***CatCost*: Better Cost Information for Catalyst R&D**

NREL NATIONAL RENEWABLE ENERGY LABORATORY

Pacific Northwest NATIONAL LABORATORY

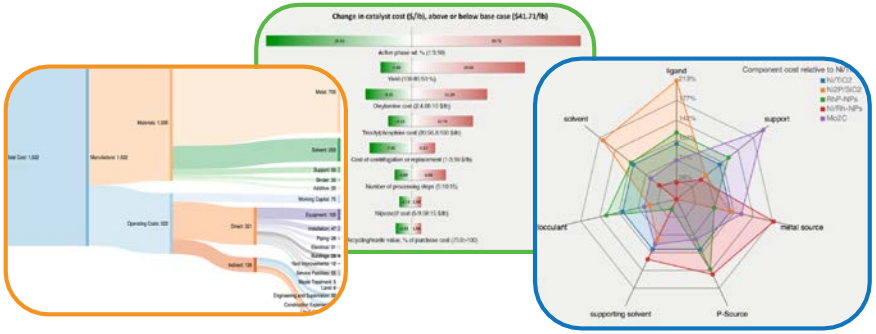
Developed at NREL and PNNL with guidance of industry experts

Problem: High commercialization risk

- Catalyst cost is a major contributor to commercialization risk for catalytic processes
- Up to 10% of capital cost and ±10% uncertainty in MFSP for biomass conversion
- ***No publicly available tools to evaluate cost***

Solution: "CatCost" Catalyst Cost Estimation Tool

- Enables early-stage comprehensive cost analysis
- No process design / TEA experience needed
- Improves cost-responsiveness of catalyst R&D

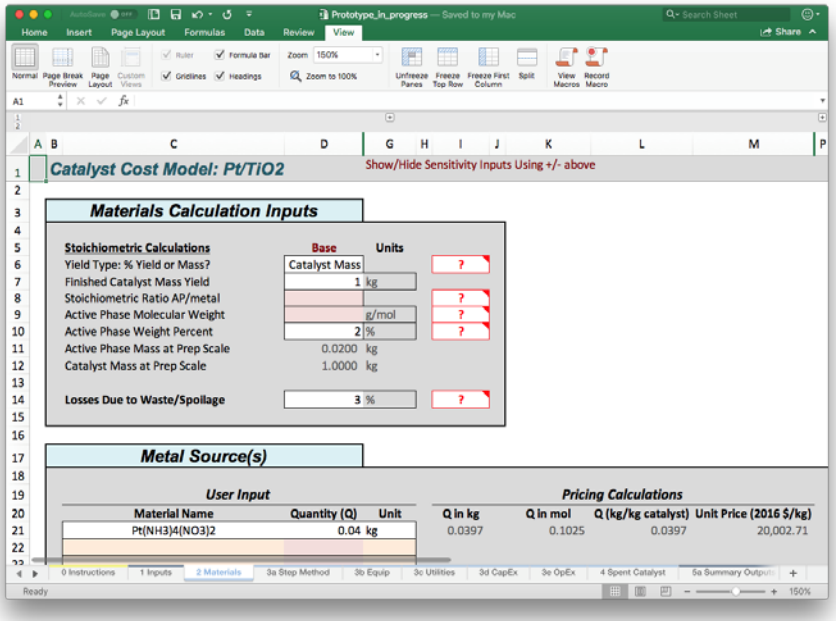


Free and public release

Fall 2018

catcost.chemcatbio.org

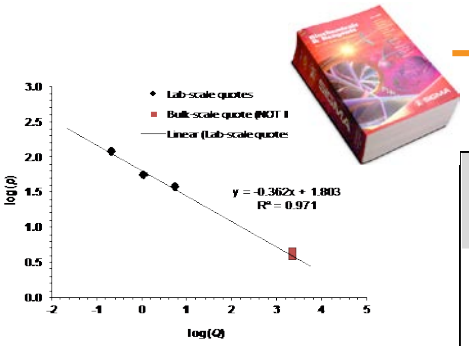
Excel- and web-based versions available



CatCost: Estimation Methods

1. Raw Materials Pricing

- Built-in library of common materials
- Guidance for obtaining quotes
- Extrapolation from lab-scale prices

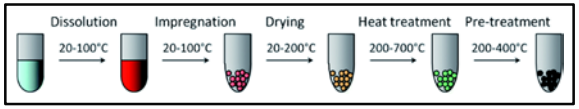


Quote Information (Inputs)

Quantity, *Q*	Units	Total Price, *P* ($)
100	g	25.72
500	g	60.20
2.5	kg	200.09

2. Detailed Process Templates for Common Catalyst Types

- E.g. metal/metal oxide, zeolite, MOFs, flow/batch nano, metal carbides
- Including equipment, labor, utilities, CapEx, OpEx (industry-standard methods)



