Techno-economic modeling & analysis in the bioeconomy

What is techno-economic modeling & analysis?

[Part 1 of 4]

LEE ENTERPRISES CONSULTING, INC.

- **Expertise** — World's largest bioeconomy consulting group - over 100 subject matter experts in all areas of the bioeconomy.
- **Approach** — Project interdisciplinary teams to meet exact needs of specific projects.
- **POC** — Handle projects with one agreement and single point of contact.
- **Cost Advantage** — Single POC = lower administrative costs = lower project cost.

The challenges of bringing renewable technologies to market.

Bringing a new technology to market is committing – it's expensive and it takes a long time.

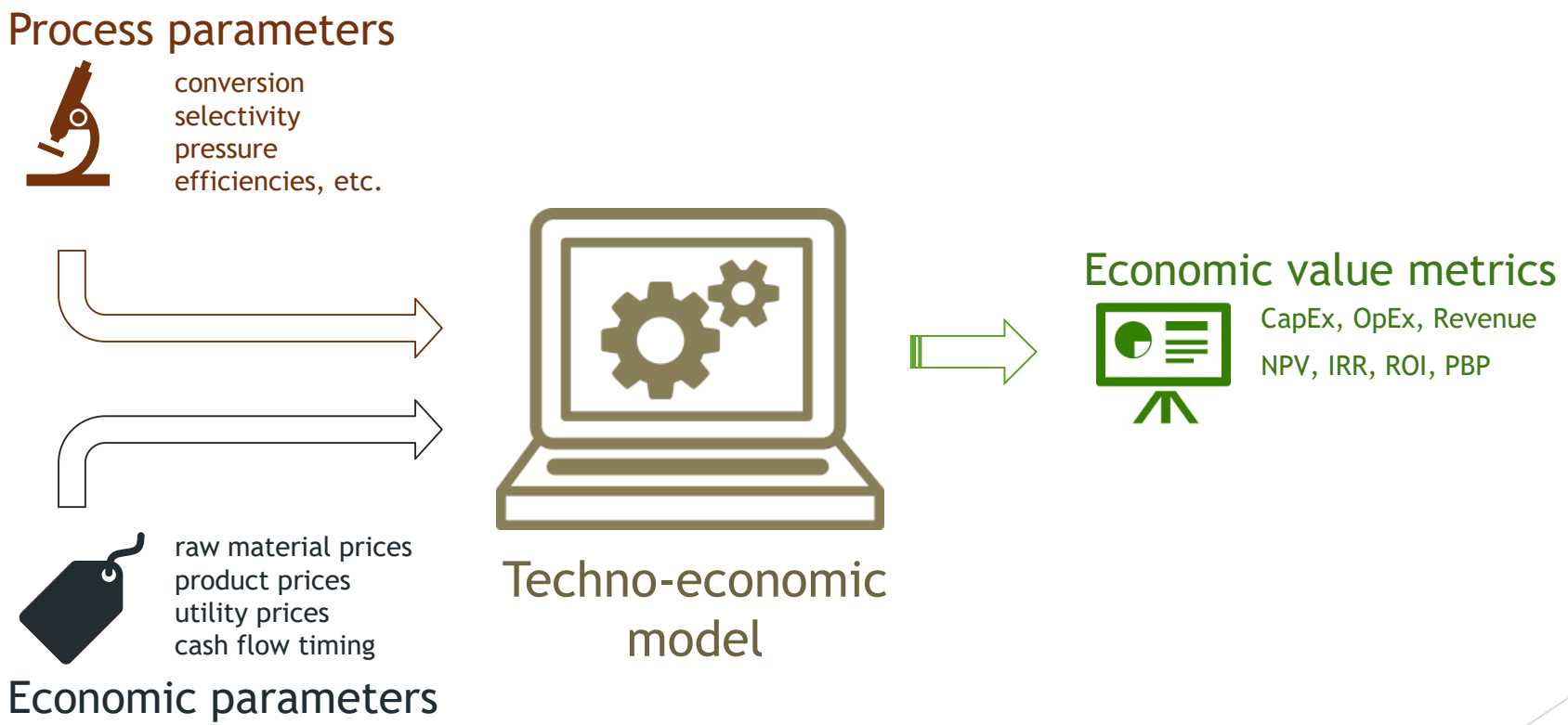
Uncertainty further complicates things. A technology's economic value often depends strongly on the unknown results of future research and development, and also on the variable prices of raw materials, utilities, labor, and products.

To make skillful decisions on the road to market, you need to understand the interactions of laboratory findings, engineering design, prices, capital costs, and operating costs.

In other words, you need a tool that can capture your best current understanding of a technology and translate it into economic value. This is the role of techno-economic modeling and analysis.

