ARGONNE NATIONAL LABORATORY

TRANSPORTATION TECHNOLOGY R&D CENTER

Mobility Chain Analysis for the RBAEF Project

Lead Team:

Argonne National Laboratory

Other Participating Teams:

Dartmouth College

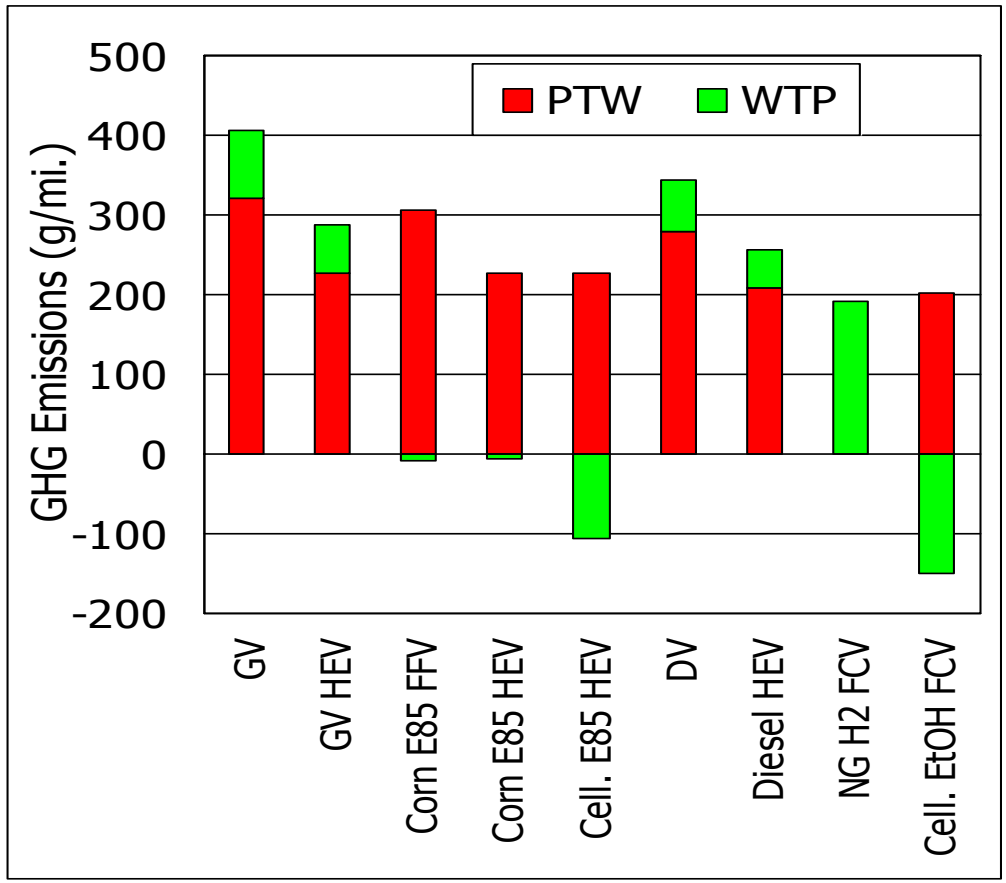
Union of Concerned Scientists

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

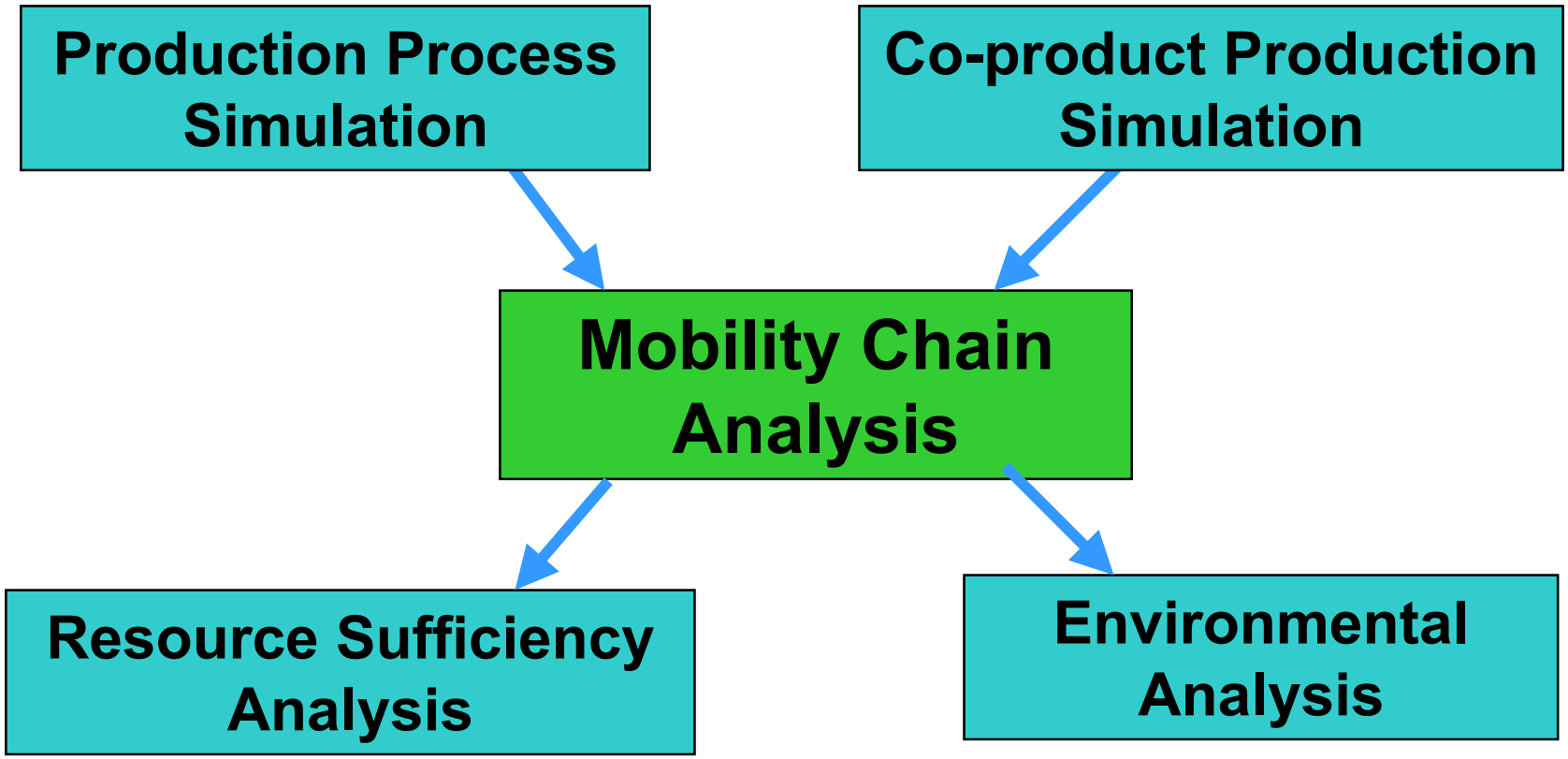
Objectives

