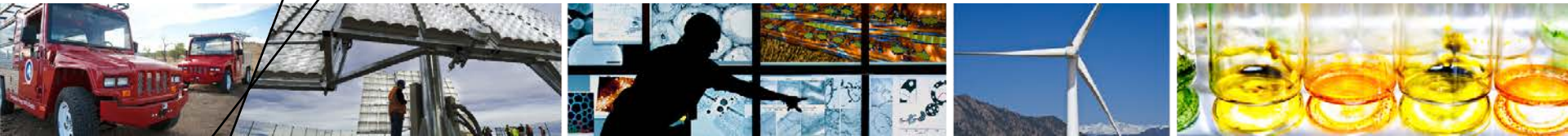


# Techno-Economics & Life Cycle Assessment



**NREL IBRF**

**Abhijit Dutta & Ryan Davis**

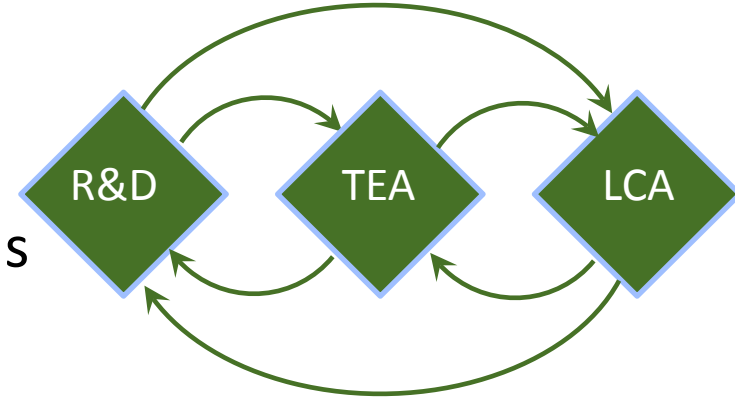
**December 14, 2011**

**NREL/PR-5100-53749**

# Overview

- **Tools for effective R&D**

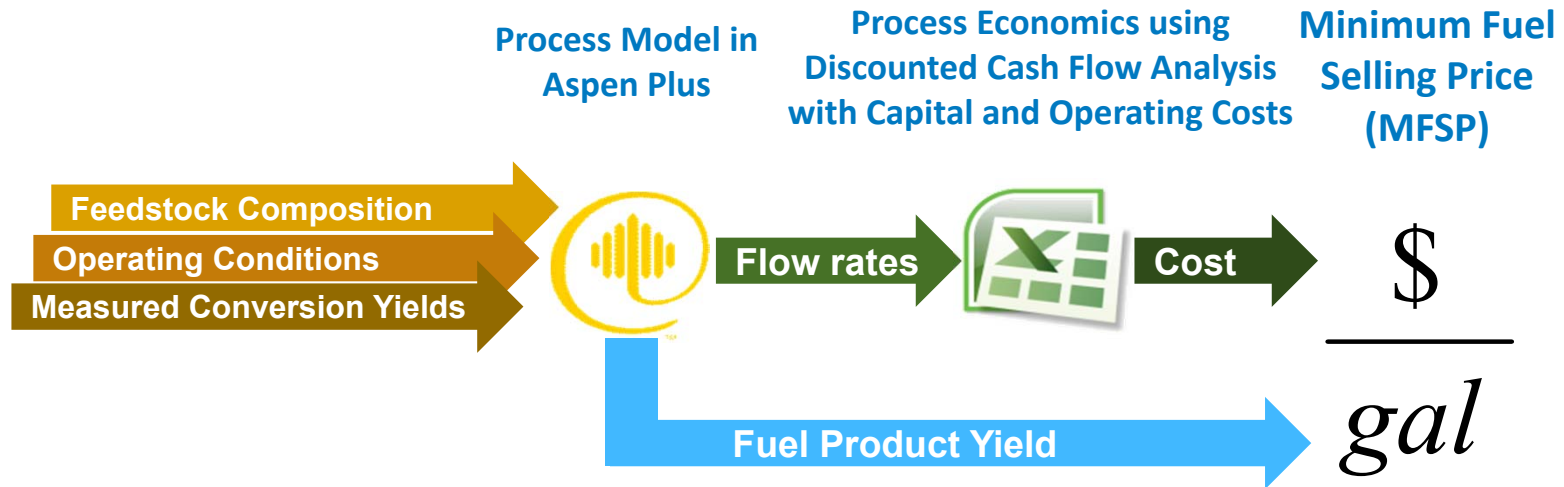
- Realize the overall impact of actions



- **Techno-Economic Analysis (TEA) & Life Cycle Assessment (LCA)**

- TEA: Assess technical & economic feasibility of process
  - Detailed process analysis with mass and energy balances
  - Impact of major cost drivers (sensitivity studies)
  - Set research targets & use them as measure of research progress
- LCA: *Overall* environmental impacts of the technology
  - Quantification of impacts and areas of improvement
- Track research progress (economic & sustainability criteria)

