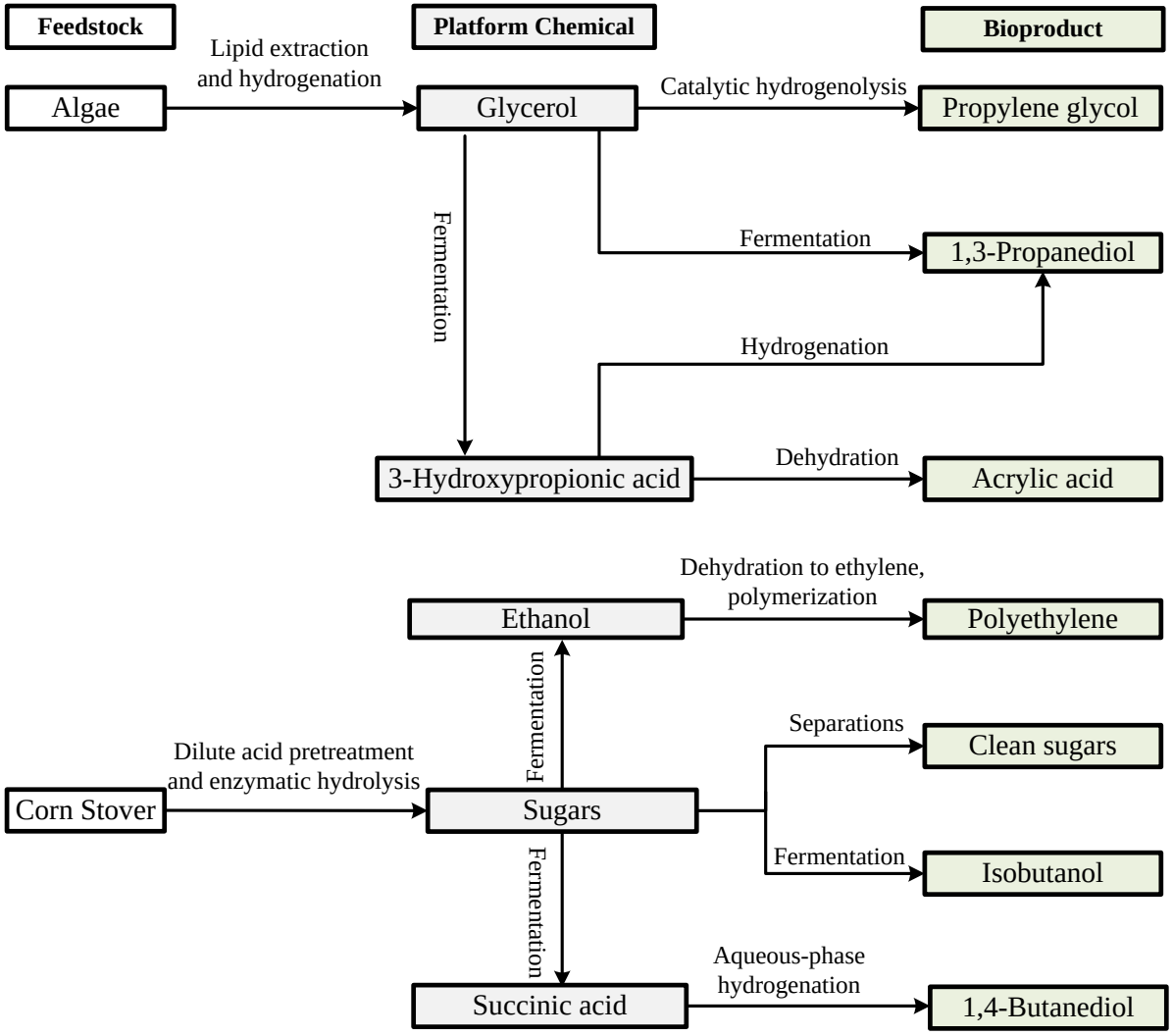
Bioproduct Life Cycle Analysis with the GREET™ Model

