

# Green Chemistry Education Webinar Series

## The Value of Green Chemistry

October 23, 2013



# Today's Speakers

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Hewlett-Packard  
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Genentech  
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Safety



# **The Value of Green Chemistry to Business**

Helen Holder / Oct 2013

# Why is HP so interested in Green Chemistry?

## RoHS – the law that changed everything

EU Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment



Logo from companion regulation  
Waste Electrical and Electronic Equipment  
(WEEE) Directive

# Assessing Alternatives for RoHS Compliance

## “Traditional” Alternatives Assessment

Material selection based on:

- Cost
- Performance
- Reliability
- Manufacturability

All unregulated substances treated as equally acceptable.



1 July 2006

# Substance Regulations

Substance restrictions have become a major class of regulation for finished electronic products

- More substances
- More jurisdictions
- More reporting



# Business Case for Better Alternatives

## Replacing materials is expensive

- Want to select alternatives that won't be restricted in the future
- Avoid unintended consequences

## Common sense

- If you go through the trouble of getting rid of a substance because of environment or human health impacts, you should make sure the replacements have lower impact.



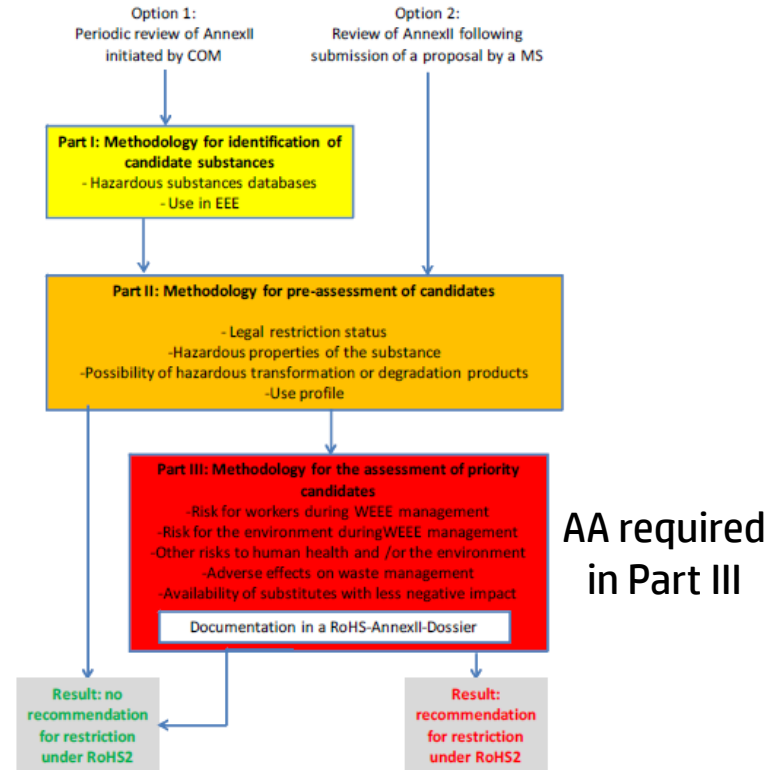
# Regulators Catching On

Jurisdictions requiring assessing alternatives to restricted substances:

- EU (ROHS 2 Methodology)
- California
  - Washington
  - Maine

Building expertise in AA:

- EPA DfE
- EU JRC/DG Env
- Washington Ecology
- California DTSC



From proposed methodology for ROHS 2, as described in the *Study for the Review of the List of Restricted Substances under RoHS2*





# What do these trends mean for Green Chemistry?

➤ **Chemicals get restricted**

➤ **Companies choose lower impact alternatives as part of a risk mitigation strategy**

