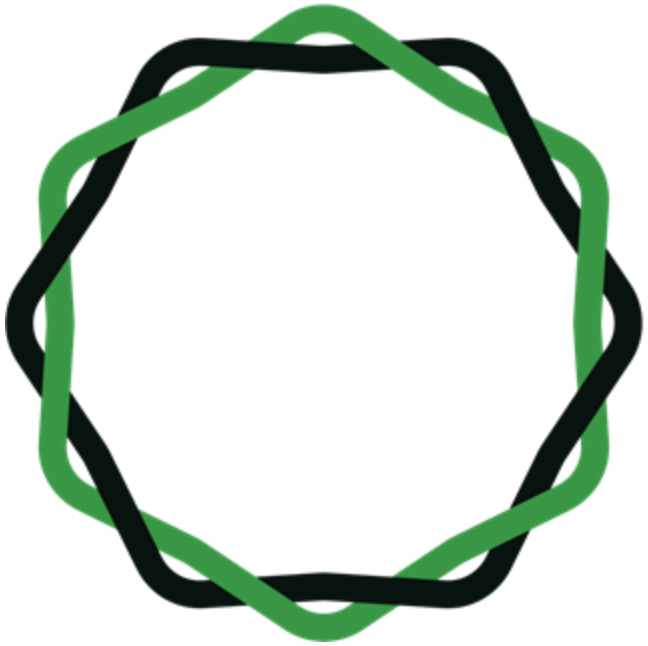

Green Chemistry Business Value

Green Chemistry Change Management

Tabitha Petchey

18 Sep 2024

Agenda

- Is “green” enough?
- Finding Business Value
  - Costs of Hazardous Chemistry
  - Entering New Markets
  - Innovative Products
  - Performance Advantage
  - Consumer Demand
  - Regulatory Pressure
- Sustainable Business Models for Chemistry
- Conclusions and Further Reading
- Exercise: Your Business Case

GREEN ROSE CHEMISTRY

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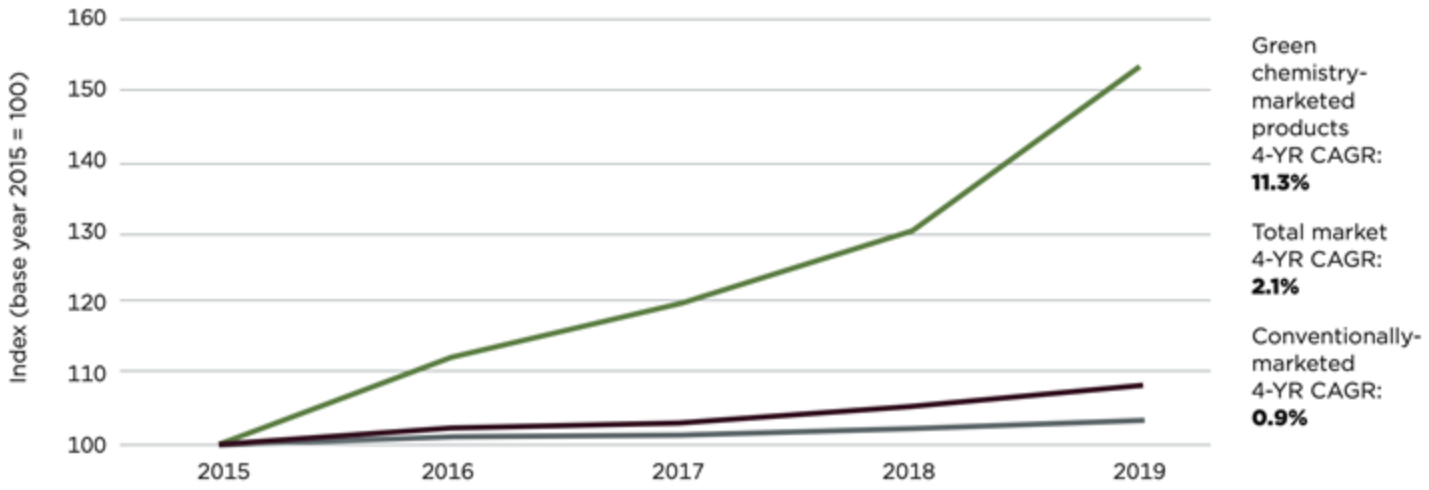
Is “green” enough?

No.

Pretty much never.

Necessary, but insufficient

- Sustainability is important and necessary, but usually not sufficient for business success
- Until externalities are reflected in costs, sustainability won't win on economics
- Can still have significant business value



Source: GC3, Green Chemistry Business Opportunity

Risk of innovation

- Change and innovation come with risks
  - losing sales
  - losing market share
  - reputation harm
  - losing R&D investment
  - regrettable substitution
- Benefits must outweigh these risks to create change

Why is green chemistry booming?