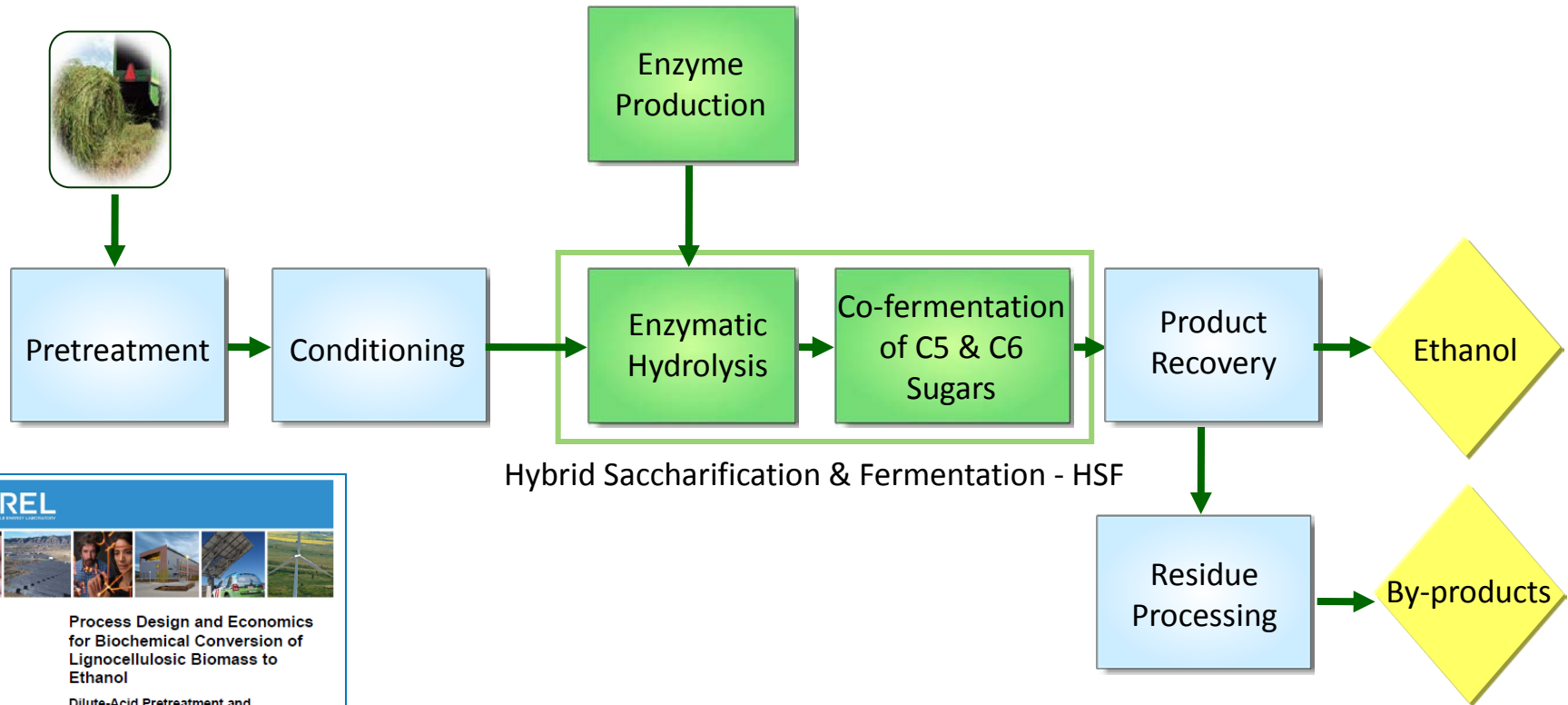
# TEA Methods



- **Requirement-based scope and level of detail**
  - Literature, research data, vendor quotes
  - Increase model fidelity with research progress

# TEA Output (e.g. Biochemical Design Report)

Drives R&D direction, helps pick among alternatives



Hybrid Saccharification & Fermentation - HSF

**NREL**  
National Renewable Energy Laboratory