3. A Simple "Step Method" to Supplement Process Templates

- All-in costs in $/hr for typical unit ops. (e.g. Belt Filter, Reactor, Spray Dryer)
- Quick addition of new catalyst types or steps to existing process templates

4. Complete Spent Catalyst Value

- Including precious metals recycling, catalyst attrition, landfill/disposal costs

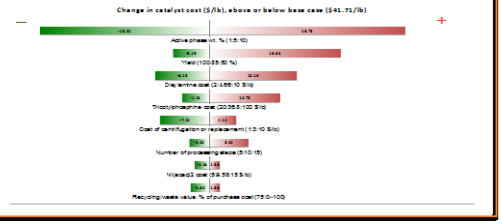
Metals Reclamation Calculations	Base	Units
Catalyst solids after use	0.98	kg/kg catalyst
Metal content in fresh catalyst	0.0200	kg/kg catalyst
Metal losses during use (typical)	10	%
Metal losses during refining (typical)	3	%
Recoverable metal	0.0175	kg/kg catalyst
Recoverable metal, troy ounces	0.5614	oz t/kg catalyst
Spot price	31,873.61	$/kg metal
Recoverable metal value	**556.51**	**$/kg catalyst**

Integrating the best methods in catalyst cost estimation into a powerful analysis tool

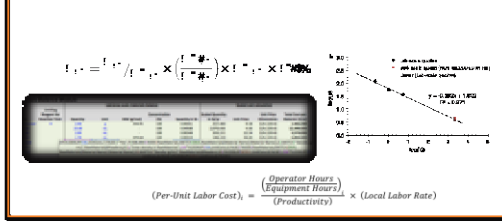
CatCost: A Convenient and Powerful Tool for Researchers

Flexible for a Variety of Uses

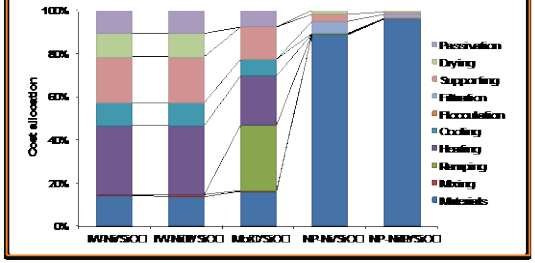
Cost Sensitivity Analysis
(assessing commercialization potential and risks)



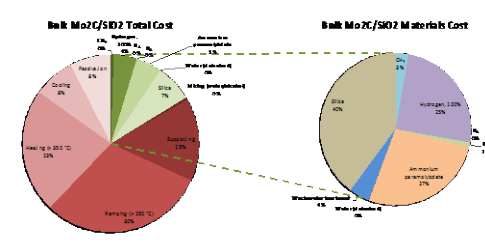
Cost Analysis Framework
(incorporation into TEA studies; LCA-compatible outputs, etc.)



Comparison of Multiple Catalysts
(purchasing, deployment testing)

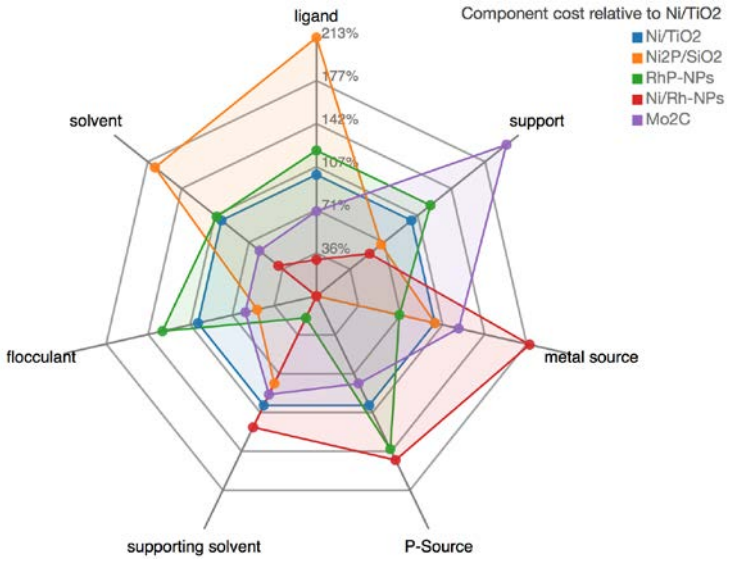


Component Cost Analysis
(directing R&D to areas of need)



Enabling better R&D decisions by providing catalyst researchers with actionable cost information

- Built-in, industry-vetted analysis features
- Extensively reviewed by industrial experts
- Powerful visualizations
- **Verified (± 20%) with market cost data for high-volume commercial catalysts**



***Free public* release in the fall of 2018 at**
catcost.chemcatbio.org

Contact the team at CatCost@nrel.gov

ChemCatBio
Chemical Catalysis for Bioenergy

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