➤ **Green Chemistry becomes a business opportunity for suppliers**

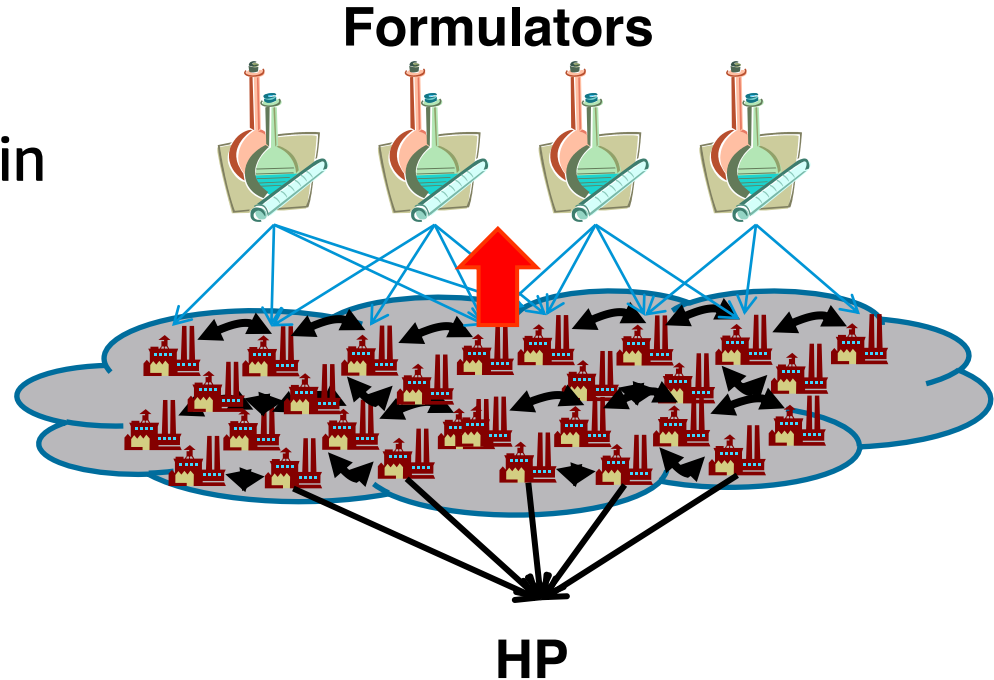
# Articulating Materials Goals

**If we don't articulate environmental requirements to suppliers, we won't get better materials**



# Engaging with Formulators

- Engage directly with formulators far up supply chain
- Give a range of feedback, in addition to cost
- Successfully used with other materials criteria (not just environment)



# Influencing What's on the Menu

- Introduce Green Chemistry tools and metrics to formulators
- Create white lists and procurement guidance
- Encourage design of green materials from the beginning
  - Reduces cost adders
  - Reduces multiple substitutions

Green Screen Assessments of Similar Function Chemical		
Common Name	CAS #	Full Name
<b>Preferred</b>		
Design	none	Design material out, dematerialize
Substance 0	#####-##-#	Chemical name
<b>Use but still opportunity for improvement</b>		
Substance 1	#####-##-#	Chemical name
Substance 2	#####-##-#	Chemical name
<b>Use but search for alternatives</b>		
Substance 3	#####-##-#	Chemical name
Substance 4	#####-##-#	Chemical name
Substance 5	#####-##-#	Chemical name
Substance 6	#####-##-#	Chemical name
<b>DO NOT USE</b>		
Substance 7	#####-##-#	Chemical name
Substance 8	#####-##-#	Chemical name
Substance 9	#####-##-#	Chemical name
Substance 10	#####-##-#	Chemical name
Substance 11	#####-##-#	Chemical name
Substance 12	#####-##-#	Chemical name



# Suppliers Will Need to Do More

- Chemical producers and EMS companies may have additional operations goals and constraints
  - EH&S of manufacturing process
  - Energy/carbon of processes and transport
  - Water use
  - Raw material sourcing
- **TREND:** Expect more reporting of carbon, water, material sourcing, process chemicals, and waste/emissions







**Genentech**

*A Member of the Roche Group*

# Green BioPharma @Genentech

Tse-Sung Wu, PhD

October 2013

[tsesung@gene.com](mailto:tsesung@gene.com)

- Genentech Backgrounder
- Definition of Green BioPharma
- Green Chemistry at Genentech
- Organizational Change Model
- Highlights of Accomplishments to Date
- Roadmap



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## Backgrounder

Since 2009, Genentech fully owned by Roche, 80,000 EE worldwide  
 Genentech South San Francisco (15,000 EEs)

- US Roche HQ, R&D, process development, mfg, sales/mktg
- Global clinical development

Strong mission-oriented corporate culture, driven by science, innovation and patients

Consistently on Fortune's "Great Place to Work" list

Oncology, immunology, metabolism; new: neuroscience, infectious diseases

Roche Group commitment to stay on DJSI (top 3 among health care)

1500 Green Genes Team members in SSF

FDA approval



Genentech Backgrounder

- Definition of Green BioPharma

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Highlights of Accomplishments to Date

Roadmap

## Definition and Vision

### Definition

Green BioPharma is the design, development, and implementation of biological and chemical products and processes that reduce or eliminate our impact on human health and the environment.



### Vision

With the incorporation of Green BioPharma:

- Customers, business partners, and the community regard Genentech as a leader in efforts that **reduce its ecological footprint resulting from its core competencies**.
- Employees continuously **innovate**, evaluate, and implement ways to reduce the environmental impact of their decisions and operations.
- Wherever possible, the result of green innovations are **quantified**.

*Green BioPharma forges the bridge between patients, people and the environment.*

Genentech Backgrounder

Definition of Green BioPharma

- **Green Chemistry at Genentech**

Organizational Change Model

Highlights of Accomplishments to Date

Roadmap

# Green Chemistry @Genentech: a short timeline

## ~2009

- Roche Technical Working Group on Green Chemistry established
  - 1-2 Genentech process chemists involved
  - sponsors lectures and annual process chemistry contest
  - limited exposure to rest of company
  - no organizational structures

## Fall 2011

- Green Genes "lunch 'n' learn" talks by Green Chemistry scientists at Berkeley
  - Great response from employees
  - Green Genes subteam
- Launched the Green BioPharma Program
  - Established Green BioPharma Steering Committee, as part of Sustainability Council

## 2012

- Steering Committee endorsed 2012 goals and projects
- Green Genes Subteam is ~~28-90~~ 130 volunteers
- Obtained VP support in key department