**Process Design and Economics for Biochemical Conversion of Lignocellulosic Biomass to Ethanol**

**Dilute-Acid Pretreatment and Enzymatic Hydrolysis of Corn Stover**

D. Humbird, R. Davis, L. Tao, C. Kinchin, D. Hsu, and A. Aden  
*National Renewable Energy Laboratory  
Golden, Colorado*

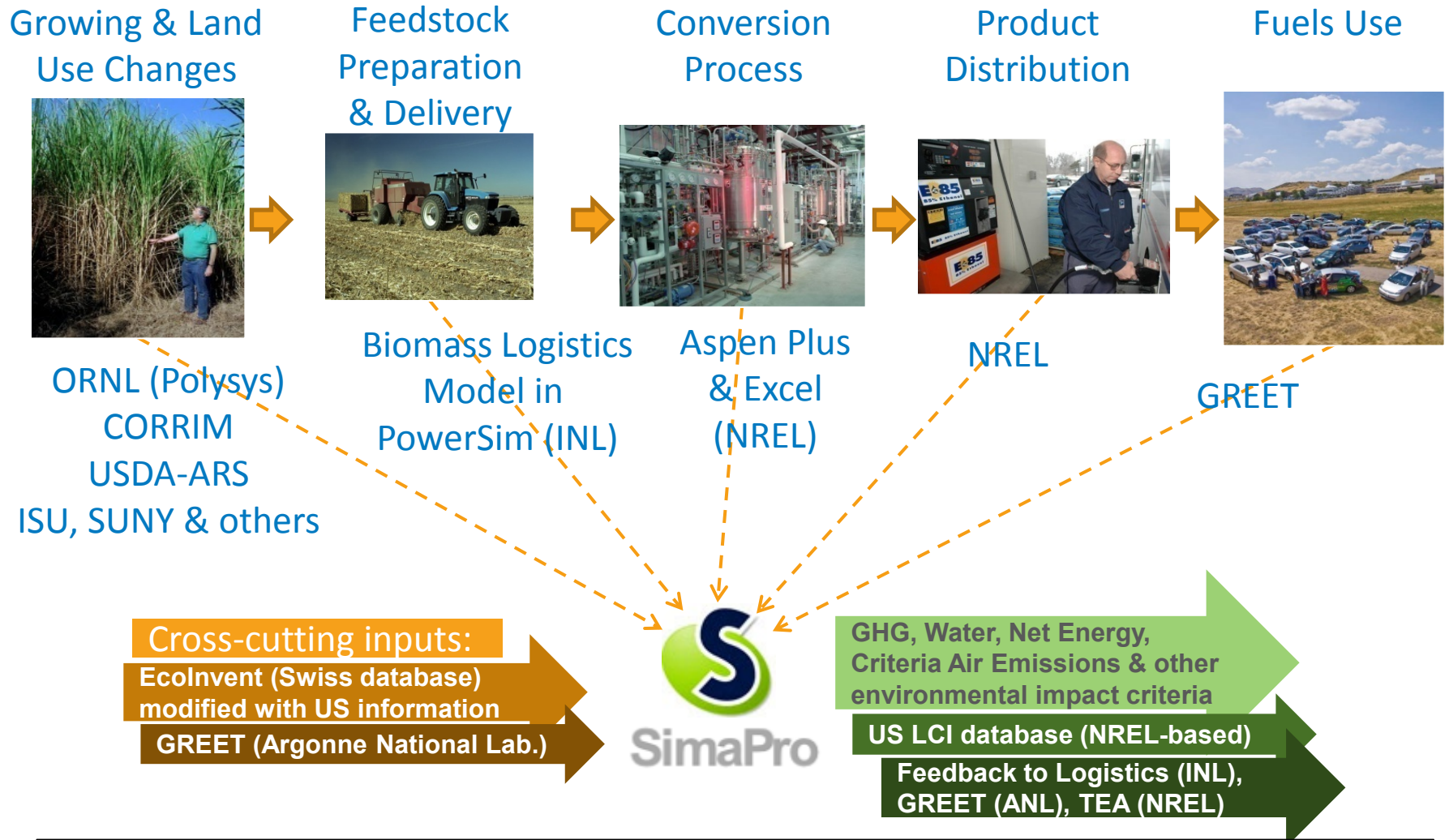
P. Schoen, J. Lukas, B. Olthof, M. Worley, D. Sexton, and D. Dudgeon  
*Harris Group Inc.  
Seattle, Washington and Atlanta, Georgia*