- Hazardous chemistry has significant monetary costs
- Safer chemistry can allow entry into new markets
- Sustainable chemistry can create entirely new products
- Biobased chemistry can have performance advantages
- Consumer and NGO pressure creates risk
- Chemical legislation is incentivising safer chemistry

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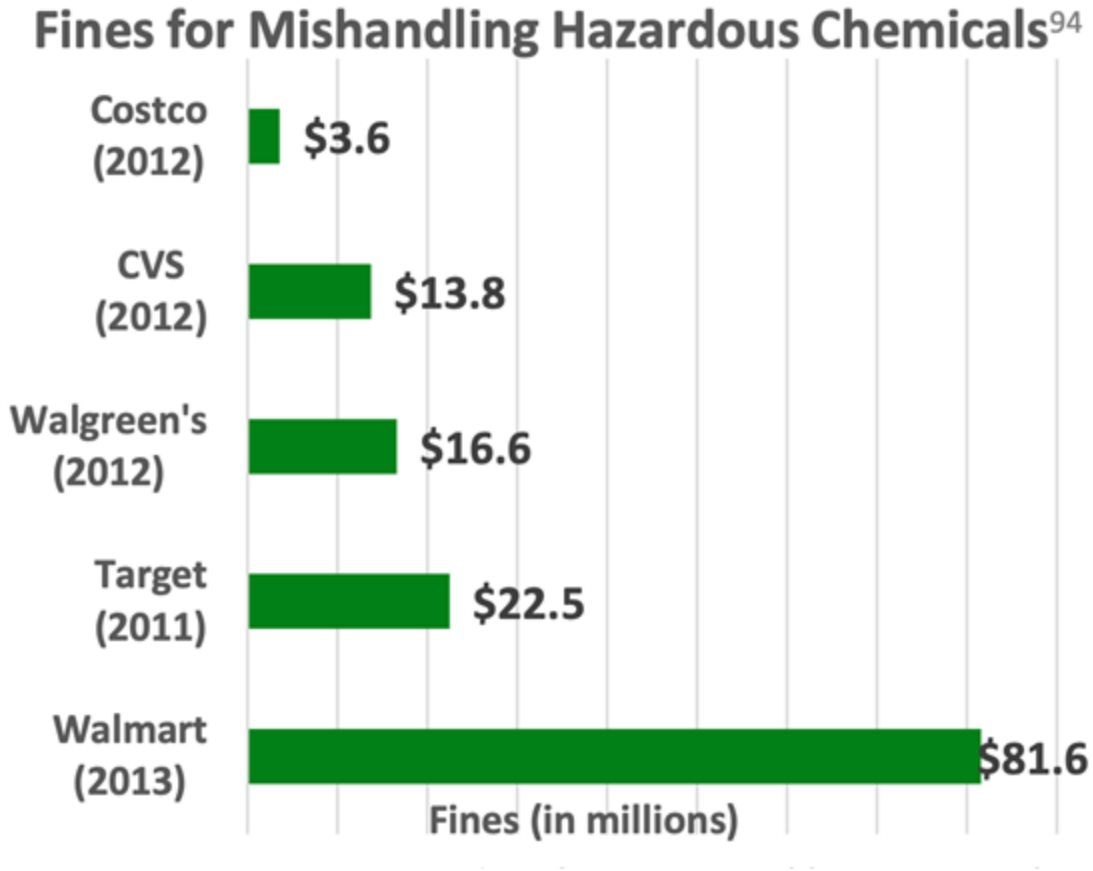
Finding Business Value