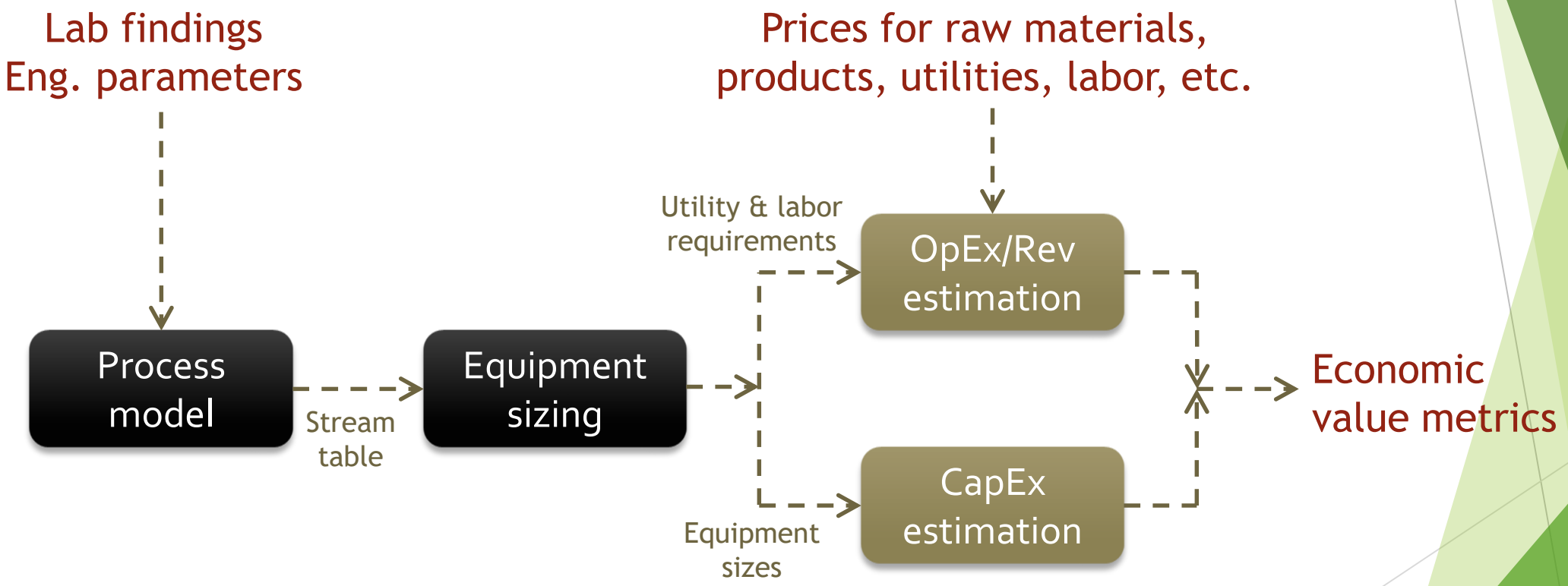
What is techno-economic modeling?

By linking process and market parameters with economic value, techno-economic modeling enables quantitative analysis and objective decision-making.



How it works.

Techno-economic modeling connects lab findings and engineering design to economic value metrics through a network of correlations.



Cost estimation methods and accuracy.

For techno-economic modeling, cost estimates need to be detailed enough to respond to changes in process parameters, yet abbreviated enough to be effectively automated.

For techno-economic modeling, cost estimates need to be detailed enough to respond to changes in process parameters, yet abbreviated enough to be effectively automated. These constraints typically lead practitioners to use a ‘factored’ approach for estimating capital and operating costs, with an expected accuracy in the range of +/- 30% to 40%.

Capital costs are one time expenses that typically occur at the beginning of a project, for things like equipment, construction labor, instruments, and engineering design. Major equipment costs are estimated from equipment sizes using either correlations from literature or by scaling from vendor quotes. Other capital costs are then extrapolated from these.

Operating costs are recurring expenses for things like raw materials, power, operations, supervision, and overhead. Some of these are estimated by applying prices directly to information from the stream table or equipment sizing. Others, like maintenance costs, are estimated from capital costs.

Platforms for techno-economic analysis.

Techno-economic modeling is typically performed using either a process simulator, like Aspen, or spreadsheet software, like Excel.

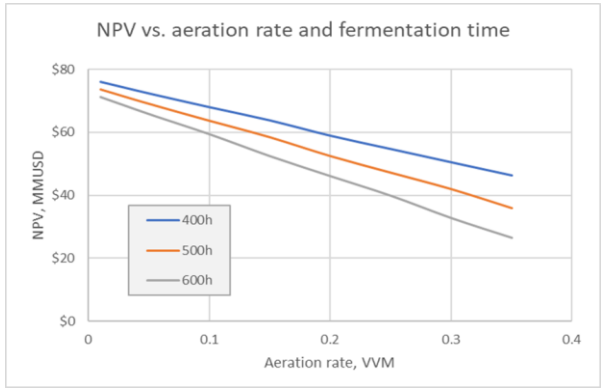
Process simulators are generally best for modeling well-defined processes. When used properly, they give accurate and detailed process results, and they can handle complex phase equilibria and complex material balances.