- **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.

Mobility Chain Analysis Is An Integral Part of the RBAEF Project



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

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

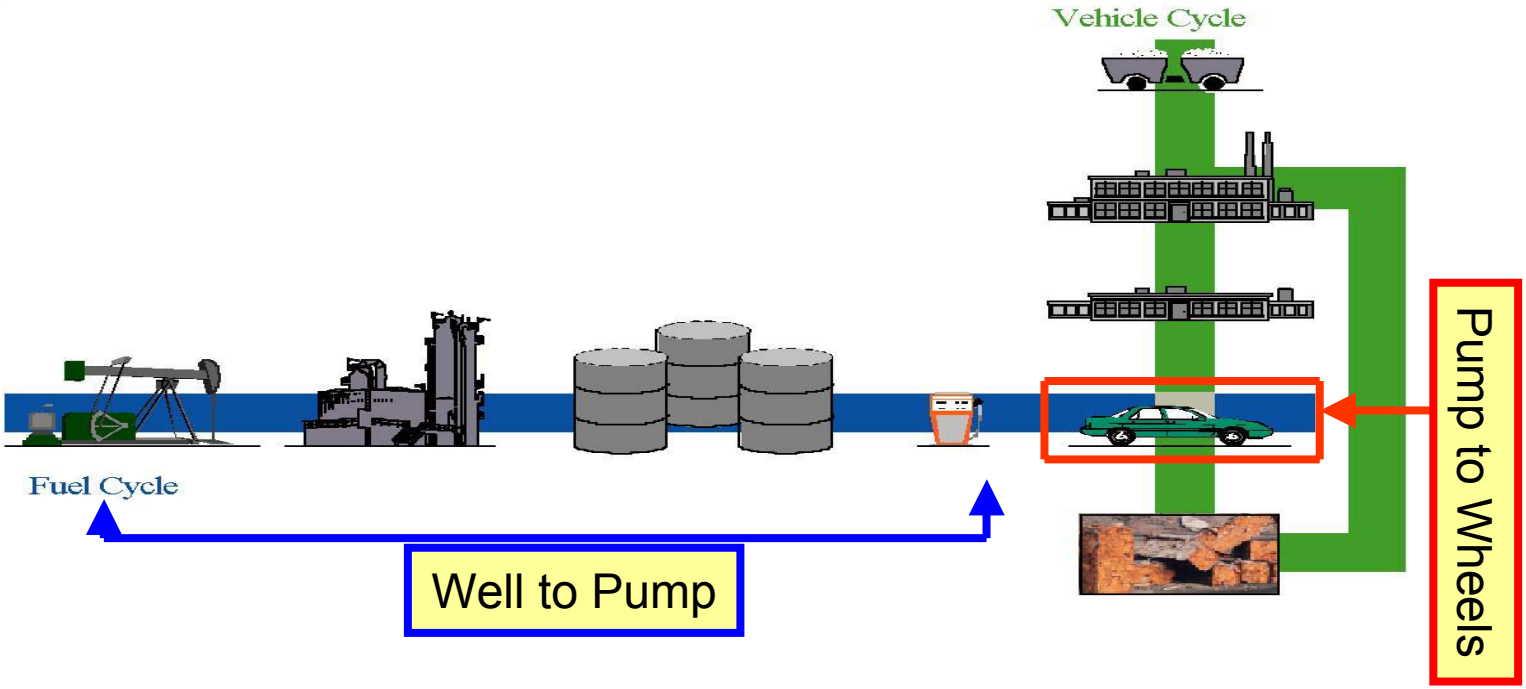
Notes: a) Hybrid electric vehicles are powered by an internal combustion engine;
b) Fuel-cell vehicles will be determined for hybridization or not.