Costs of Hazardous Chemistry

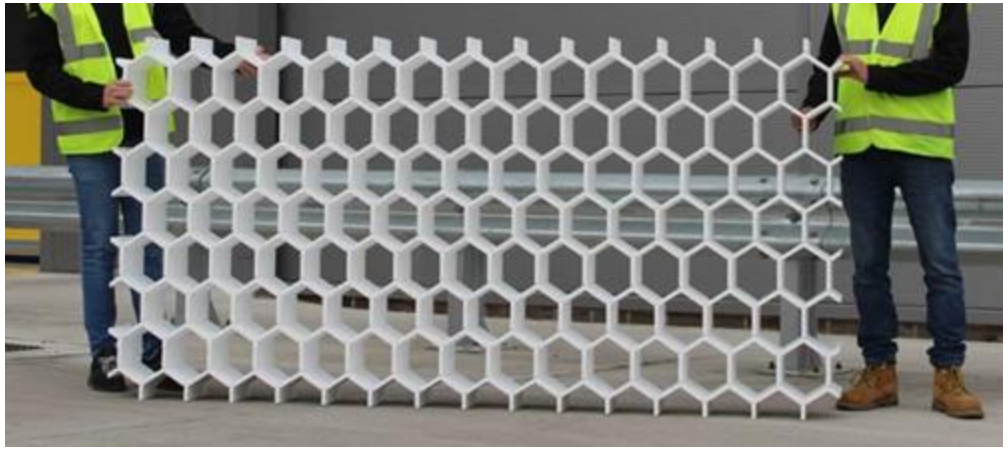
Costs of Hazardous Chemistry

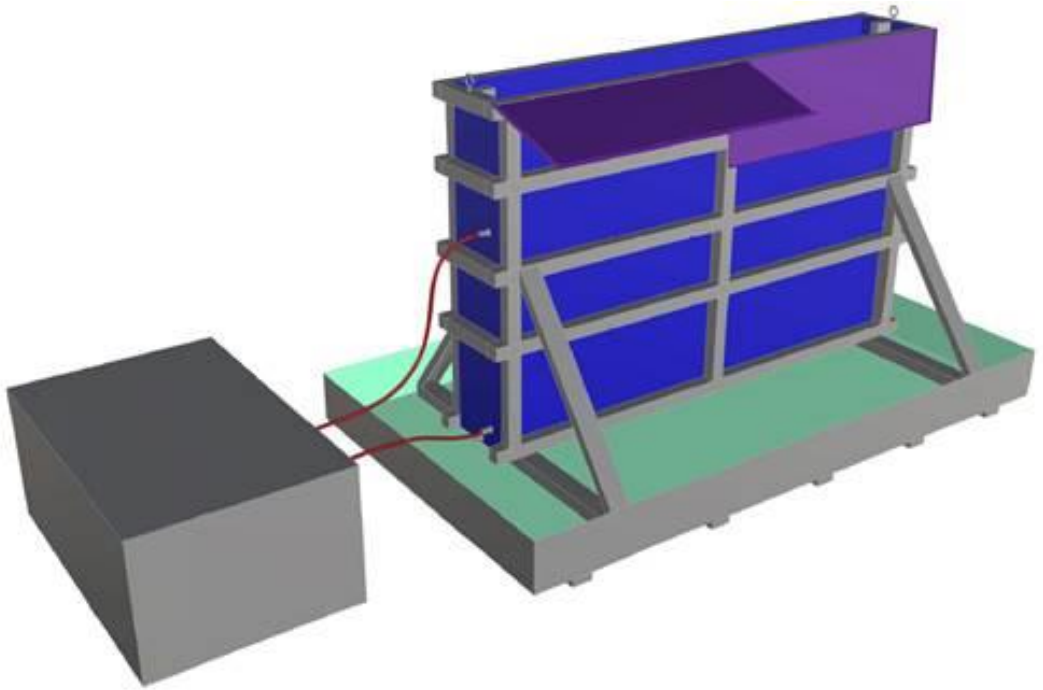
Sector	Business Value at Risk	Impact	Time Period
All	Federal Enforcement	$9.7 billion in private industry cleanup actions and equipment, along with $163 million in fines[86]	2014
All	Tort Settlements	$17 million in settlements for violating California Prop 65[87]	2013
Consumer Products	Lawsuits	25 lawsuits filed against companies using BPA in their products[88]	2009-2010
Beauty & Personal Care	Market Share	-8.4% in market share of Johnson & Johnson due to consumer concern about ingredients[89]	2008-2010
Toys	Shareholder Value	-25% stock price of RC2 from lead-painted toys[90]	2007
Health Care	Market Share	Existing vendor lost $70 million contract because it could not provide PVC/DEHP-free medical products[91]	2005-2010
Chemicals	Market Value	$200 billion (or 31% of assets' value) due to lawsuits and toxic releases[92]	2001
Chemicals	Regulatory Fines	$16.5 million of DuPont for Teflon® pollution; faced class-action lawsuits[93]	2005-2008



Source: Trucost, Business and Economic Case for Safer Chemistry

Cost Savings: Construction Manufacturing





Problem: EPS dissolution without toluene

Cost Savings: Construction Manufacturing

Initial requirements

- Close to cost of toluene
- Dissolves EPS as quickly as toluene
- Less flammability risk, other hazards are fine

Final solution

- More expensive solvent (>10x cost)
- Slower dissolution of EPS
- Completely hazard-free

Client: 

Cost Savings: Construction Manufacturing

- Primary driver for substitution was cost savings
- Quantifying process costs made solvent cost unimportant
- Other factors became more important than speed of cleaning
  - Reliability
  - Ease of use
  - Worker safety
  - Absence of reputational risk/litigation costs

Cost Savings: Construction Manufacturing

Hazardous Solvent

- Build outdoor cleaning site far away from manufacturing buildings
- Forklift tools across site
- Fireproof storage
- Secondary and tertiary containment systems
- 24h monitoring for spills
- Power generator
- Volatile solvent pumps
- Extensive operator training
- No climate control = unreliable cleaning

Non-hazardous Solvent

- Locate tank inside main manufacturing building
- Easy and safe transfer for cleaning
- No special storage needs
- Secondary containment, tertiary not necessary
- No monitoring
- Use existing power supply
- Standard pumps
- Minimal operator training
- Consistent temperature and cleaning

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Finding Business Value

Entering New Markets

New Markets

- Business growth can be achieved by using safer chemistry to enter new markets
- Established brands are investing in green chemistry R&D to boost future revenue

Sectors with the greatest potential growth in green chemistry.