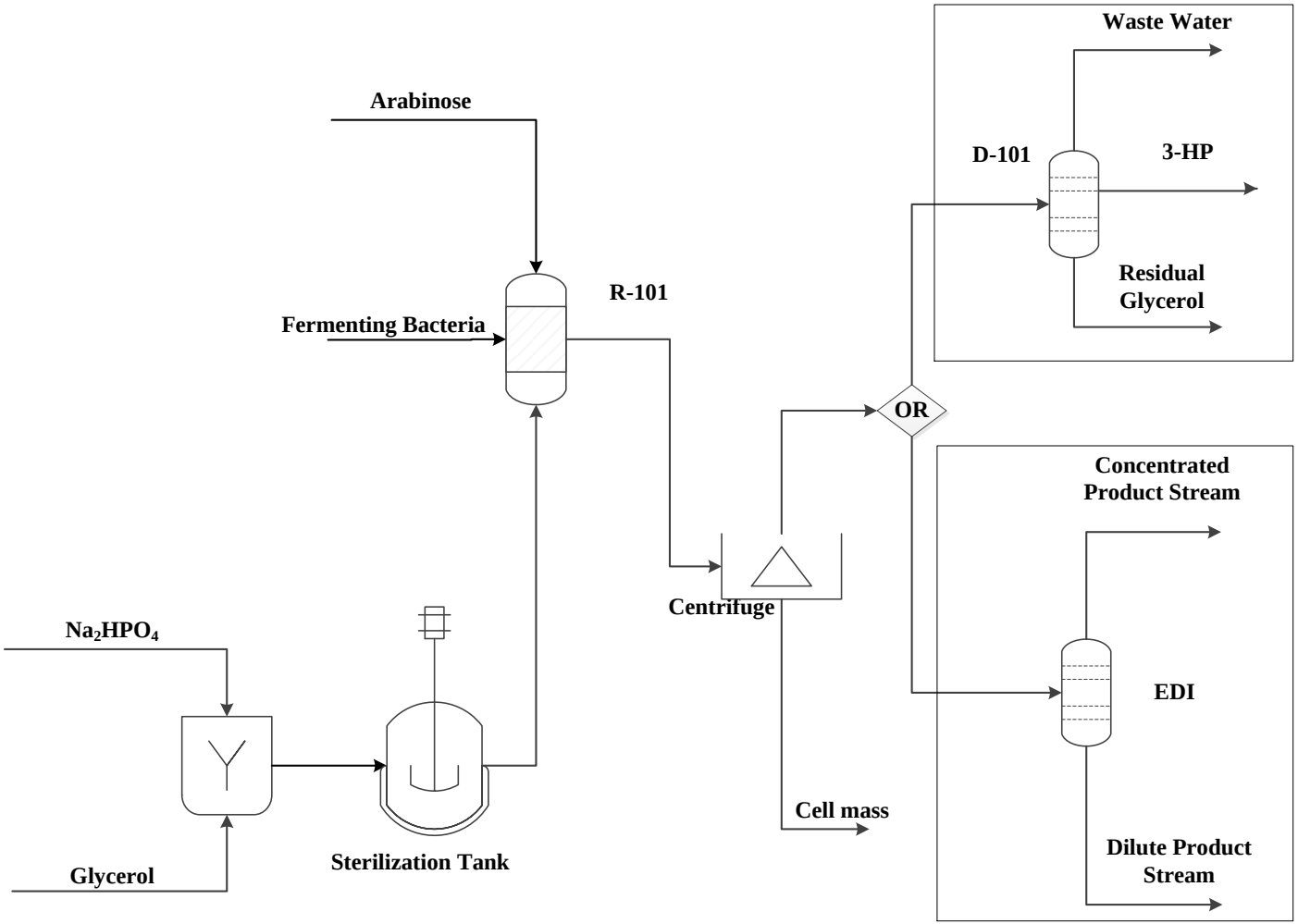
Jennifer B. Dunn
Biofuel Life Cycle Analysis Team Lead
Systems Assessment Group
Argonne National Laboratory

