

A Compelling Business Case for Forest-Based Biofuel

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AAAS 2008 ANNUAL MEETING
Boston, MA, February 18, 2008

Presentation Content:

Building “compelling business case” for forest-based biofuel concepts

- **Biofuel/Biorefinery R&D at FPL**
- **Context & Rationale**
- **FPL Approach**
- **Case Examples**

Biofuel/Biorefinery R&D at FPL

Range of disciplines

- Microbiology
- Chemistry
- Engineering
- Economics

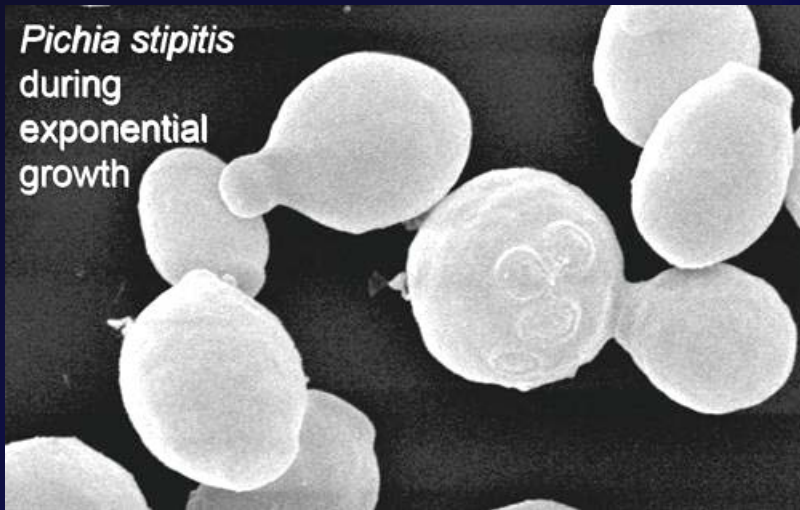
FPL Biofuel/Biorefinery R&D

(project examples)

- **Value prior to pulping (VPP)**
- **5-carbon sugar fermentation**
- **Novel gasification technology**
- **Analysis of business cases ←**



R&D at FPL encompasses both biochemical and thermochemical biofuel/biorefinery concepts . . .



Engineering *Pichia stipitis* genome for faster xylose metabolism; T. Jeffries et al.



FPL-UW molten metal bench-scale wood gasification unit; M. Dietenberger & M. Anderson

Context & Rationale

- **Agency Goals (USDA Forest Service)**
 - Reducing fuel loading on public forestlands
 - Replacing fossil fuel with renewable fuel
 - Reducing carbon emissions of fossil fuels



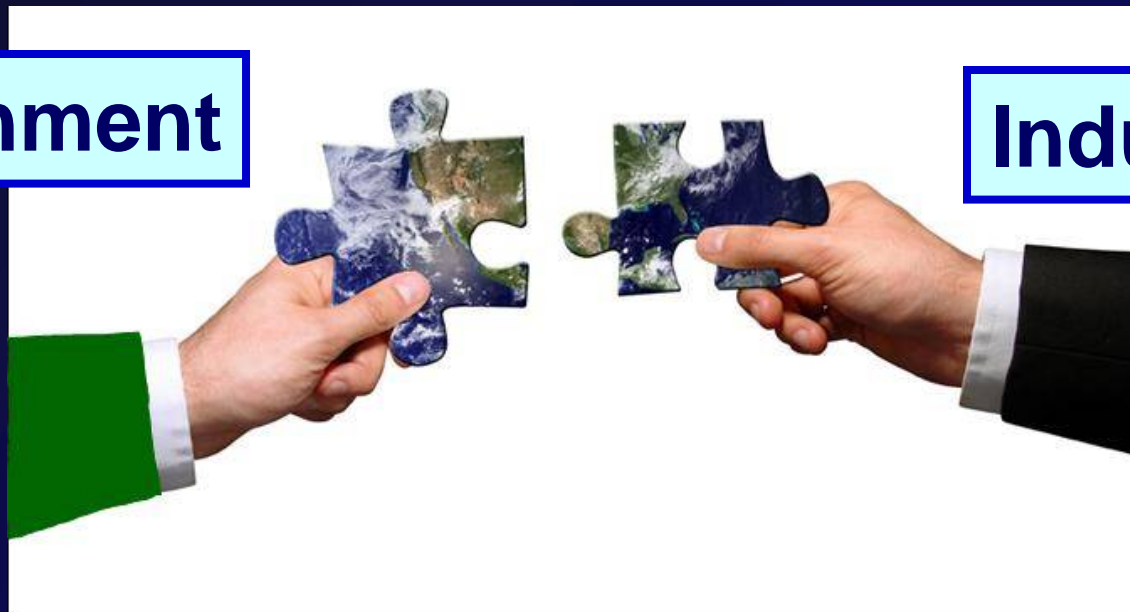
Biofuel R&D

Evaluating the business case for wood-based biofuel concepts serves government and Industry goals:

Government

Industry

**Agency
goals**

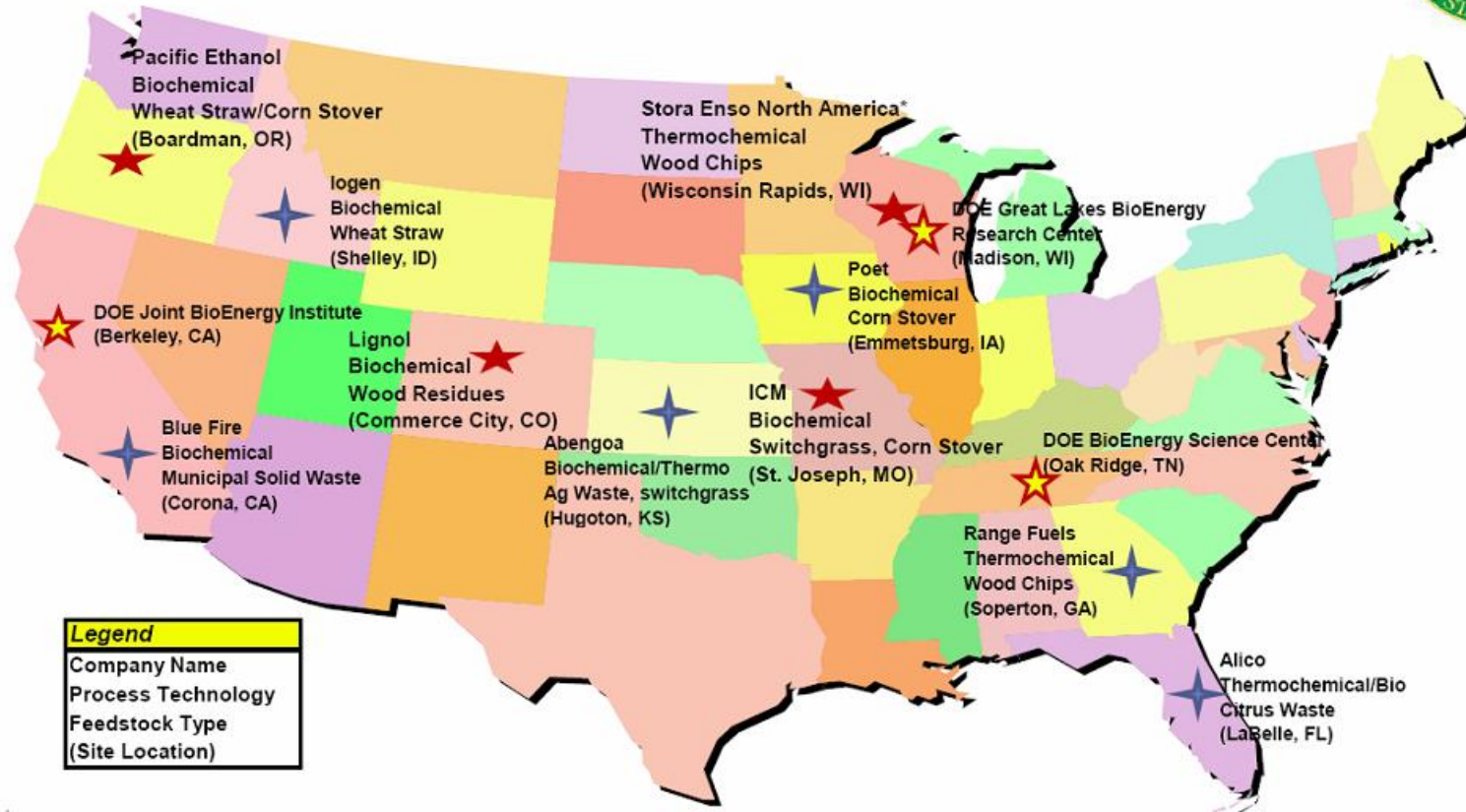


**Profit
goals**

Lignocellulosic biofuel projects are underway . . .

Major DOE Biofuels Project Locations

Geographic, feedstock and technology diversity



Legend	
Company Name	
Process Technology	
Feedstock Type	
Site Location	

- ★ Six Commercial-Scale Biorefinery Projects; DOE will invest up to \$385 million
- ★ Four Small-Scale Biorefinery Projects; DOE will invest up to \$114 million (first round)
- ★ Three Bio-Energy Centers; DOE will invest up to \$405 million

* Acquired by NewPage Corporation

FPL Approach:

Stage 1: *Model the Business Concept
(→ process & economic models)*

Stage 2: *Perform Risk Assessment
and Evaluate Risks & Returns*

Stage 3: *Focus FPL R&D on more
“Compelling” Business Case
(higher Risk/Return profile)*

Modeling a business concept typically involves these elements:

- Production Process Model
(steady-state, mass & energy balance)**
- Market Pricing Model (or data)**
- Investment Cash Flow Model**

Our cash flow models are based on the ChargeOut! Model (E. M. Bilek, 2007)

- Calculates after-tax expenses per unit of time or output
- Incorporates inflation and sensitivity analysis
- Flexible methodology, adaptable to various processes



United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory

General
Technical
Report
FPL-GTR-171



CHARGEOUT! Determining Machine and Capital Equipment Charge-Out Rates Using Discounted Cash-Flow Analysis

E.M. (Ted) Bilek



FPL Approach:

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Stochastic variability among production parameters or market variables (e.g. prices) is translated via stochastic simulation into an expected distribution of financial returns . . .



