



***Green Chemistry Case Studies:
Presidential Green Chemistry Challenge
Awards 2012 Winners***

Nicole Casasnovas
Hannah Needleman
July 2012





Case 1: Elevance Renewable Sciences, Inc.

Winner in the Small Business Category





Disclaimer:

Elevance recently filed a Form S-1 with the US Securities and Exchange Commission (SEC) which allows public companies to register their securities. In this pre-IPO period, there are restrictions on what Elevance can say to promote or market itself. Therefore, the information on Elevance in this report is limited.

Overview

Title: *Using Metathesis Catalysis to Produce High-Performing, Green Specialty Chemicals at Advantageous Costs*

Summary:

Elevance employs Nobel-prize-winning catalyst technology to break down natural oils and recombine the fragments into novel, high-performance green chemicals. These chemicals combine the benefits of both petrochemicals and biobased chemicals. The technology consumes significantly less energy and reduces greenhouse gas emissions by 50 percent compared to petrochemical technologies. Elevance is producing specialty chemicals for many uses, such as highly concentrated cold-water detergents that provide better cleaning with reduced energy costs.

Elevance Receiving EPA Presidential Green Chemistry Challenge Award



Motivation

Business Drivers

Why was it important to spend resources developing this technology?

- A number of challenges currently impact the specialty chemical industry, including the following:
 - *Demand for improved performance characteristics driven by evolving consumer preferences or changing regulatory requirements;*
 - *Limited availability of certain critical feedstocks and intermediate chemicals*
 - *Feedstock price level and volatility; and*
 - *Increasing demand for products made from non-toxic, environmentally friendly and renewable sources.*
- Elvance saw a demand for a technology that meets these needs

Motivation

Business Drivers (Continued)

Why was it important to spend resources developing this technology?

- Biorefinery is a key element of Elevance's business strategy
 - *Biorefinery allows Elevance to produce innovative high performance specialty chemicals that are the company's primary products.*
- Elevance strives to produce high-performance green chemicals through more efficient processes and at lower costs, especially when compared to petrochemical processes
- Markets adding up to \$176 billion for Elevance's green chemicals produced from renewable oils

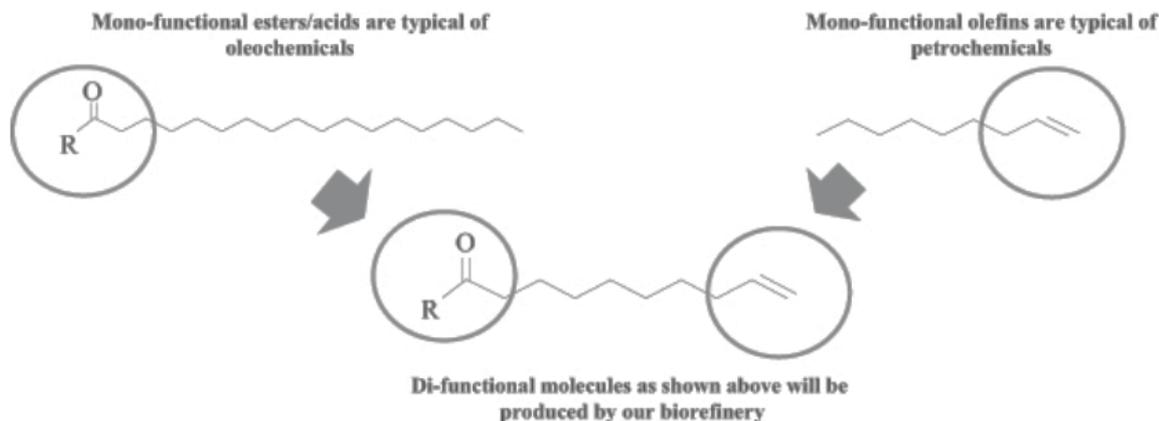
Motivation

Innovations in Science and Engineering

- Specialty chemicals are used in multiple products like novel surfactants, lubricants, additives, polymers, and engineered thermoplastics
- Industry customers need specialty chemicals with the functional attributes of multiple chemistry families to make their products
- Existing Technology
 - Conventional producers have developed manufacturing capabilities using either
 - Olefins and related derivatives (largely produced from petroleum), or
 - Esters and acids (often oleochemicals derived from natural oils)
 - To access these functional attributes simultaneously, producers have to blend and formulate a number of separate ingredients, which increases production costs
- **Can we do better?**

Technology Development

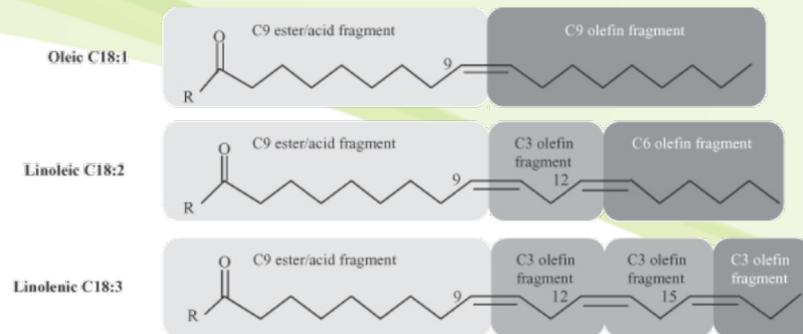
- Elevance's core technology is based on Nobel Prize-winning innovations in metathesis catalysis by Dr. Robert H. Grubbs, Dr. Yves Chauvin, and Dr. Richard Schrock
- **Metathesis catalysis** is a chemical reaction that uses a highly efficient and selective catalyst to break down and recombine molecules into new chemicals
 - Metathesis can break carbon-carbon double bonds
 - Desired fragments and new molecules are made by controlling reaction conditions
- Elevance uses metathesis to make novel, **difunctional molecules** which can be used as building blocks for the specialty chemical business



