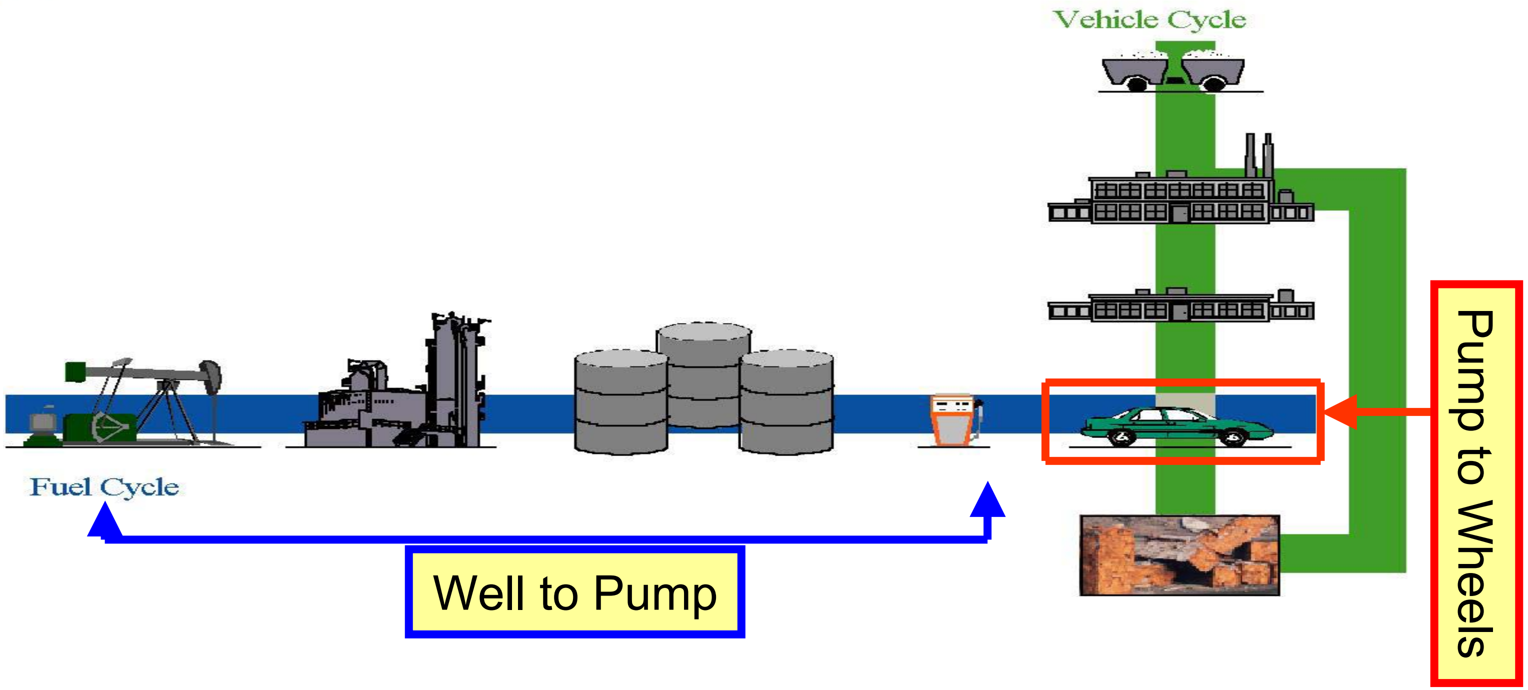
Some of the Fuel Options Could Have Multiple Production Pathways

Feedstock	Fuel	Process	In GREET?
Petroleum	**Gasoline**	Refining	Yes
	Diesel	Refining	Yes
Natural gas	G.H2 MeOH FTD/DME	SMR Synthesis Synthesis	Yes Yes Yes
Corn	Ethanol	Fermentation	Yes
Cellulosic biomass	**Ethanol**	Fermentation/Thermochemical	Yes/No
	Methanol	Thermochemical	No
	FTD/DME	Thermochemical	No
	G.H_2	Thermochemical	No
MeOH and EtOH	G.H2	Reforming at refueling stations	Yes

Note: the fuels highlighted belong to the high-priority list.