FPL Approach:

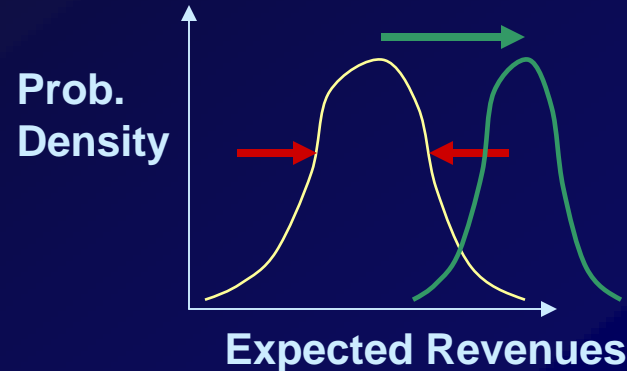
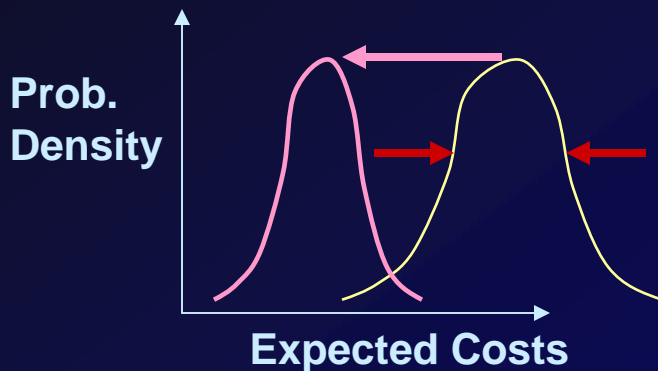
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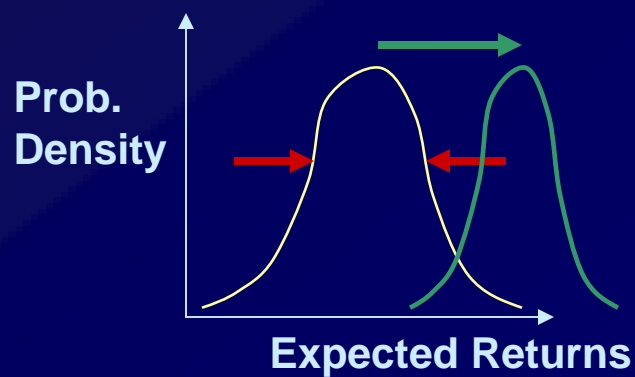
Focusing: R&D is focused on shifting costs or revenues, thus impacting expected returns:

R&D →
(new knowledge)



\$\$
Costs \$
Revenues \$

Cash Flow Model



**R&D focuses on “compelling business case”
= higher returns with greater certainty of returns**

Case Studies:

- (I) Biomass gasification and biofuel synthesis**

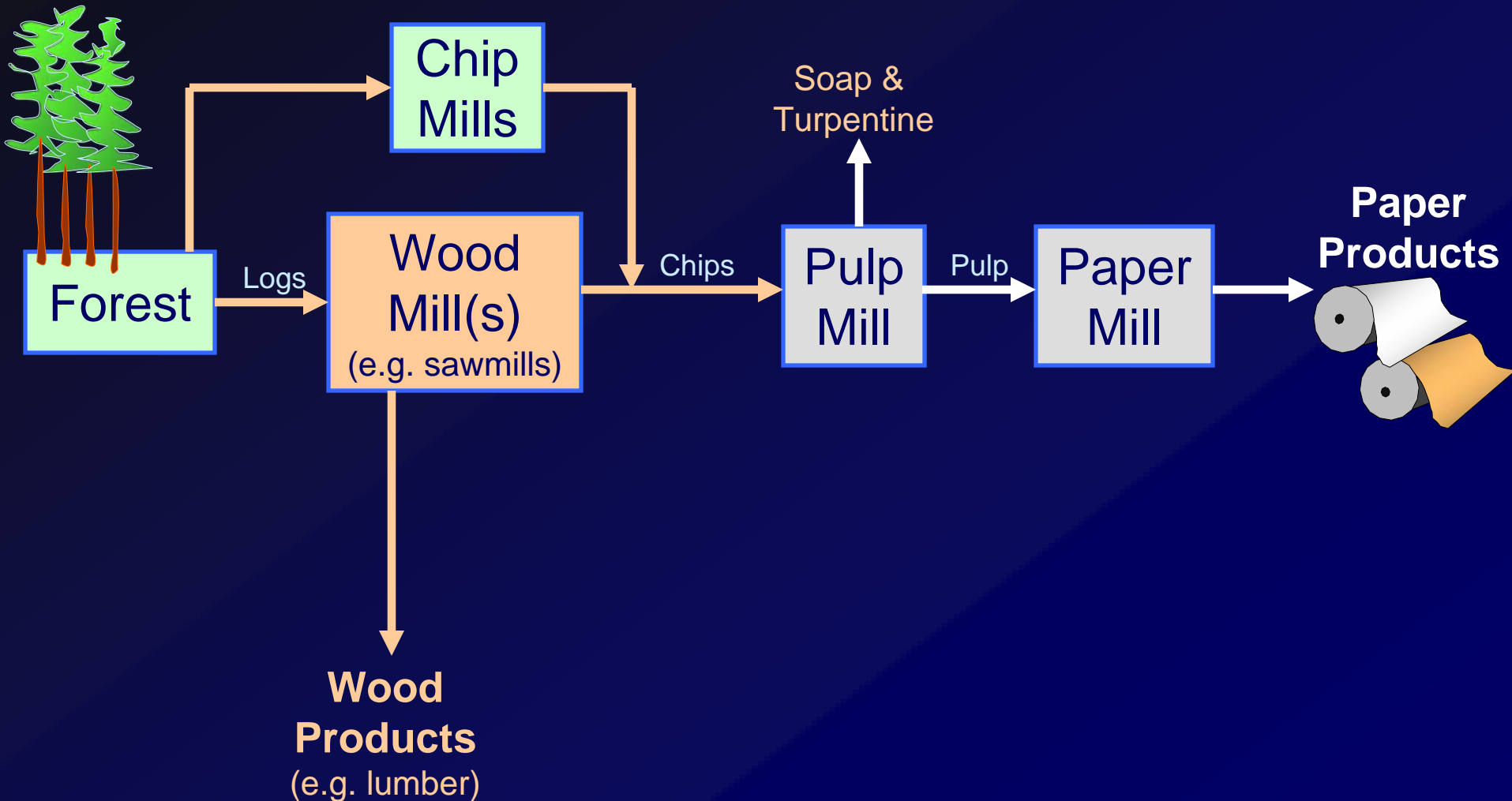
- (II) Value Prior to Pulping (VPP): hemicellulose extraction**

**(I) Biomass gasification and
biofuel synthesis**

**(II) Value Prior to Pulping (VPP):
hemicellulose extraction**

This study explores the business case for biofuel synthesis via biomass gasification at existing forest product mills . . .