## 2013

- Published a video on this effort
- Formalized the role of Green BioPharma Project Manager

Genentech Backgrounder

Definition of Green BioPharma

Green Chemistry at Genentech

- **Organizational Change Model**

Highlights of Accomplishments to Date

Roadmap

# Organizational Change Model

## 1 Operationalize environmental values into action:

Help define what it is to be greener in one's work

## 2 Presented as opportunities for innovation

Diffuse changes within your target audience

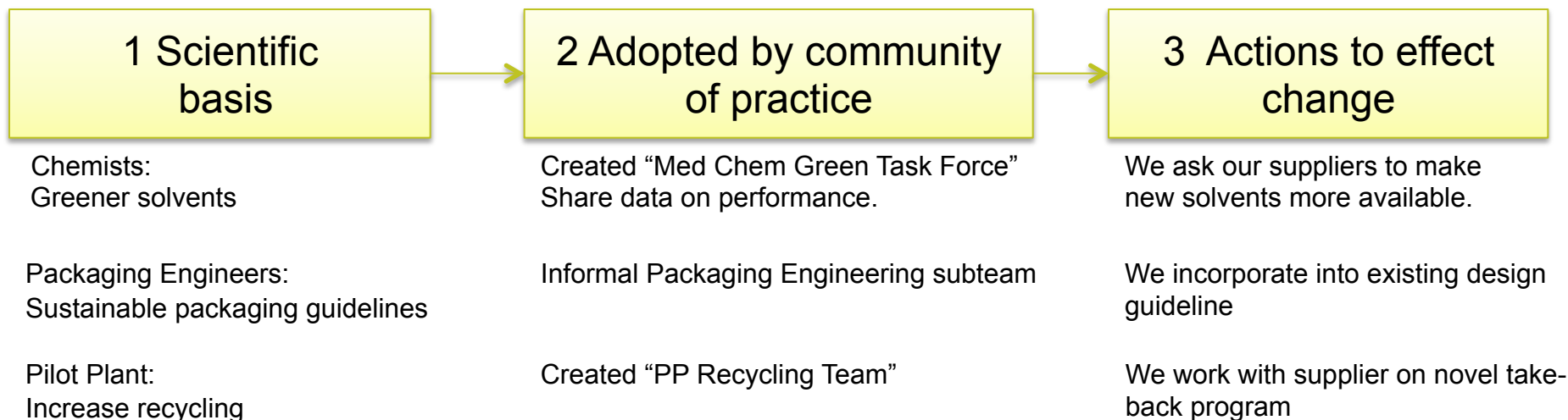
## 3 Behavioral changes lead to influencing decision-making

Pick low-hanging fruit

Ensure all efforts are rational, scientific, scalable.

•••

Changes must be at parity if not superior to existing processes/products.





Genentech Backgrounder

Definition of Green BioPharma

Green Chemistry at Genentech

Organizational Change Model

- **Highlights of Accomplishments to Date**

Roadmap

## Internal

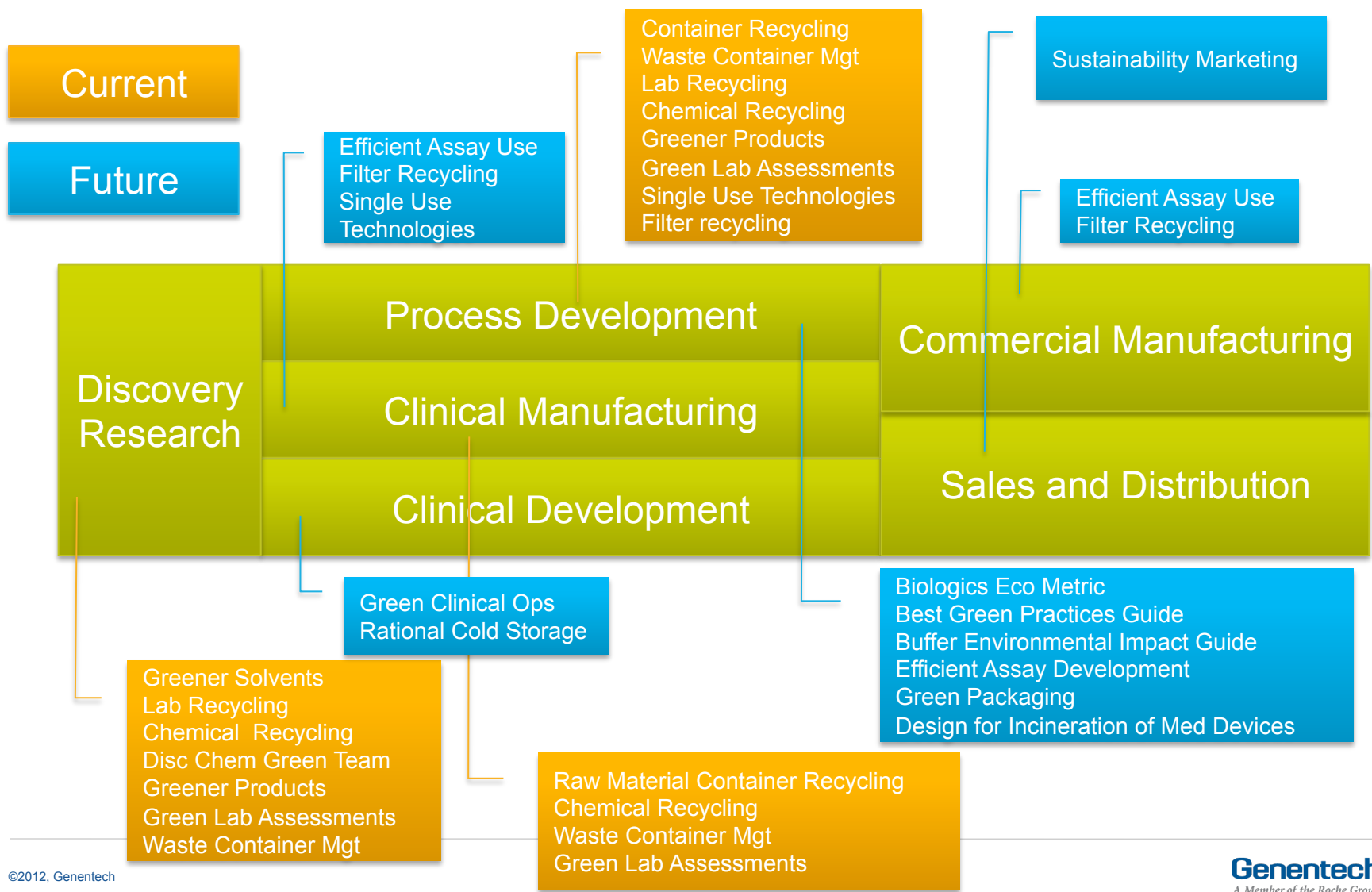
- Steering Committee empaneled and meeting monthly
- 11 of 12 goals completed in 2012; 2013 goals are on-track
- Green BioPharma Project Mgr role made permanent
- Program documentation