1	Packaging
2	Polymers and Plastics
3	Biobased Products
4	Consumer Products
5	Apparel and Textiles
6	Building Materials
7	Pharma and Life Sciences
8	Specialty Chemicals
9	Electronics

Source: GC3, Green Chemistry Business Opportunity

New Markets: Paints and Coatings

- Brand supplying paints and coatings to multiple sectors
- Established in construction and DIY trade markets
- No presence in consumer DIY market
- Needed USP to enter consumer market competitively

New Markets: Paints and Coatings

- Green chemistry solution
  - Safe, biobased coating product would be unique on the market
- Market advantages
  - Less price-sensitive; can support higher product price
  - Societal and environmental benefits more important
- Other drivers
  - Corporate sustainability goals
  - Government investment initiatives
  - Grant funding to de-risk R&D

New Markets: Paints and Coatings

- Replaced two petrochemical process solvents with one biobased, low-hazard option
- High performance level maintained
  - One metric actually improved
- Established partnership between global brand and green solvent supplier
- Patent pending for new coating technology
- Technology is quickly being scaled from small subsidiary market to global market

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Break

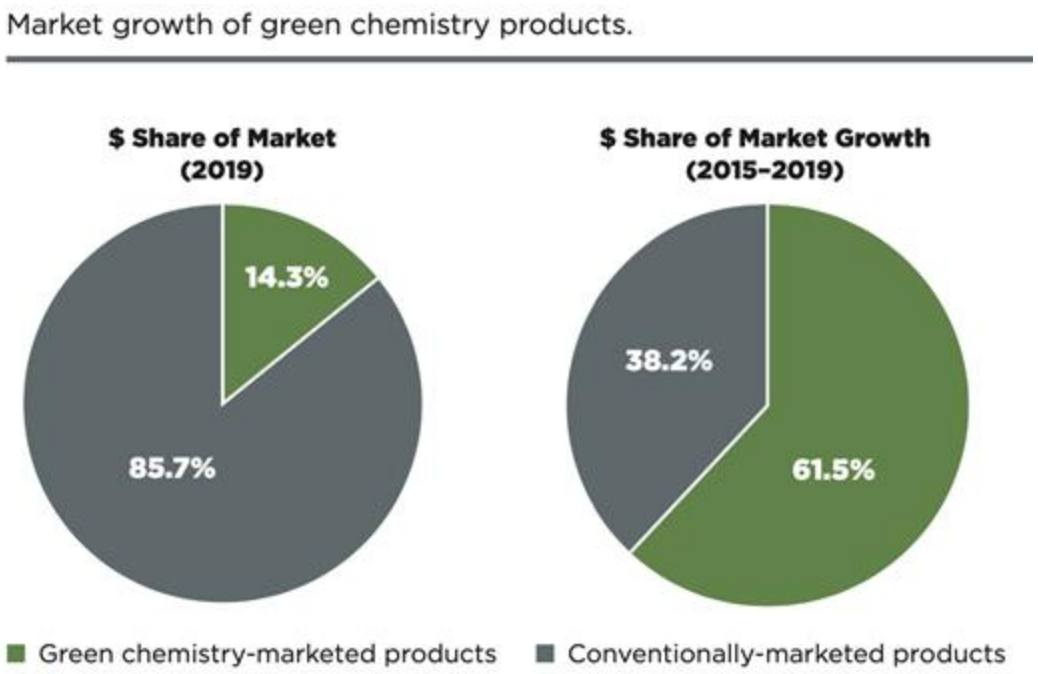
GREEN ROSE CHEMISTRY

Finding Business Value

Innovative Products

Innovative Products

- Sustainable chemistry can create valuable innovation
- Green chemistry enables
  - performance advantage
  - eco-labeling
  - cost reduction
  - new business models



Source: GC3, Green Chemistry Business Opportunity

Innovative Products: Detergent

- Smol: UK detergent and home cleaning
- Founded in 2018 to supply dish detergent tabs
- $34M in funding in 2021
- Direct-to-consumer subscription service
- Estimates 2.5M washes per week

Innovative Products: Detergent

- Chemistry innovation
  - Super concentrated tablets
  - 30 tabs in mailable package
  - All-in-one: no salt or rinse aid
  - Fewer chemicals, same performance
- Packaging innovation
  - Child-proof cardboard box
  - Plastic-free
- Affordable: 19p vs. 14-32p