Existing Forest Product Facilities (base case):



The generic business case involves wood biomass gasification (to syngas) and synthesis of FT liquid, with distillation to diesel and naphtha biofuels, and wax co-products . . .

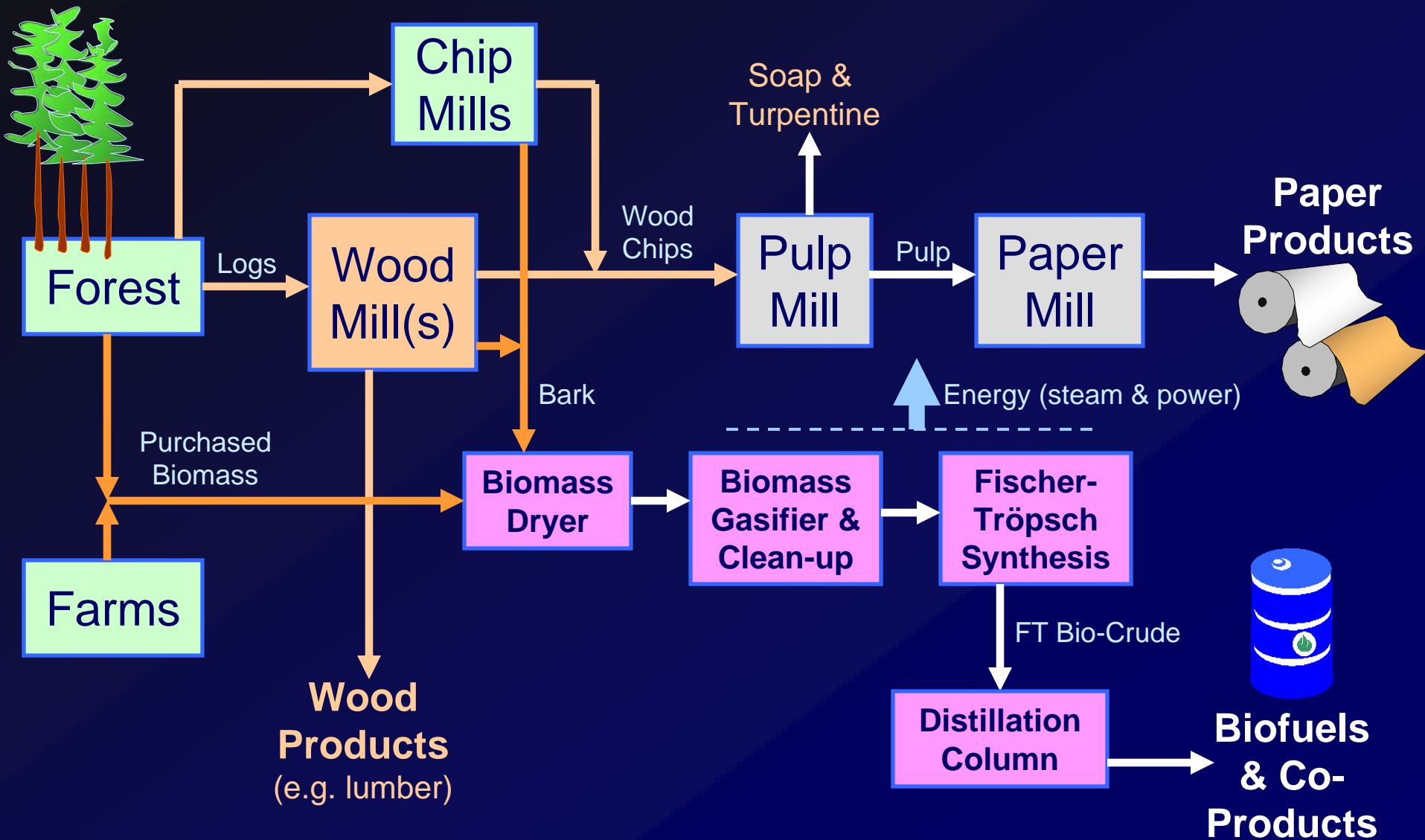
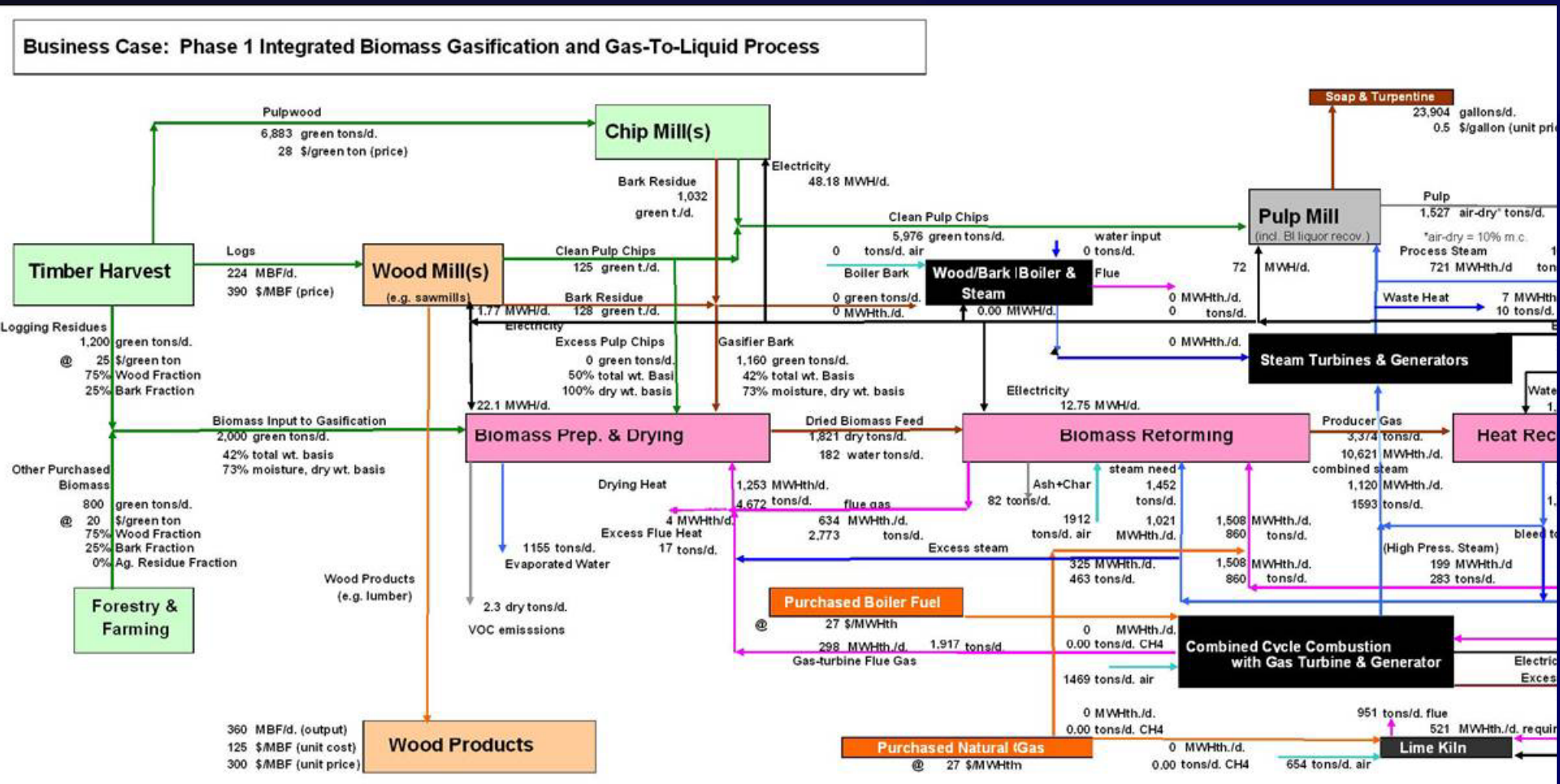