Biomass 2014
July 29 and 30, 2014

Selection of bioproducts based on a high-level market analysis



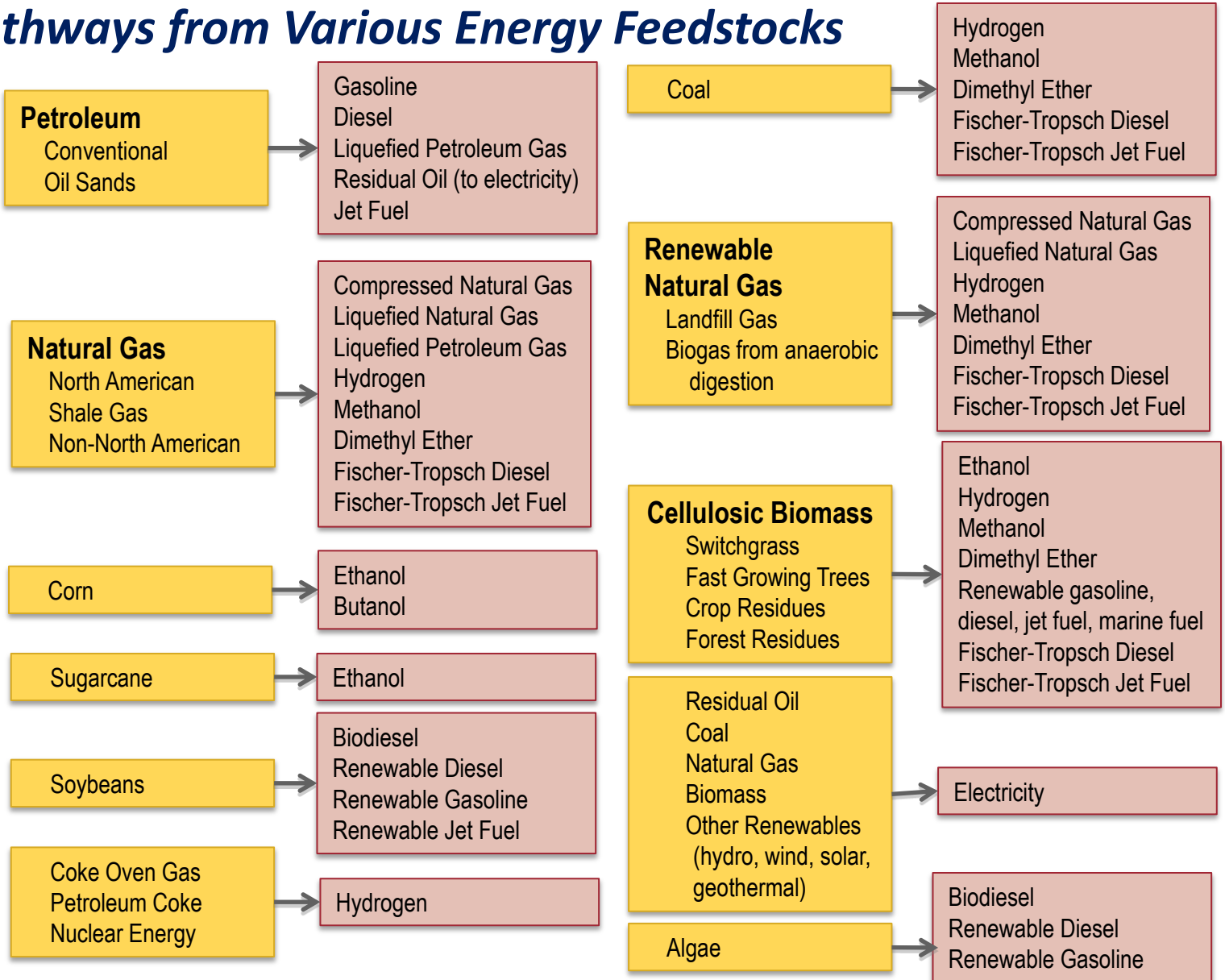
Process simulations provided material and energy flows used in analysis