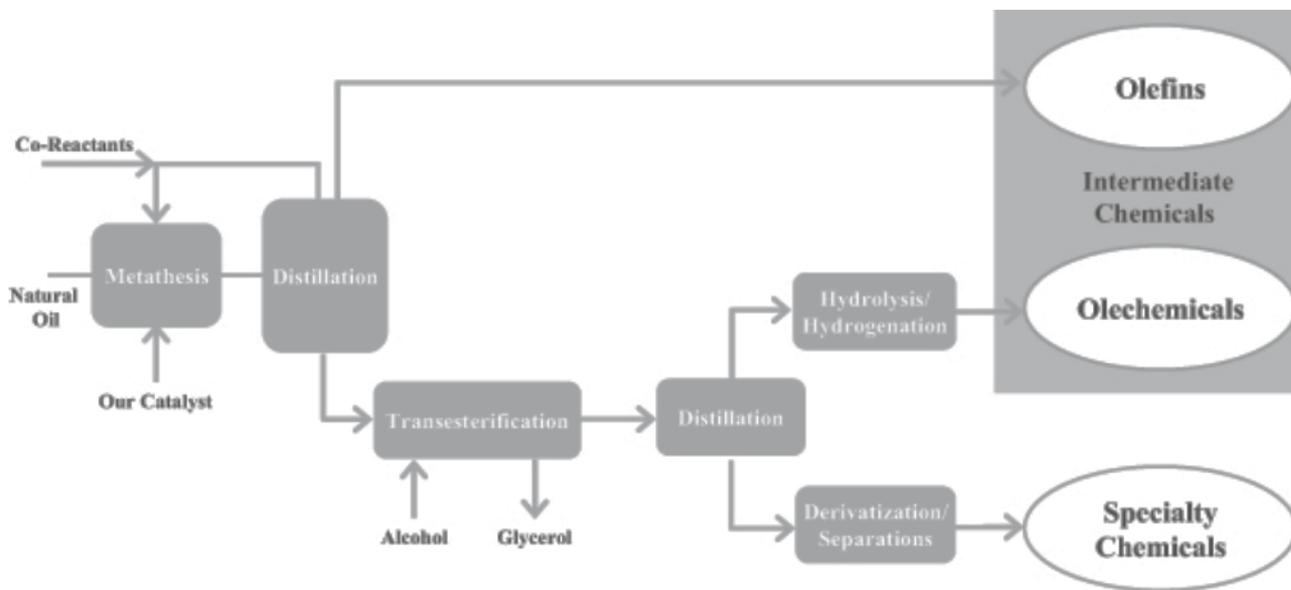
*Elevance's molecules combine the functional attributes of an **olefin** (typical of petrochemicals) and a **mono-functional ester or acid** (typical of oleochemicals) in a single molecule.*

Technology Development

- **Elevance's biorefinery** process combines metathesis of natural oils with established industrial processes to economically produce:
 - Specialty chemicals
 - Intermediates and molecule fragments



Common molecule fragments created from natural oils



Molecule fragments and intermediate chemicals are useful materials in industrial processes and present a large commercial opportunity.

Business Activities

- Elevance has about 125 employees and has generated almost \$400 million in annual revenues since 2007
- Elevance is the only company to date that can economically produce these chemicals, which provides access to a large market opportunity
- Collaborations with the US Department of Energy (DOE) and industry leaders
- Elevance has secured strategic collaborations with the following companies: Arkema, Cargill Inc., Clariant, Dow Corning Corporation, Stepan Company, Trent University, Tetramer Technologies, United Soybean Board, SaskCanola and Wilmar
 - *Other relationships are not currently public.*
- Committed to advancing partners' businesses with high-performing specialty products

Impact

Environmental, Health, and Safety Benefits

- Elevance's biorefinery process allows for lower energy requirements and reduced source pollutants due in part to:
 - Fewer major process steps
 - Lower operating temperatures and pressures providing energy efficiency
 - Limited production of hazardous and toxic by-products
 - GHG emissions are reduced by 50% when compared to petrochemical technology
- Competitive strengths include:
 - Flexibility in feedstock requirements given that a variety of natural oils found in multiple geographic regions can be used (e.g., palm, soy, rapeseed, algae oils)
 - Ability to integrate process into existing industrial sites
 - Low capital requirement and relatively short engineering/construction cycle

Impact

Economic Benefits

- Elevance's biorefinery results in lower production costs, energy consumption, and capital expenditures than petrochemical refineries
- **Elevance addresses a market of \$176 billion in the specialty chemicals industry**

Platform	Market Segment	Addressable Market Size
Consumer Ingredients & Intermediates	Detergents and cleaners	\$20 billion
	Personal care products	\$6 billion
	Performance waxes	\$5 billion
Lubricants & Additives	Lubricant base oils	\$17 billion
	Lubricant and fuel additives	\$12 billion
Engineered Polymers & Coatings	Specialty polyamides, polyesters, and polyols	\$25 billion
	Epoxies and polyurethanes	\$58 billion
	Coatings and cross linking agents for coatings	\$33 billion

- Consumer Impact Example: Detergents
 - Elevance's specialty chemicals enable detergents that have more concentrated formulations and improved solvency (better cleaning) while working in cold water (reduced energy costs)

Thank You!

- The following representative was integral in the creation of this report:
 - Rick Black, **Elevance Renewable Sciences, Inc.**