The Product Improvement Process as a Driver for Green Chemistry Innovation

CA Department of Toxic Substances and Control (DTSC) Industry Practices in Product R&D - an Alternatives Analysis Symposium

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Contents

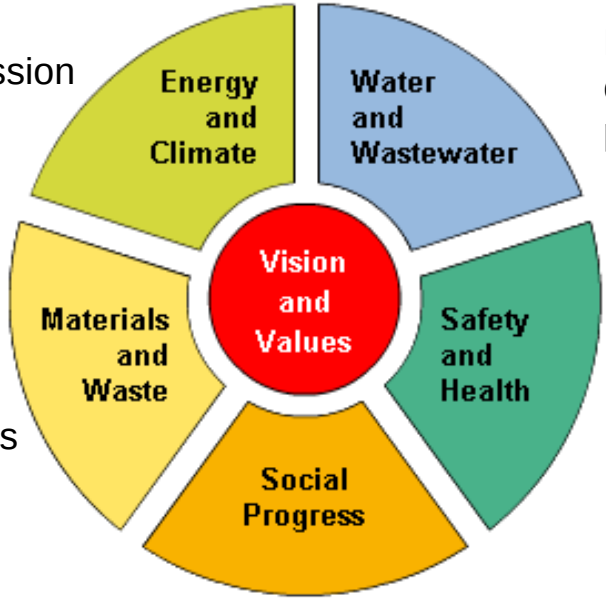
Background: Henkel Sustainability Focal Areas

Green Chemistry & Product Improvement Process (PIP) Imbedded

Examples:

Energy efficient products and processes with less GHG emission

Reduction of water consumption from our products and production



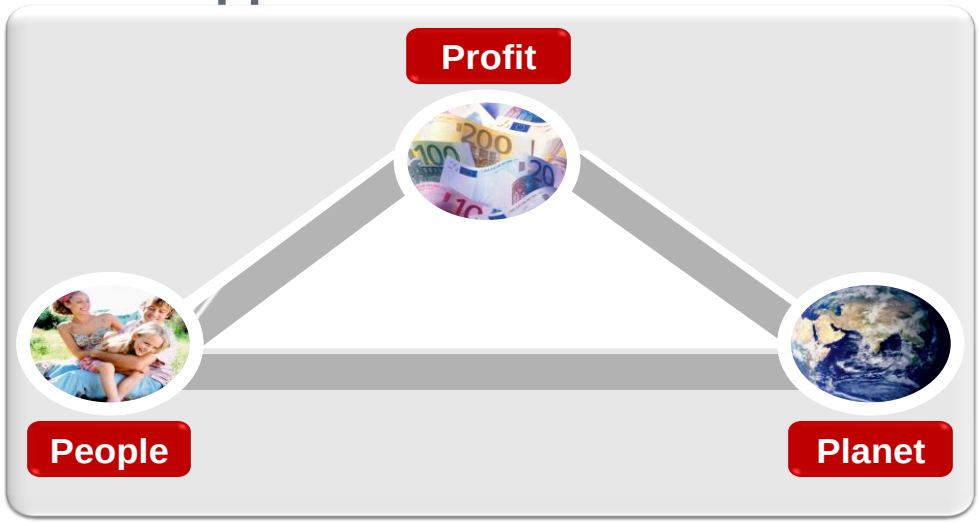
Efficient formulations with renewable or biodegradable ingredients and minimal wastes

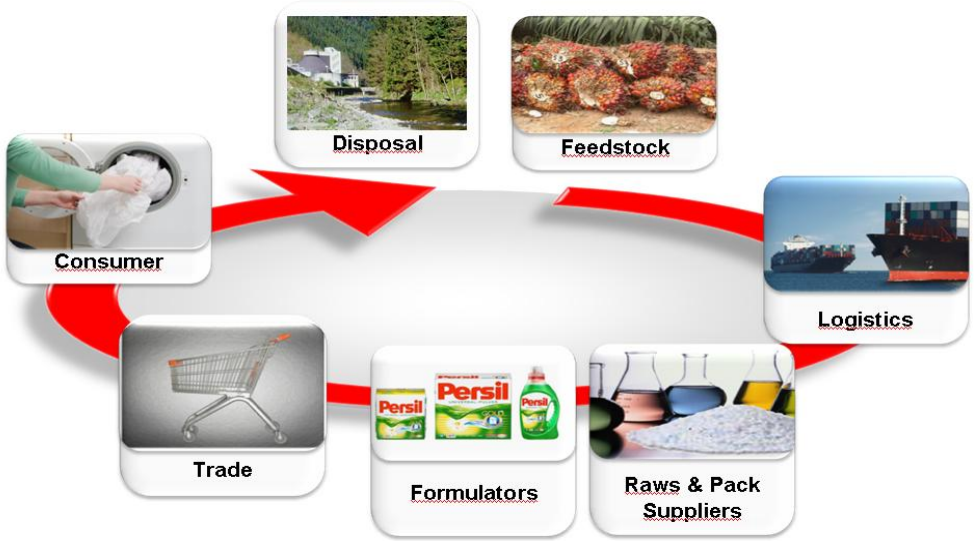
Assurance programs in every stage of a product life cycle