## External

- Discovery Chemistry Green Team established
  - driving green solvent substitution
  - entirely staffed and led by Disc Chemistry employees
  - has VP approval
- Surplus Chemical Recycling Program piloted & improving
- Performed 10 Green Lab Assessments
  - building a network of peer resources to demonstrate and share best green practices in labs
- Container recycling/diversion, saving \$10,000s in supplies and waste costs.
- Industry collaboration to develop Green BioPharma tools
  - BioPharma Focus Group of the Pharmaceutical Roundtable of the ACS Green Chemistry Institute

- Genentech Backgrounder
- Definition of Green BioPharma
- Green Chemistry at Genentech
- Organizational Change Model
- Strategic Focus Areas and Success Factors
- Highlights of Accomplishments to Date
- Roadmap

# Greening Genentech's core competences: a roadmap



# Acknowledgements

## Genentech EHS

Bruce Maeda, Director  
Jon Kawamoto, Sr Mgr, Environmental Group

## GB Steering Committee

Tina Larson, Sr. Dir, Process Dev (Executive Sponsor)  
Ekta Mahajan, Sr. Engineer, Process Dev Engineering  
Debbie O'Connor, Sr. Mgr, Pilot Plant  
Asha Radhamohan, Engineer, Process Dev

Jacob Corn, Scientist, Early Development Biochemistry Research  
Stefan Koenig\*, Scientist, Small Molecule Process Chemistry Research

Joe Jerkins, Sr. Mgr, Quality Systems, Production  
Srinavyana Vutukuru, Engineer, Manuf Sci & Tech

Tse-Sung Wu, EHS (Team Lead)  
Kristi Budzinski, EHS (GB Project Mgr)

\*Chair of the Roche-Genentech Green Chemistry Technical Working Group

Process Dev

Research

Manufacturing

**Bruce Roth, VP Discovery Chemistry**

**Many Green Genes volunteers and emerging leaders**



## Better Chemistry Video Clip (3:35)

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[http://www.youtube.com/watch?v=R2\\_0i-6nyQ0](http://www.youtube.com/watch?v=R2_0i-6nyQ0)

(search for “genentech better chemistry”)



# Genentech

*A Member of the Roche Group*



# GC3 Green Chemistry Education Webinar

Andy Shafer

October 23, 2013



# Elevance Renewable Sciences

## Who We Are

Elevance Renewable Sciences is a leader in the chemical conversion of renewable feedstock into a wide range of both traditional and novel specialty chemicals

## What We Do

Elevance produces a wide range of specialty chemicals from renewable oils using proprietary, olefin metathesis technology

## Key Stats

Employees: ~150

Founded: 2007

Headquarters: Woodridge, IL



## Beginnings...



Source: Rose Walker LLC

## The Challenges ...

- Delivering competitive and novel performance
- Cost competitiveness
- Efficient manufacturing
- Feedstocks and supply chain
- Access to markets & customers
- Regulatory requirements