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.

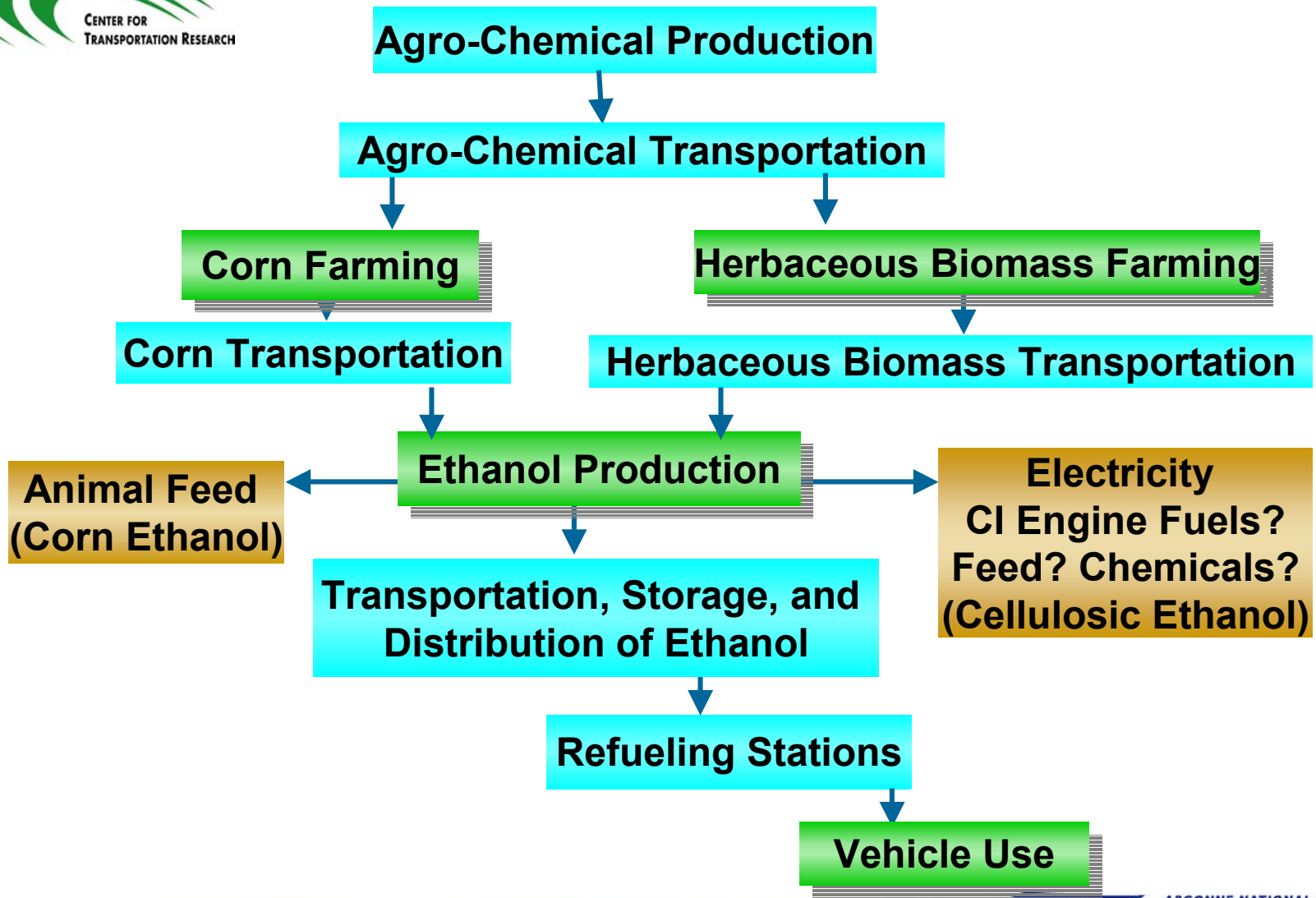
GREET Will Be Expanded for Mobility Chain Analysis



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