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Technical Report  
NREL/TP-5100-47764  
May 2011  
Contract No. DE-AC36-080023308

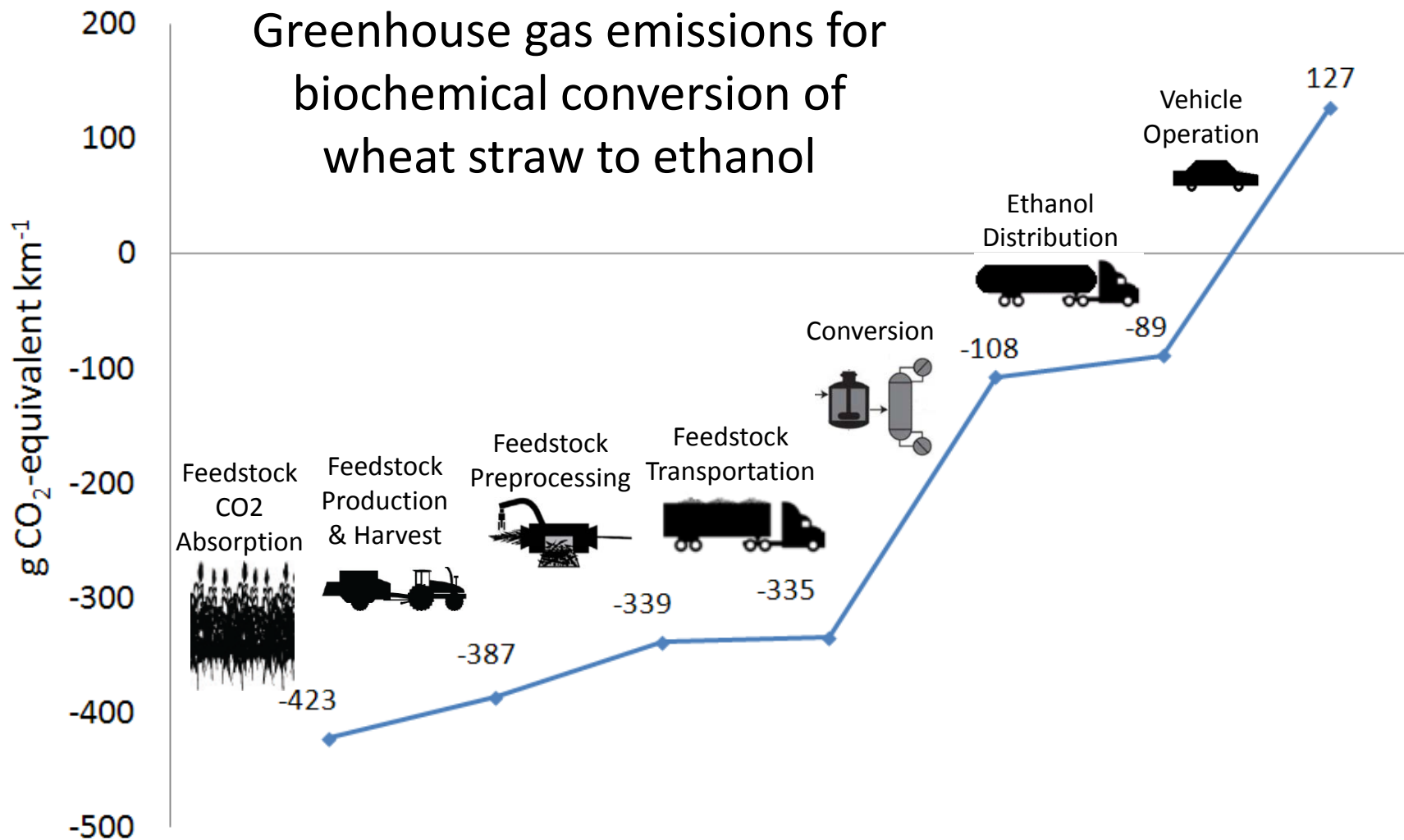
- **Conceptual design of a 2,000 tonnes/day commercial plant – one possible tech package**
- **NREL pilot plant based on this process**
- **Basis for connecting R&D targets to cost targets**
- **Has undergone rigorous peer review**
- **Basis for comparison against other technology options**