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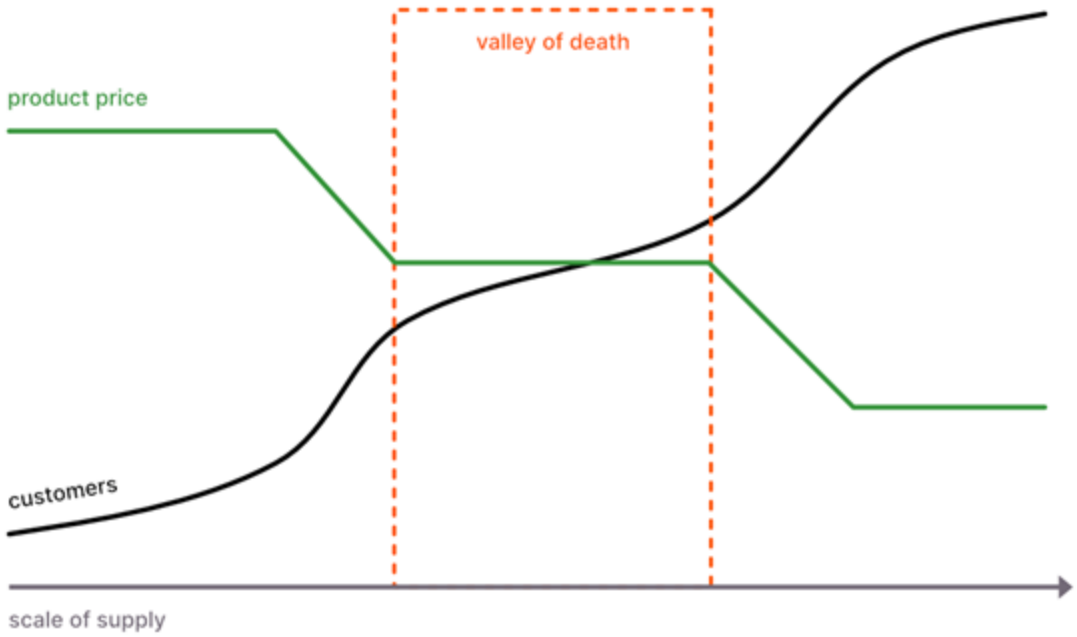
Finding Business Value

Performance Advantage

Performance Advantage

- Biobased versions of petrochemicals can be particularly hard to sell
- Chemically identical, but more expensive and less stable supply during scale-up
- If pricing is not competitive, must have a real performance advantage



Performance Advantage: Solvents

- Biobased production of acetone and butanol is being attempted by several companies
- Varying degrees of success
- Bulk solvent is chemically identical regardless of source

Performance Advantage: Solvents

- Focus on differences to find value
- Petrochemical acetone contains trace benzene (carcinogenic) and propylene (reactive)
  - Lack of reactivity can improve efficiency of catalytic reactions
  - Lack of carcinogenicity can access health-conscious markets
- Biobased butanol can be added to biofuels
  - Improves performance of biodiesel
- Biobased acetone and butanol may smell different
  - Potential applications in fragrances, camping fuels

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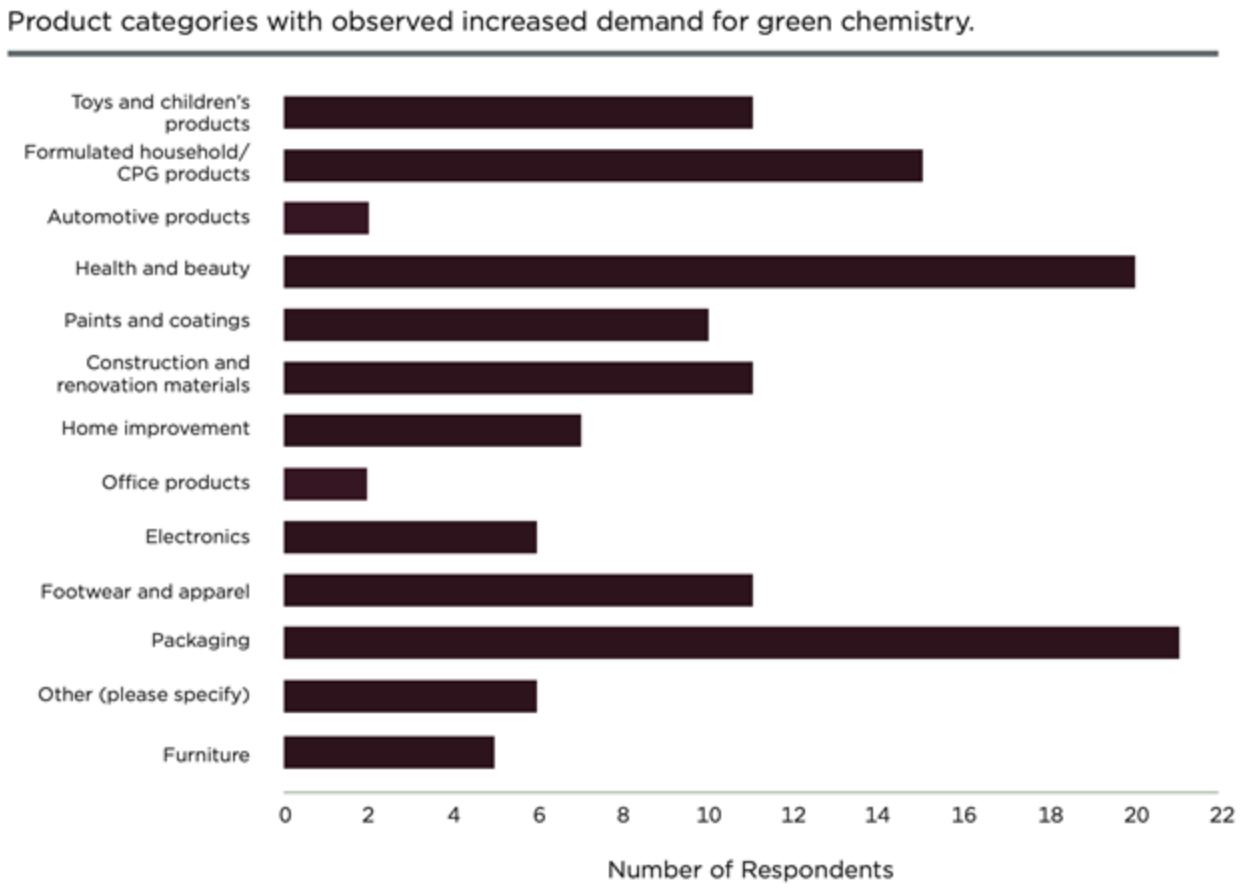
Finding Business Value