# The impact is just emerging and is affecting several major markets

	<u>Market Size</u> Sales, USD	<u>Bio-based products</u> Current examples	<u>Key drivers</u>
<b>Fuel</b>	~ \$500 billion	<ul style="list-style-type: none"> <li>• Ethanol</li> <li>• Biodiesel</li> <li>• Advanced Biofuels</li> </ul>	<ul style="list-style-type: none"> <li>• Downstream customer requirements</li> <li>• Technology breakthroughs</li> <li>• New bio-based building blocks</li> <li>• Regulatory push</li> <li>• Recognized need for innovation</li> <li>• Major private investments</li> </ul>
<b>Polymers and petrochemicals</b>	~ \$500 billion	<ul style="list-style-type: none"> <li>• PLA, PHA, Sorona</li> <li>• Glycols</li> <li>• Ethylene</li> <li>• Acrylic acid</li> </ul>	
<b>Specialty chemicals</b>	~ \$300 billion	<ul style="list-style-type: none"> <li>• Surfactants</li> <li>• Lubricants</li> <li>• Detergents &amp; Cleaners</li> <li>• Flavors, fragrances</li> <li>• Ag &amp; Oil Field Chemicals</li> </ul>	
<b>Fine chemicals</b>	~ \$100 billion	<ul style="list-style-type: none"> <li>• Pharma intermediates</li> <li>• Amino acids</li> <li>• Vitamins</li> <li>• Citric acid</li> </ul>	

Source: McKinsey, SRI, press clipping, company publications

**Potential for major discontinuities**

# Benefits of the Bio-based Products

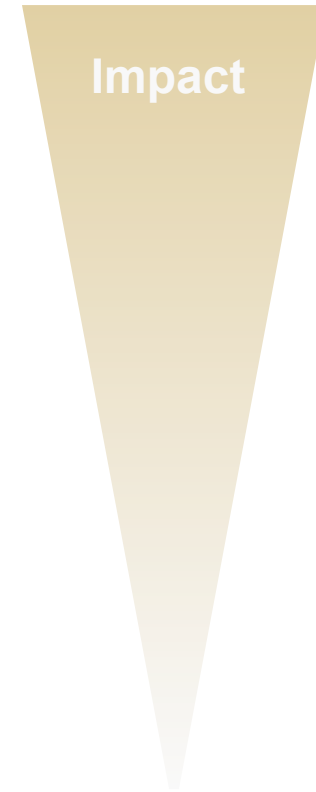
Better products for consumers

More economical for industry and consumers

More dependable, renewable and lower-cost feedstocks

Smaller environmental footprint:

- More environmentally friendly products/processes

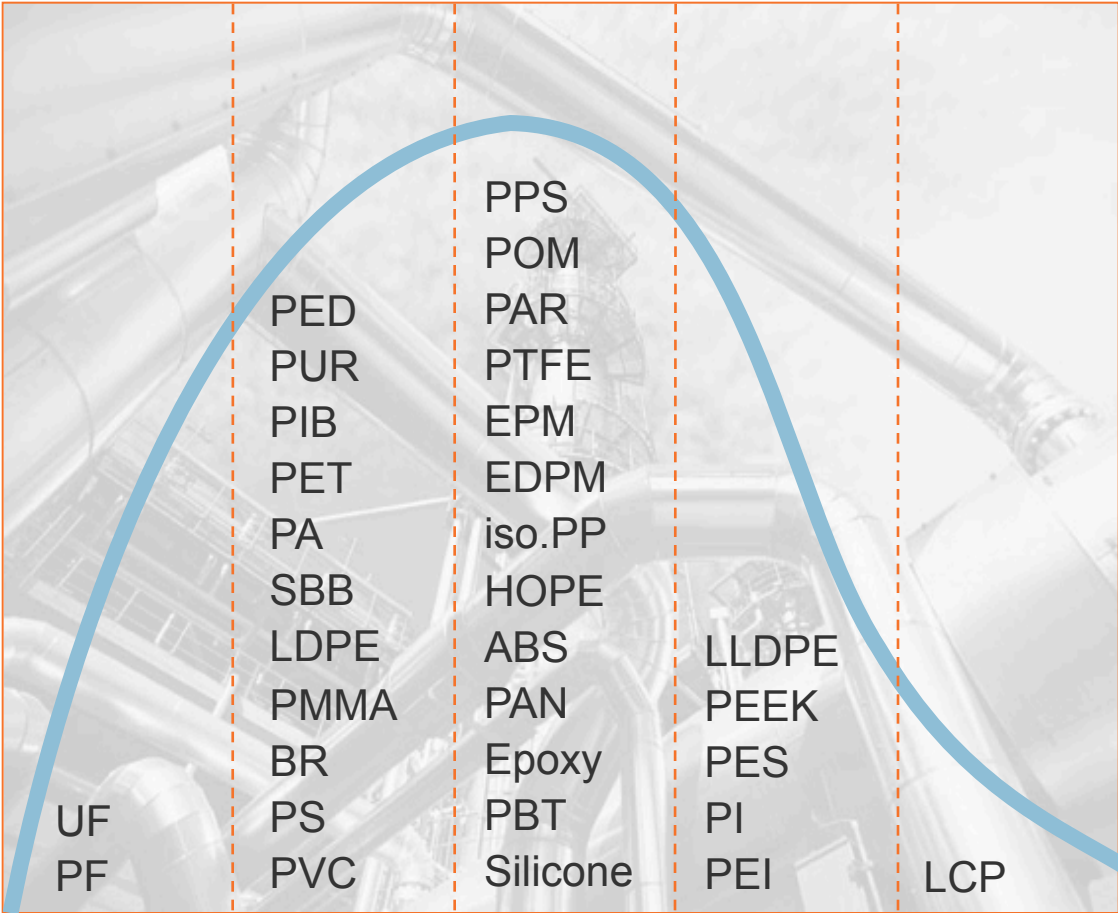


# The innovation potential of fossil building blocks appears largely exploited



- Ethylene
- Propylene
- Butadiene
- Benzene
- Toluene
- Xylene
- Methanol

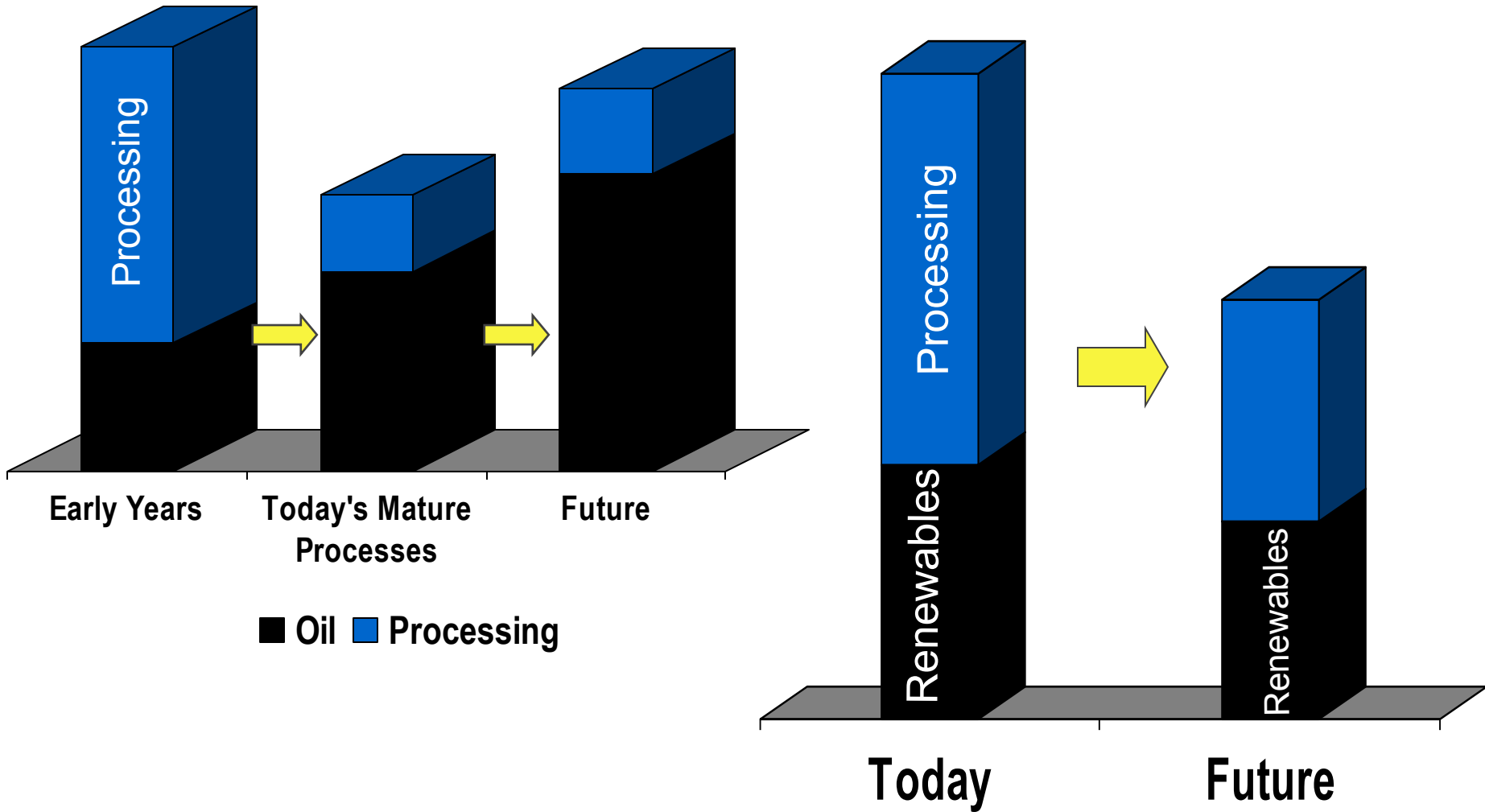
**Polymer innovation based on fossil building blocks**



1900                      1920                      1940                      1960                      1980                      2000

Slide courtesy of McKinsey

# Impact of Raw Material & Processing Costs



# Elevance Products address critical customer needs

## Detergents & Cleaners

- ✓ Improved cold water performance
- ✓ Alternative feedstock with pricing/supply dynamics