EDI: electrodeionization

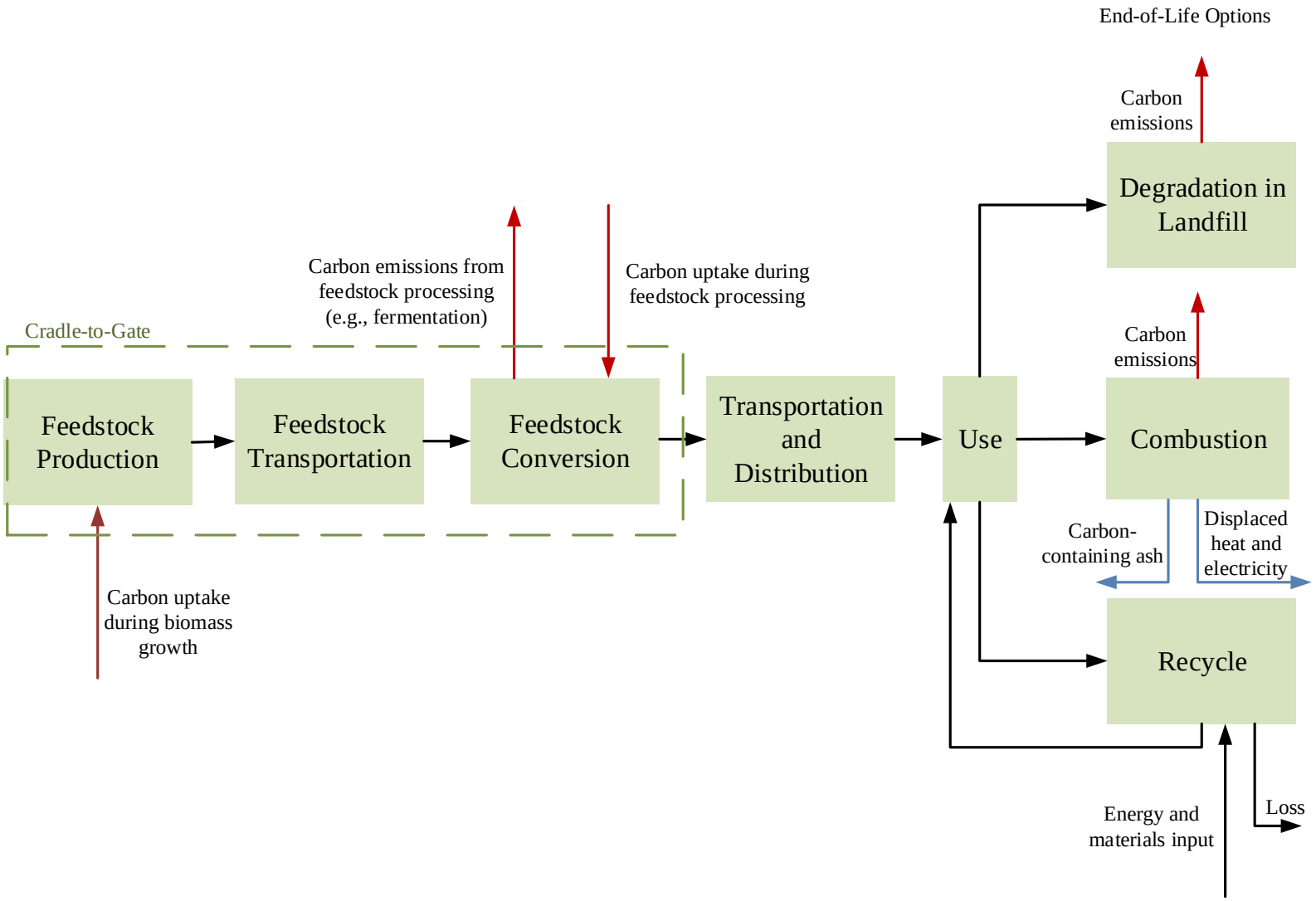
The GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation) Model at Argonne National Lab

GREET Includes More Than 100 Fuel Production Pathways from Various Energy Feedstocks