Consumer Demand

Consumer Demand



- NGOs and increasingly informed consumers are creating market pressure
- Increased demand for sustainable products
- Hazardous chemicals can cause loss of market share

Source: GC3, Green Chemistry Business Opportunity

Consumer Demand: Personal Care

Pressure from Campaign for Safe Cosmetics

May 2009

J&J market share drops by 8.4%

2009-2011

J&J pledges to remove formaldehyde, 1,4-dioxane

Nov 2011

J&J spends 10's of millions to reformulate baby products

2011-2014

J&J releases reformulated baby shampoo

Jan 2014

Campaign for Safe Cosmetics

Johnson & Johnson

Consumer Demand: Baby Car Seats

- Uppababy was first to US market with a baby car seat free of flame retardant chemicals
- Functional substitution: merino wool fabric that naturally resists fire
- More expensive than their standard car seats
- First production run sold out within days

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Finding Business Value

Regulatory Pressure

Regulatory Pressure

Sector	Restriction	Impact	Time Period
Personal Care	Minnesota Legislation	Phase out of triclosan from consumer soap by 2017; FDA cost estimates for reformulation: $112-369 million[74, 75]	2014
Consumer Products	California Legislation	Chemical regulatory model and standard for interstate manufacturers and retailers[76]	2008-Present
Building Materials	California Legislation	Lumber Liquidators flooring with formaldehyde 6-20 times the limit; -26% in stock price[77]	2015
Coatings	California Legislation	Manufacturers must provide post-use disposition for architectural paint or face $10,000 daily fines[78]	2012
Electronics	EU RoHS	Apple and HP eliminated substances of concern for market access[79]	2011
Electronics	EU RoHS	29% of US firms lost or delayed EU sales due to non-compliance (average $1.84 million per firm)[80]	2006-2010
Chemicals & Electronics	EU REACH and RoHS	Global compliance: $32 billion for RoHS and $2 billion for REACH[81, 82]	2006-2010

Source: Trucost, Business and Economic Case for Safer Chemistry

- EU REACH restricts use of many hazardous chemicals and penalises non-compliance
- CSS promises stronger regulations to come, favouring sustainability in addition to safety

Other Drivers

- Avoid finite resources
  - Petroleum market increasingly unstable
  - Lithium becoming problematic
- Investors and shareholders
  - Expectations are changing
  - Increasing pressure to act sustainably
- Maintaining competitiveness
  - Investing in green R&D yields patents
  - Keep from getting stuck behind others' IP
- Demand from institutional buyers