Photo of a biomass gasification unit (courtesy TRI, Inc.):



We are developing a generic spreadsheet model of this process, including quantitative mass and energy flows parameters . . .

(partial view of spreadsheet model)



Objectives of 1-Year Project – *Generic modeling of business case for investment in gasification of wood biomass with syngas-to-liquids:*

(sequential)

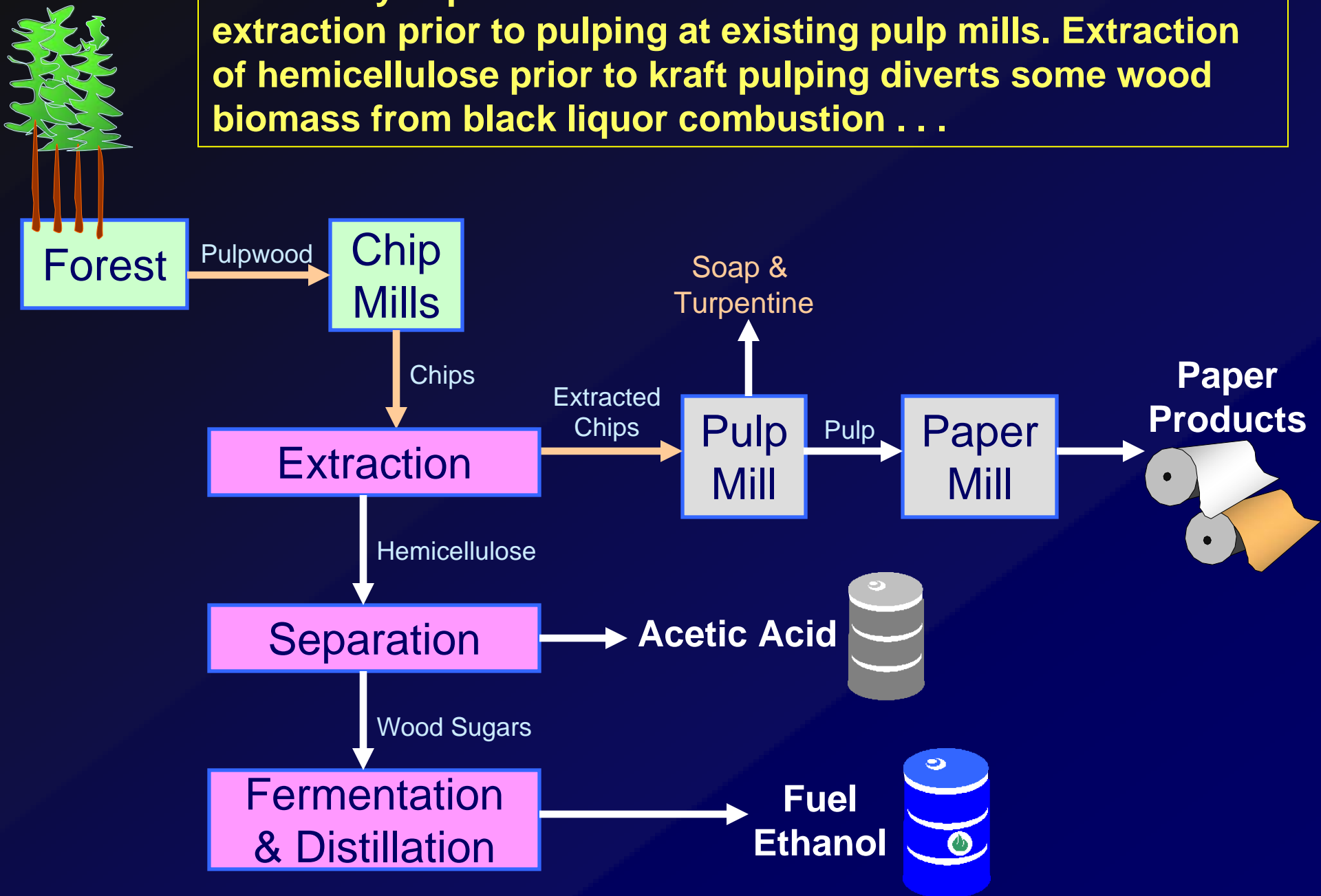
- ✓ Scope out generic business concept
- ✓ Construct generic process model
- ✓ Build generic cash flow (investment) model
 - Develop stochastic price analysis
 - Develop case study results using risk assessment
 - Obtain peer reviews of models and findings
 - Package models into generic business plan framework