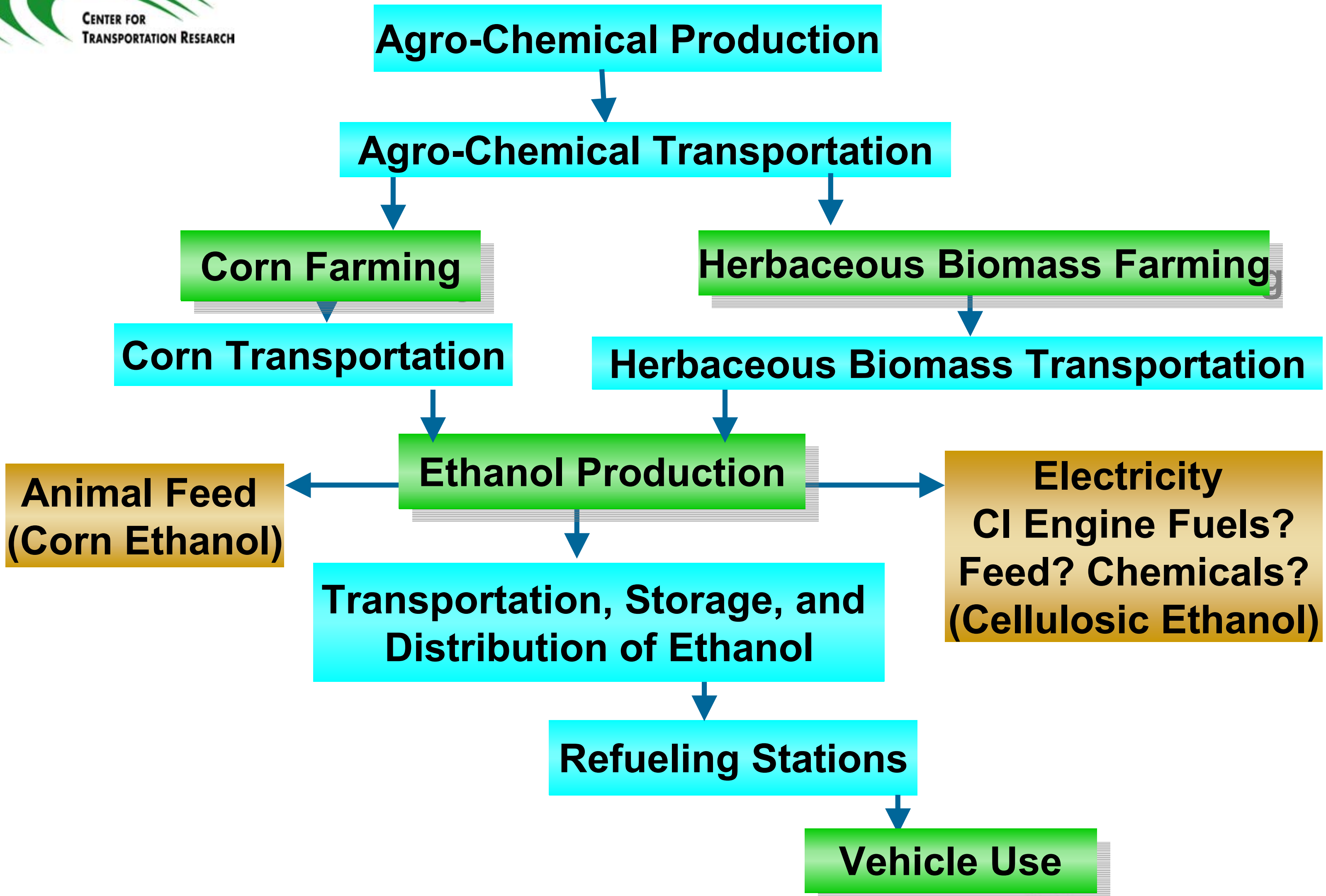
GREET Will Be Expanded for Mobility Chain Analysis



Argonne has been developing the GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation) model

- The GREET model and its documents are available at **http://greet.anl.gov**
- There are about 1,100 GREET users worldwide including governmental agencies, industries, universities, and research institutions

Mobility Chain Example:
Bio-Ethanol via Fermentation in GREET



Vehicle Use Analysis

- Vehicle efficiency is a key factor determining results of mobility chain analysis as well as those of other tasks
- Attention will be paid to mature vehicle technologies with equal vehicle performance and driving behavior
- Will rely on already completed studies rather than conducting vehicle simulations
- Need to reconcile differences and inconsistencies among completed studies
- Results will include fuel economy and criteria pollutant emissions

Key Outstanding Issues

- Definition of mature technologies for various fuels and vehicle technologies; consequent energy and emission effects to be analyzed with GREET
- By-products: power, feed, chemicals, etc.; analytical issues need to be addressed in GREET
- Types of energy sources: total energy, fossil energy, and petroleum