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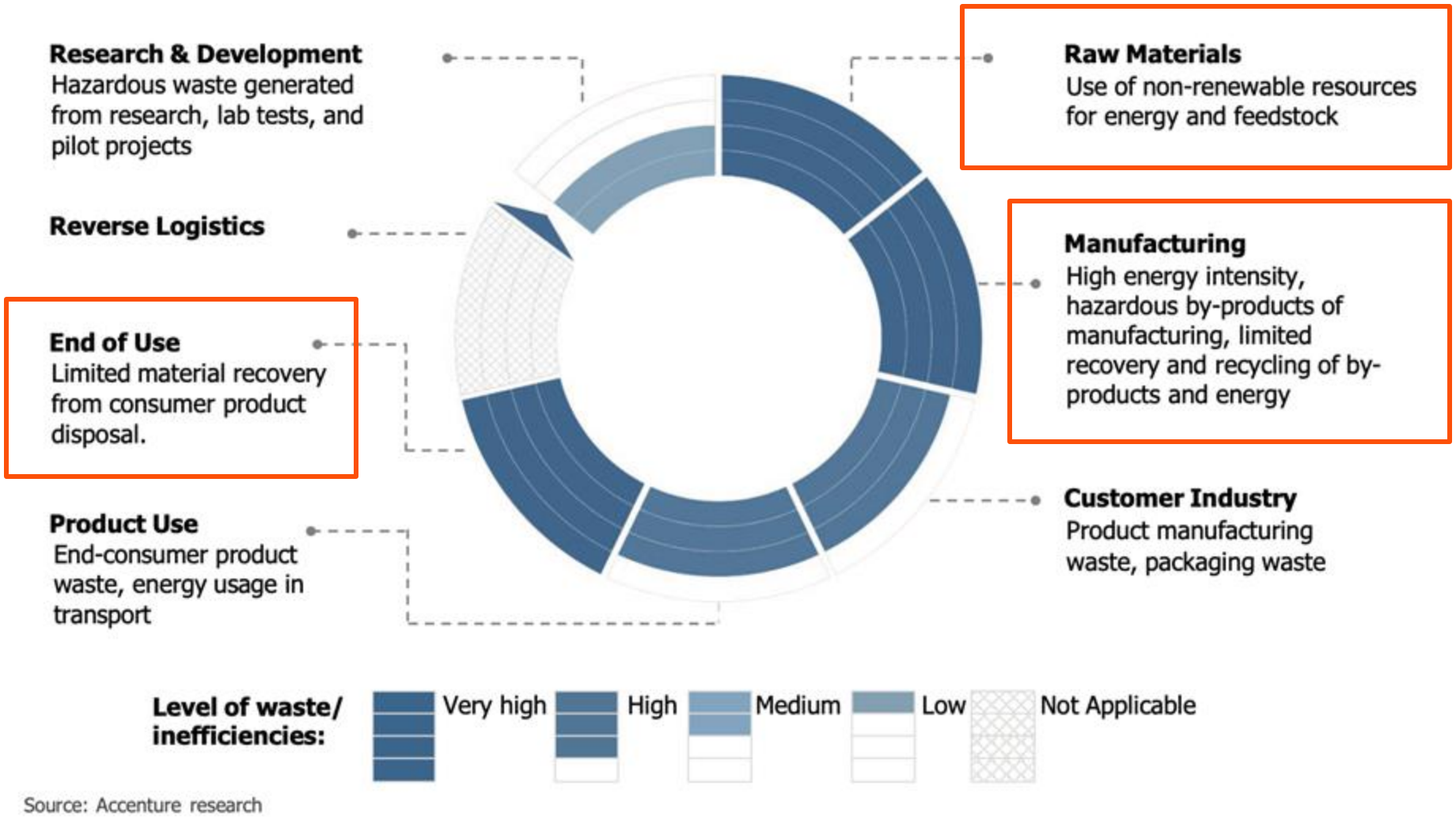
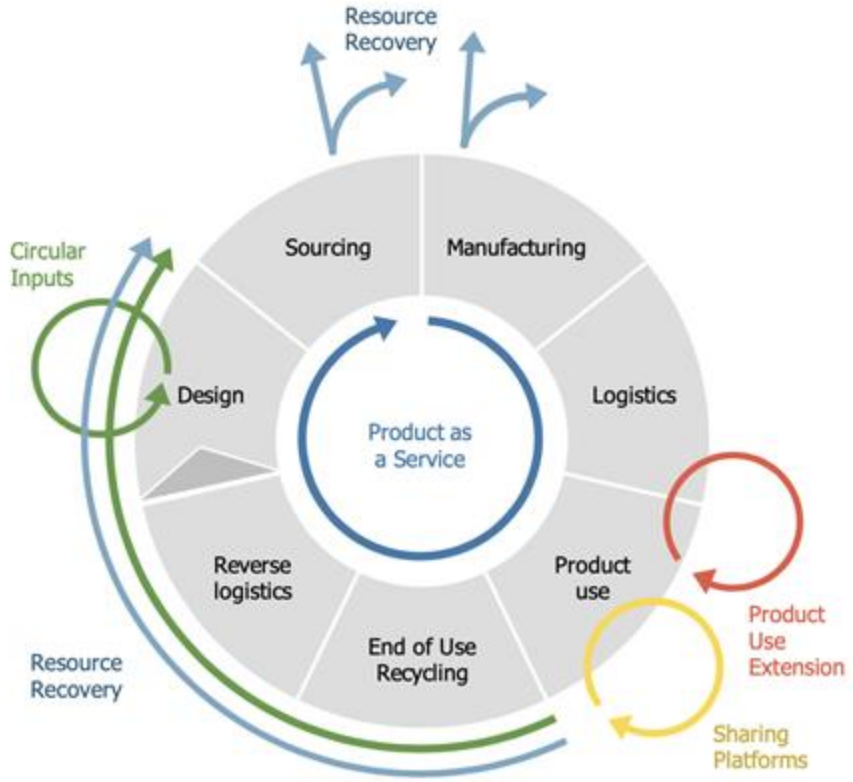
Sustainable Business Models for Chemistry

Where is waste generated?