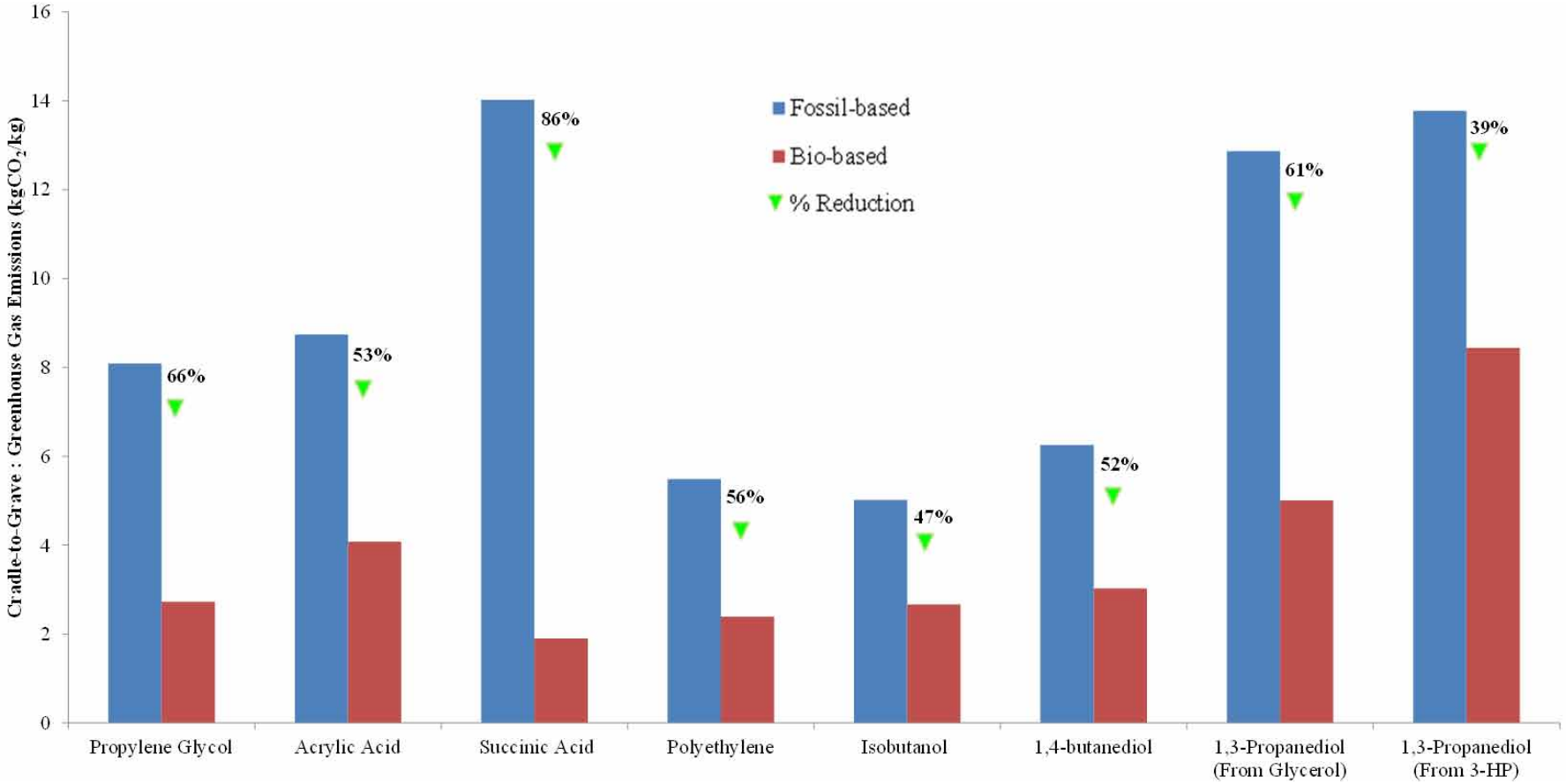


The yellow boxes contain the names of the feedstocks and the red boxes contain the names of the fuels that can be produced from each of those feedstocks.