Spreadsheet software is standard toolkit in the science, engineering, and business communities. This makes them effectively free and enables sharing and communicating across disciplines and organizations. They also offer more flexibility for customization, which is useful for modeling early-stage technologies.

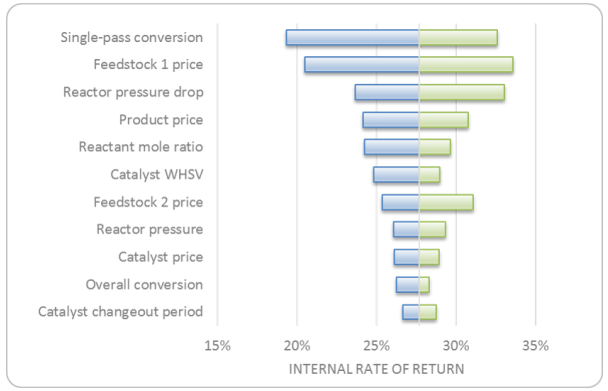
	Process simulation	Spreadsheet software
General considerations		
Accessibility & sharing		✓
Customization		✓
Transparency		✓
Cost		✓
Complex systems	✓	
Pre-configured algorithms	✓	
Process definition		
Early-stage design	✓	
Well-defined processes		✓

Using a techno-economic model.

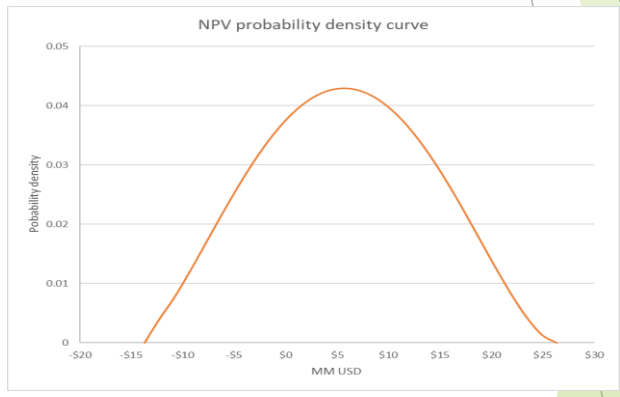
A techno-economic model is more than a one-off cost estimate. When combined with sensitivity analyses, like tornado diagrams and Monte Carlo analysis, it offers a window to understanding the key factors that drive the economic value of our technologies.



Process optimization

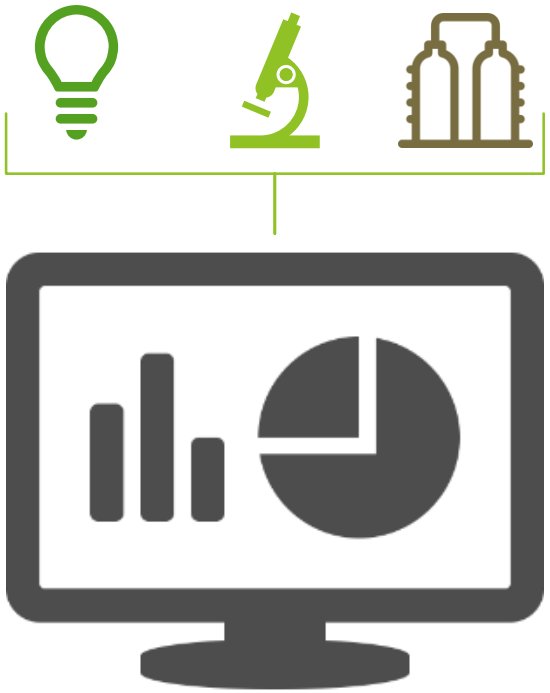


Prioritizing R&D



Mitigating risk

Coming up next in the series.



This is the first in a four-part series on techno-economic modeling for new technologies in the bioeconomy. The next installment will look at specific applications to technology investing.

Techno-economic modeling & analysis in the bioeconomy

1. What is techno-economic modeling and analysis?
2. Techno-economics for technology investors.
3. Techno-economics for technology developers.
4. Advantages of using a third party.

Chris Burk, PE
Professional bio

Accredited Member

LEE ENTERPRISES CONSULTING, INC.

Chris specializes in techno-economic analysis. He works with companies that are developing or investing in new chemical and bioprocess technologies, helping them use techno-economic modeling to better understand their economics at a commercial scale. His clients include venture capital firms, universities, national labs, independent startups, and startup incubators.

Prior to consulting, Chris spent twelve years in industry working in R&D, scale-up, and pilot plant EPC. He speaks and writes regularly on the importance and best practices of early-stage cost modeling.

He is a licensed Professional Engineer and he holds BS and MEng degrees in Chemical Engineering from Cornell University.

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