# LCA Methods



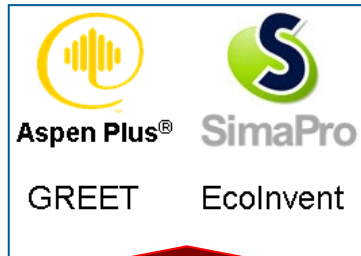
Framework allows for transparent scientific basis for assumptions and modifications.

# LCA Output (e.g. tracking overall CO<sub>2</sub>)



Note: This is an example. Details about assumptions are not shown.

# Value of working with NREL on TEA & LCA



Conversion	Selectivity
Interest Rate	Depreciation
Water Use	Emissions
.....	.....

Bench/Pilot Scale  
 Proof of Concept  
 Scale-up and demonstration  
 Feasibility Study  
 Sensitivity Analysis

Multiple:  
 - Industrial companies  
 - Non-profit organizations  
 - National Labs  
 - Universities

## Leverage Existing Expertise

- Models of varied conversion processes already built
- Recognized experts with domain knowledge
- Quicker turnaround
- Good quality
- Recognized experts good for joint FOA applications

## Varied and Best Available Tools

- Aspen Plus with rigorous mass & energy balance, and other robust TEA tools used
- LCA draws from knowledge base & tools from different sources, otherwise difficult to assimilate under one environment

## Customizable for Different Sets of Assumptions

- Both TEA and LCA tools are designed to make assumptions transparent

## Requirement-Based Rigor

- Analysis can be more detailed based on requirement of the client and based on the available information

## Confidentiality Maintained

- Intellectual property, data and all confidential information is protected
- NREL has proven track record of working with multiple clients in the same field

# Questions?

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- **Thank you for your attention**
- **Contacts:**
  - Andy Aden (Group Manager for Biorefinery Analysis)
    - Andy.Aden@nrel.gov
  - Rich Bolin
    - Richard.Bolin@nrel.gov
  - John Ashworth
    - [John.Ashworth@nrel.gov](mailto:John.Ashworth@nrel.gov)
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