✓ = objectives met; overall project to be completed in summer of 2008

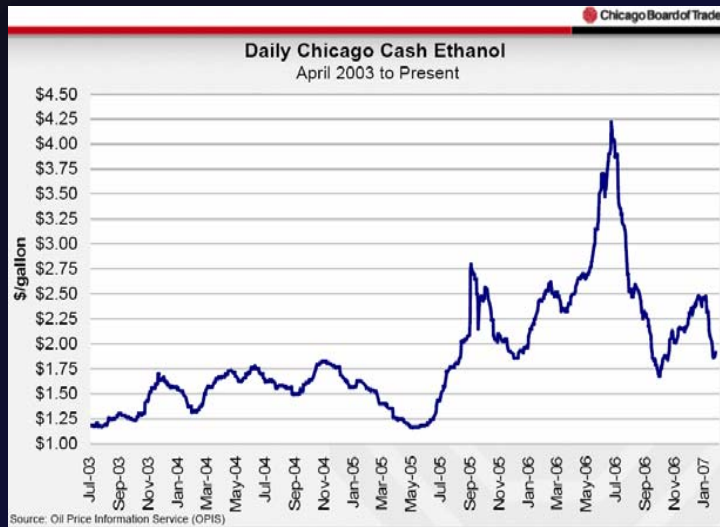
**(I) Biomass gasification and
GTL business concept**

**(II) Value Prior to Pulping (VPP):
hemicellulose extraction**

This study explores the business case for hemicellulose extraction prior to pulping at existing pulp mills. Extraction of hemicellulose prior to kraft pulping diverts some wood biomass from black liquor combustion . . .



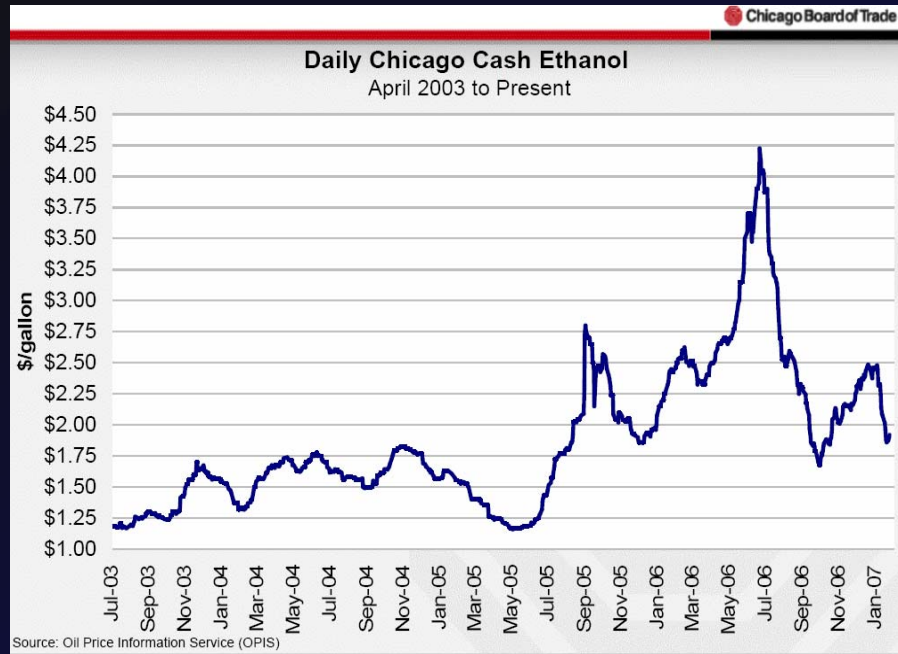
We modeled the VPP process and its financial performance.