Carbon Accounting in the Bioproduct System Boundary

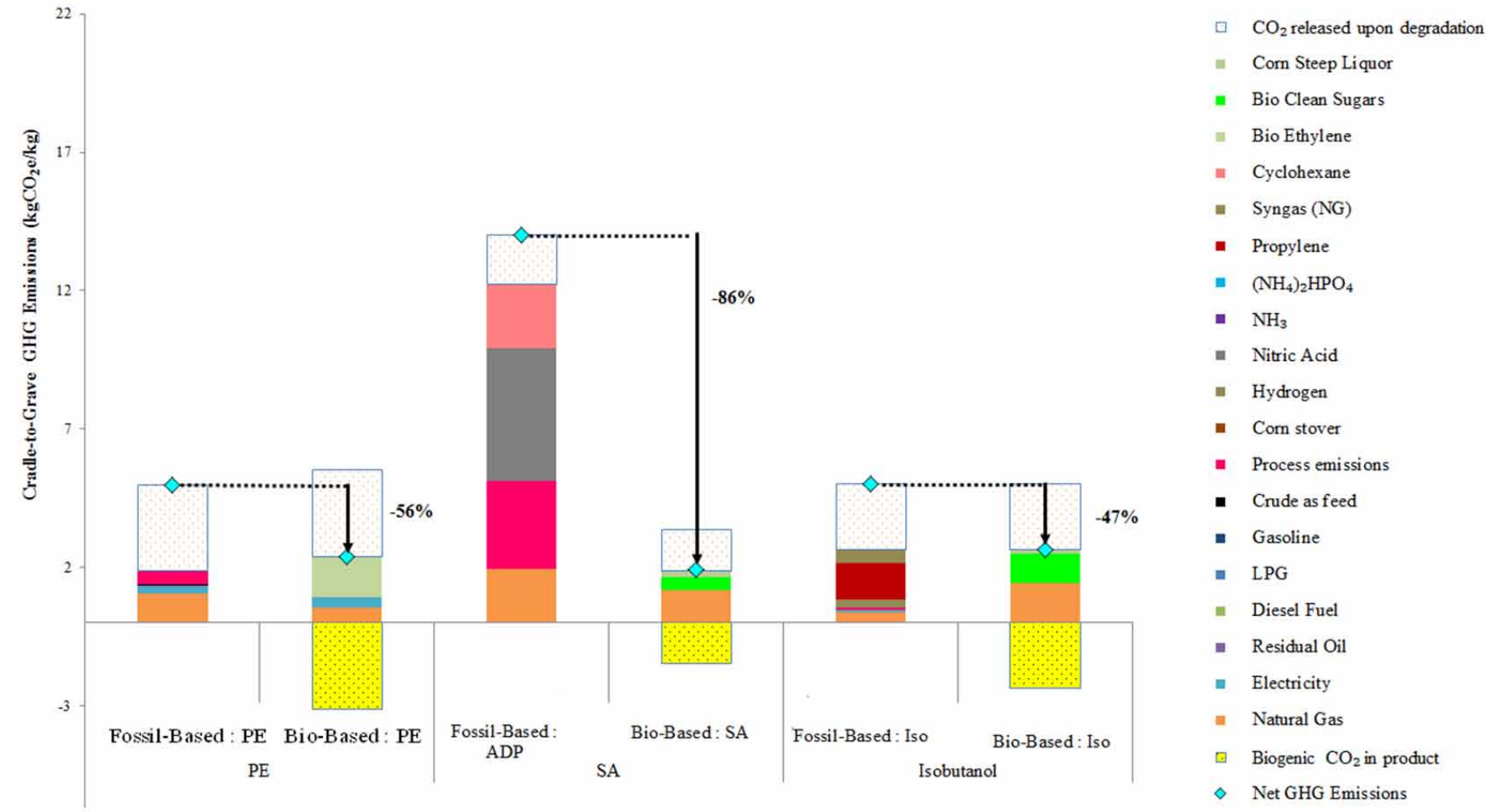


Bioproducts uniformly showed reductions compared to their fossil-derived counterparts



Preliminary Results

Process natural gas and feedstock consumption drive GHG emissions



PE: polyethylene; ADP: adipic acid

Preliminary Results

Bioproduct	Feedstock	GHG Emissions: Cradle-to-Grave		References
		$kgCO_2e/kg$	% Reduction	
Propylene Glycol	Soybean & Canola	3.2	61%	ADM
	Glycerol	1.1	66%	GREET
1,3-PDO	Corn	2.7-3.5	46-71%	Urban (2009)
	Corn	1.2-2.9	37-55%	Hermann (2007)
	Sugar Cane	-1.8	62-115%	Hermann (2007)
	Glycerol	2.7	66%	GREET
	3-HP	5.3	39%	GREET
Acrylic Acid	Corn starch	2	43%	Hermann (2007)
	Corn stover	1.2	66%	Hermann (2007)
	Sugar cane	0.7	80%	Hermann (2007)
	3-HP	8.7	53%	GREET
Succinic Acid	Corn starch	0.88	90%	Cok (2014)
		1.7	81%	Cok (2014)
		1.5	83%	Cok (2014)
	Clean Sugars	1.9	86%	GREET

Preliminary Results

Conclusions and Outcomes

- Bioproducts from corn stover and algae feedstocks have the potential for life-cycle GHG emissions that are below peer fossil-derived compounds.
- Heat integration and yield increase opportunities will improve bioproduct life-cycle GHG emissions.
- The GREET bioproducts module, to be released Fall 2014, will allow the community to explore these results and generate results for bioproduct pathways of interest.
- A technical report will document data sources and methodology used to build the GREET model.
- Bioproducts module is subject to updates as additional information becomes available. It will be expanded to include additional products.

Acknowledgements

- Felix Adom - ANL
- Jeongwoo Han - ANL
- Norm Sather – ANL
- John Molburg - ANL
- Seth Snyder - ANL
- Michael Wang - ANL
- Fengqi You - Northwestern
- Chang He - Northwestern
- Jian Gong - Northwestern
- Dajun Yue - Northwestern
- Travis Tempel - BETO
- Alicia Lindauer - BETO
- Kristen Johnson - BETO

This work was supported by the Bioenergy Technologies Office (BETO) of the Office of Energy Efficiency and Renewable Energy of the United States Department of Energy, under contract DE-AC02-06CH11357.

Contact information: jdunn@anl.gov