## Personal Care Products

- ✓ Anti-frizz and shine for leave-in hair care
- ✓ Moisturizing benefits & smoother feel for skin care



## Performance Waxes

- ✓ Thermal stability
- ✓ Increased fragrance loading



## Lubricant Base Oils

- ✓ Reduction in formulation costs
- ✓ Improved fuel economy



## Lubricant Additives

- ✓ Improved lubricity
- ✓ Enhanced cold flow properties



## Engineered Polymers & Coatings

- ✓ Feedstock and monomers that enable existing & new polymers
- ✓ Advancing product portfolios via performance and/or sustainability



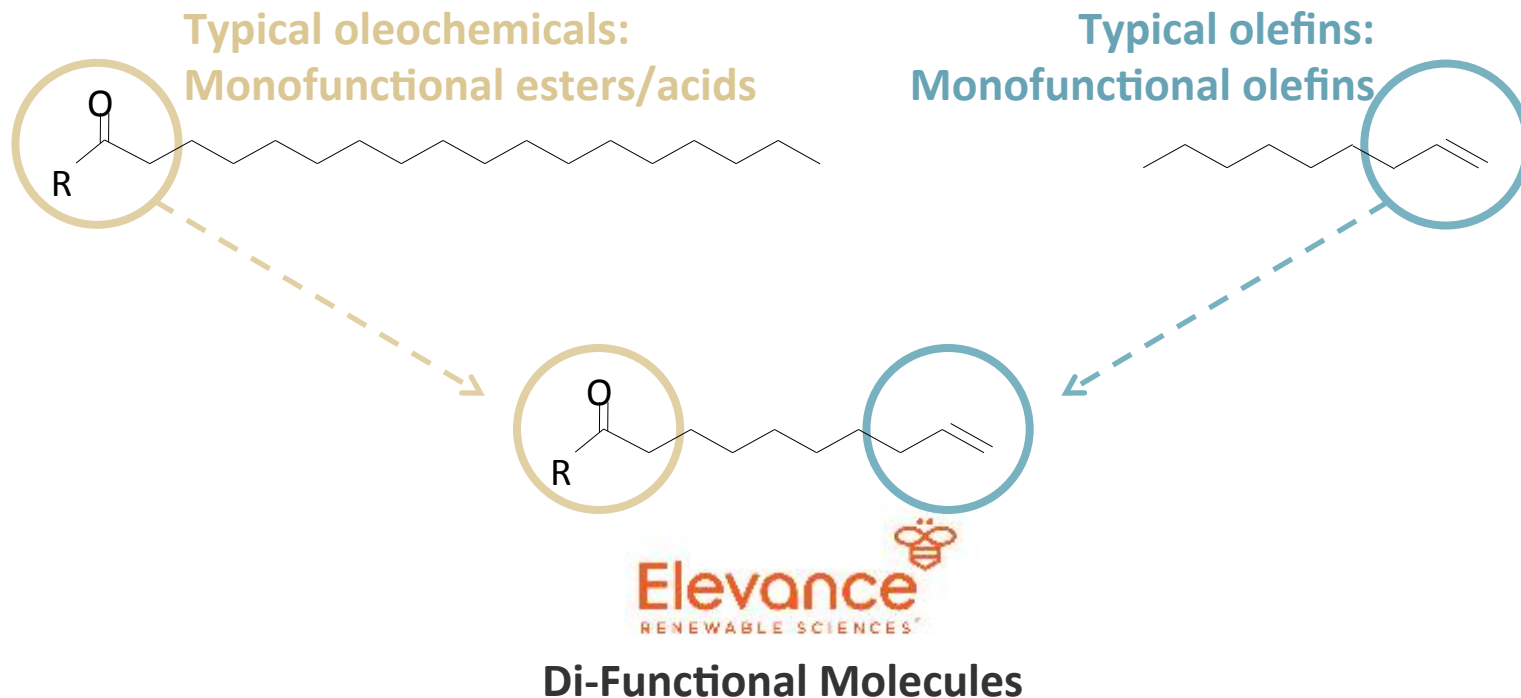
**Products specifically target customer-desired functional attributes**

# Broad applications with large addressable markets

	End Product Applications		
Consumer & Industrial Ingredients			
Lubricants & Additives			
Engineered Polymers & Coatings			
Olefins			
Oleochemicals			