Price volatility of fuel ethanol is a risk to this business case.

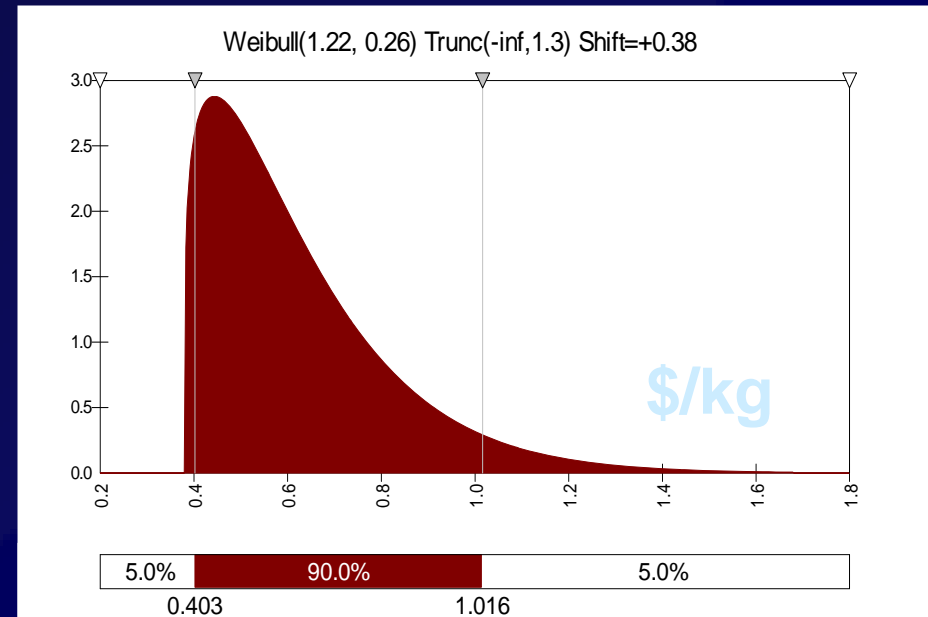
→ We apply risk assessment to evaluate impacts of price volatility . . .

Ethanol price variability is defined by historical variability in prices . . .

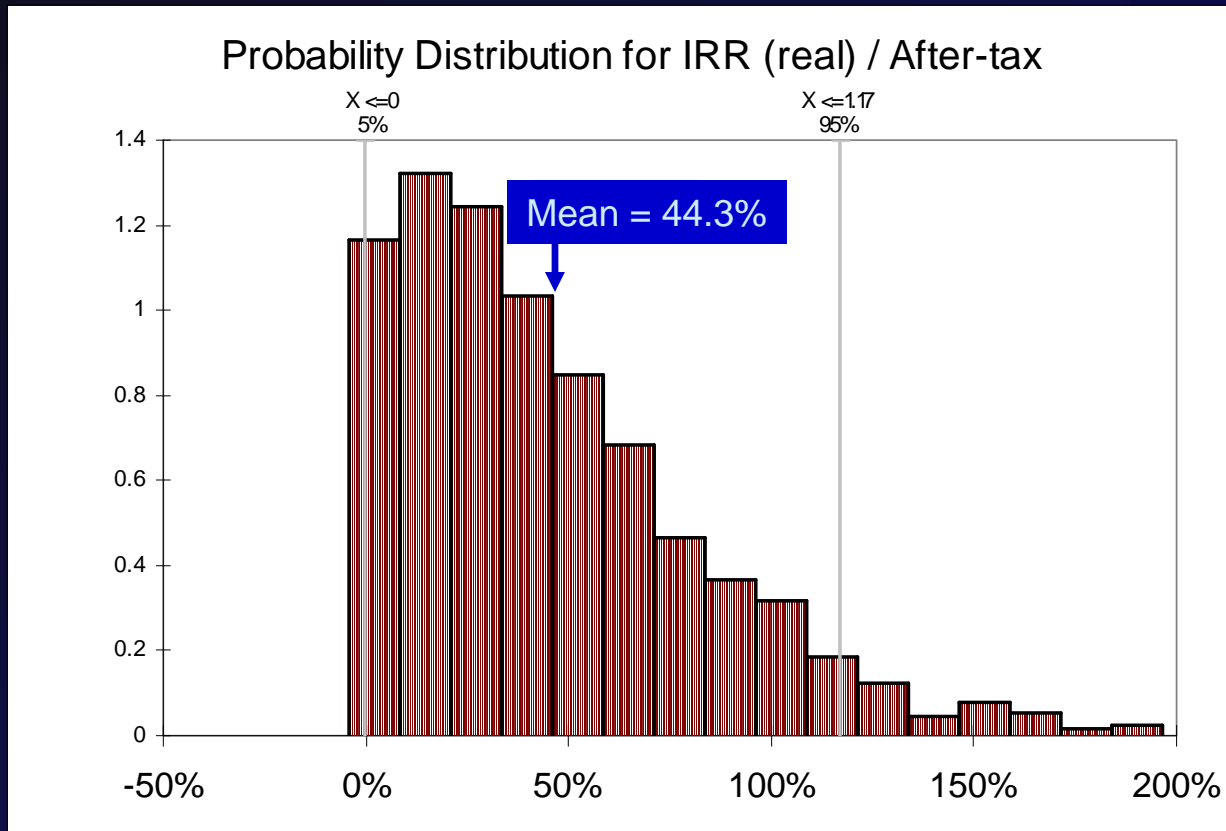


(Weibull distribution)

Historical ethanol prices (left) exhibit a distribution like the following . . .