Source: Accenture research

Business Models for Waste Reduction



- Circular inputs
  - renewable, bio-based, recycled materials and energy
- Resource recovery
  - collecting and re-processing embedded materials and energy
- Product as a service
  - sell function, not product (e.g. chemical leasing)
- Product use extension
  - Extend product lifespan through design, repairs, reconditioning, upgrades, resale
- Sharing platforms
  - Optimise resource utilisation through shared access and usage (e.g. trade excess inventory)

Source: Accenture

Circular Inputs: Method

50-100% recycled plastic bottles

Industry's first LEED platinum soap factory

95-99% renewable ingredients in most formulations

Resource Recovery: Molok

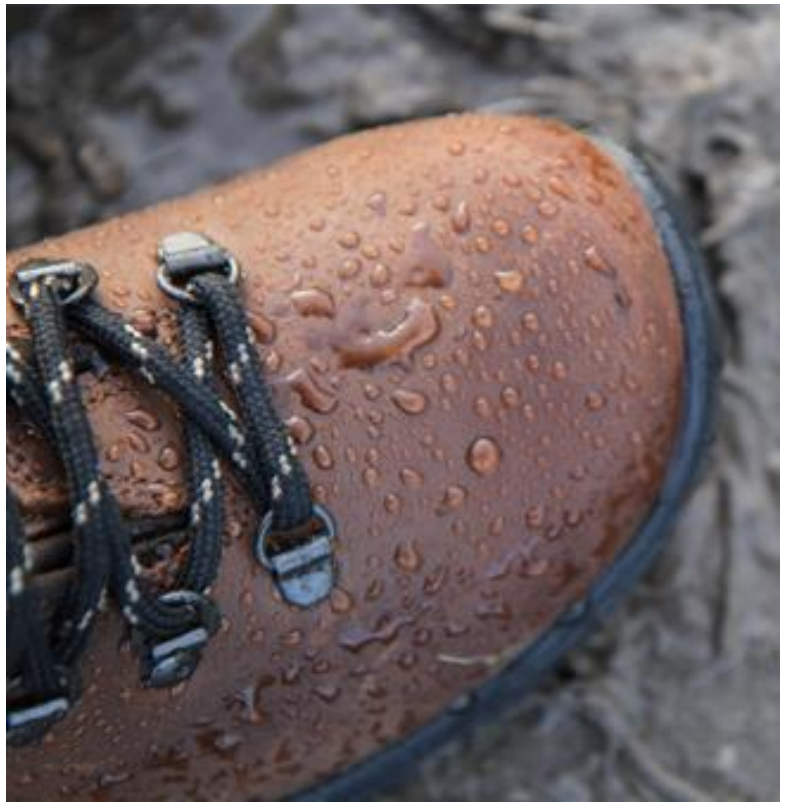
- Provider of waste and recycling containers
- “Deep collection method” involves belowground storage
- Reduces frequency of collection
- Maintenance, spare parts, upgrades prolong use
- Production process reclaims plastic cutting waste, uses recycled materials

Product as a Service: Safechem

- Chemical leasing model for metal cleaning solvents
- Sell the cleaning function, not the solvent
- Used solvent is collected by provider
- Incentivises provider to minimise waste and recycle solvent

Source: Safechem

Product Use Extension: Nikwax



- Chemical products that extend clothing lifespan
- Waterproofing, leather conditioning, UV-proofing
- Easy for consumers to use at home
- Water-based, non-aerosol, free of PFAS

Sharing Platforms: Excess Materials Exchange

- Digital matching platform for excess materials and wastes
- Identifies any material in a standardised way
- Quantifies value and impacts of materials
- Uses AI plus human expertise to match waste stream to high-value reuse option
- Example: Vitens (water company) was filtering out and disposing of water impurities, now they sell them as salts and organic compounds for reuse

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Conclusions

To sum up…

- Sustainable metrics alone are not enough
- To succeed in our traditional economy, green chemistry must create value
- Green chemistry can add benefits, from reducing risks and costs to creating performance advantage
- Business models can also make chemistry more sustainable

Further Reading

- Green Chemistry: Driver of Business Opportunity
  https://greenchemistryandcommerce.org/documents/uml-rpt-GreenChem-1.22-12.pdf
- Business and Economic Case for Safer Chemistry
  https://greenchemistryandcommerce.org/documents/trucost_gc3_report_april2015.pdf
- Sustainable Business Models for the Chemical Industry
  https://www.sitra.fi/app/uploads/2020/05/sustainable-and-circular-business-models-for-the-chemical-industry.pdf
- OECD Chemical Substitution Case Studies
  https://www.oecd.org/chemicalsafety/risk-management/case-studies-of-substitution-and-methodology.htm

GREEN ROSE CHEMISTRY

Break

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Exercise: Business Case

Analysing Business Case (60 min)

Google Sheet for group work on 1 and 2: https://bit.ly/3CPrzG0

- Case Study 1: Plastic Bag Printing (15 min)
- Case Study 2: Tea Decaffeination (15 min)

- Driver(s) for substitution
- Barriers to substitution
- What value can green chemistry add?
- Could any of the sustainable business models be applied?

Switch to handout for solo analysis of example from your industry (30 min).

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Questions?

Contact Tabitha Petchey at tabitha.petchey@greenrosechemistry.com.