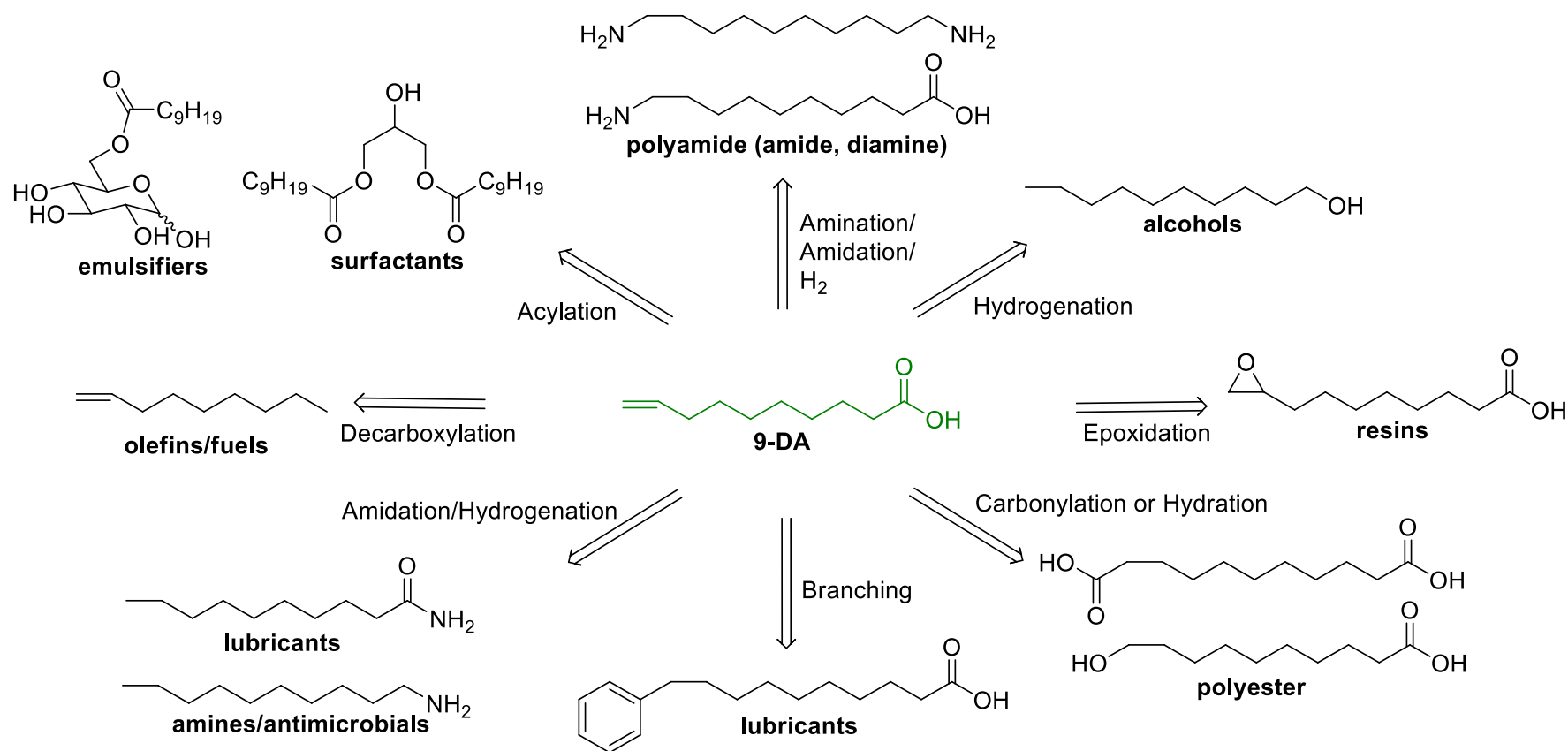
# Specialty chemicals based on novel di-functional molecules



**Chemicals from the Elevance process combine functional attributes of olefins and oleochemicals in a previously unachievable single molecule**

# Novel di-functional specialty chemicals: 9DA

- The natural product equivalent of a petrochemical building block
- Possibilities for considerable innovation in a wide variety of markets and applications



# High-performance specialty and intermediate chemicals from natural oils

- ✓ Variety of Natural Oils
- ✓ Widely Available

- ✓ Low Capital
- ✓ Low Operating Costs
- ✓ Commercial Today

- ✓ High Value Product Mix
- ✓ Addresses Critical Shortages
- ✓ Meets Customer Performance Needs



## Elevance Advantage: Feedstock diversity

- ✓ Widely available and easily transportable feedstocks provide significant advantages
  - Industrial scale quantities available in all regions
  - Low cost transportation and storage in liquid form



# Collaborative business model

## Feedstock & Technology

Reduce costs &  
expand functionality



## Manufacturing

Speed commercialization  
& reduce capital  
requirements



## Markets

Accelerate  
access to large, existing  
end markets



Leverage complementary assets and capabilities

Accelerate time to market

Reduce development investment & risk

# Challenges

## Regulatory

- Incumbent technology in chemicals is advantaged; bio-based chemistries/products need equal footing

## Connecting the value chain: from feedstocks to consumer goods

- Translating requirements from one step to the next
- Aligning on priorities between what steps need and can deliver/accept
- Leveraging non-competitive business models and vertical collaboration to accelerate progress

## Business Development skills and experience

- Real experience in BD is limited – many industries have been focused on costs not development
- Understanding of Chemistry, Green Chemistry Basics, Value chain needs and structure/property relationships

## Leadership

- By companies and individuals
- Internal and External

# Thanks for joining us!

For more educational webinars  
or to learn about the GC3:

[www.greenchemistryandcommerce.org](http://www.greenchemistryandcommerce.org)

**GC3** **GREEN CHEMISTRY &  
COMMERCE COUNCIL**  
Business Mainstreaming Green Chemistry