Using the historical distribution of ethanol prices (2003-2007) we obtained the following preliminary results for the VPP business case . . .



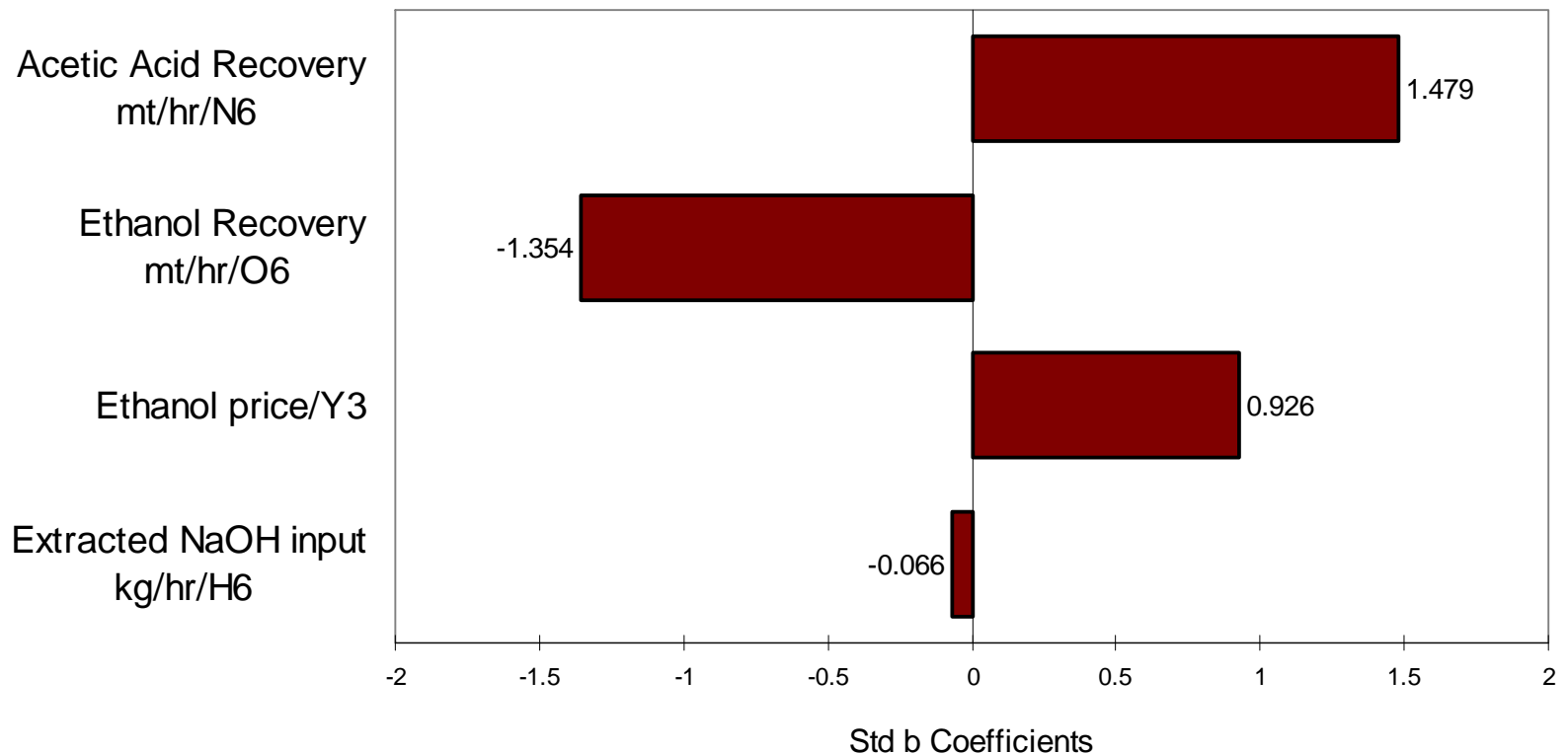
The expected internal rate of return (real after-tax IRR) is 44.3%, with only a small probability of financial loss.*

Business case for investment in VPP looks interesting despite ethanol price volatility.

*Assumes 60% equity financing, \$30 million capital investment (pulp capacity ~1,400 short tons/day)

Risk assessment also revealed which process variables have greatest influence on financial returns – e.g. acetic acid and ethanol yields. *This information can reveal how to focus R&D on developing a more compelling business case.*

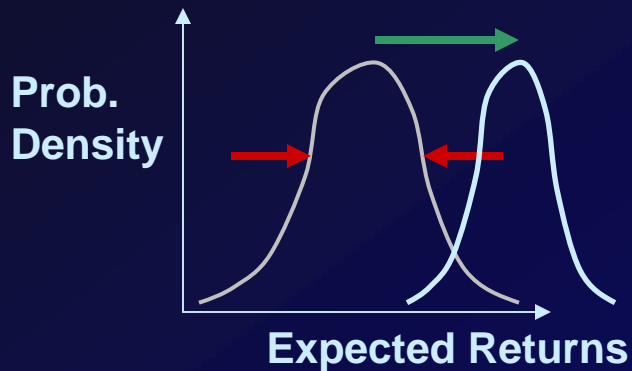
@RISK Regression Sensitivity for IRR (real) / After-tax



Summary:

- FPL focuses biofuel R&D on business cases
- FPL uses process, pricing, & cash flow models
- Result: R&D aims to develop more compelling business cases – higher returns & lower risks

Aiming for higher returns
with greater certainty . . .



- The public may become better informed about biofuel business cases, risks and opportunities