High-quality and affordable products and services

Background: Henkel Sustainability Strategy

A Holistic Approach





People, Planet, Profit

→ Triple Bottle Line

+

Sustainability along the Value Chain

= Holistic approach

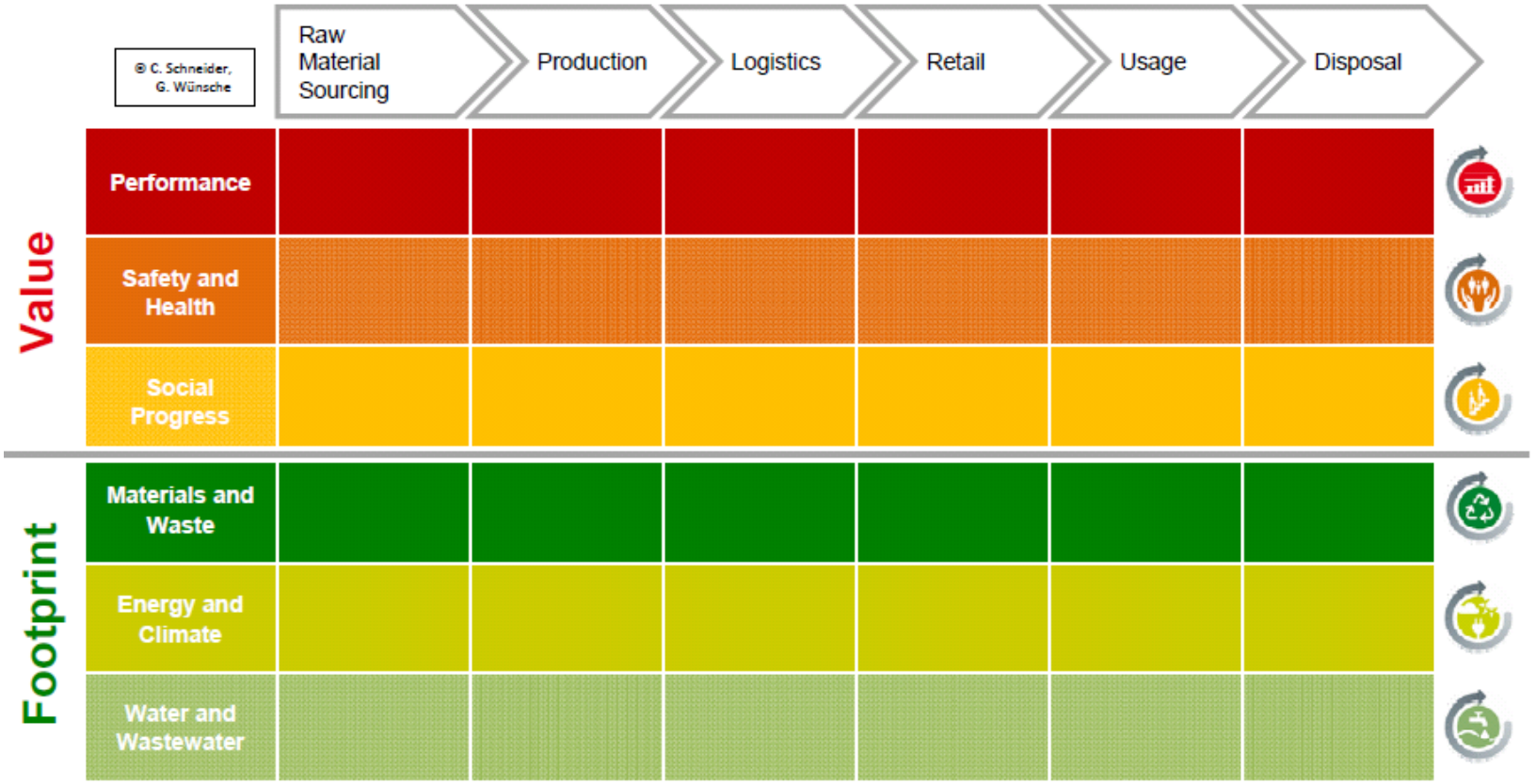
Background: Henkel Promotes More Sustainable Consumption

- **Henkel is calling for collective actions to boost the sustainability of our business activities by a factor of 3 for 2030***

* Henkel Chairman Kasper Rorsted's presentation in Montreux to detergent industry (October 6, 2010)
http://www.henkel.com/com/content_data/193659_Rorsted_Montreux_20101006g.pdf

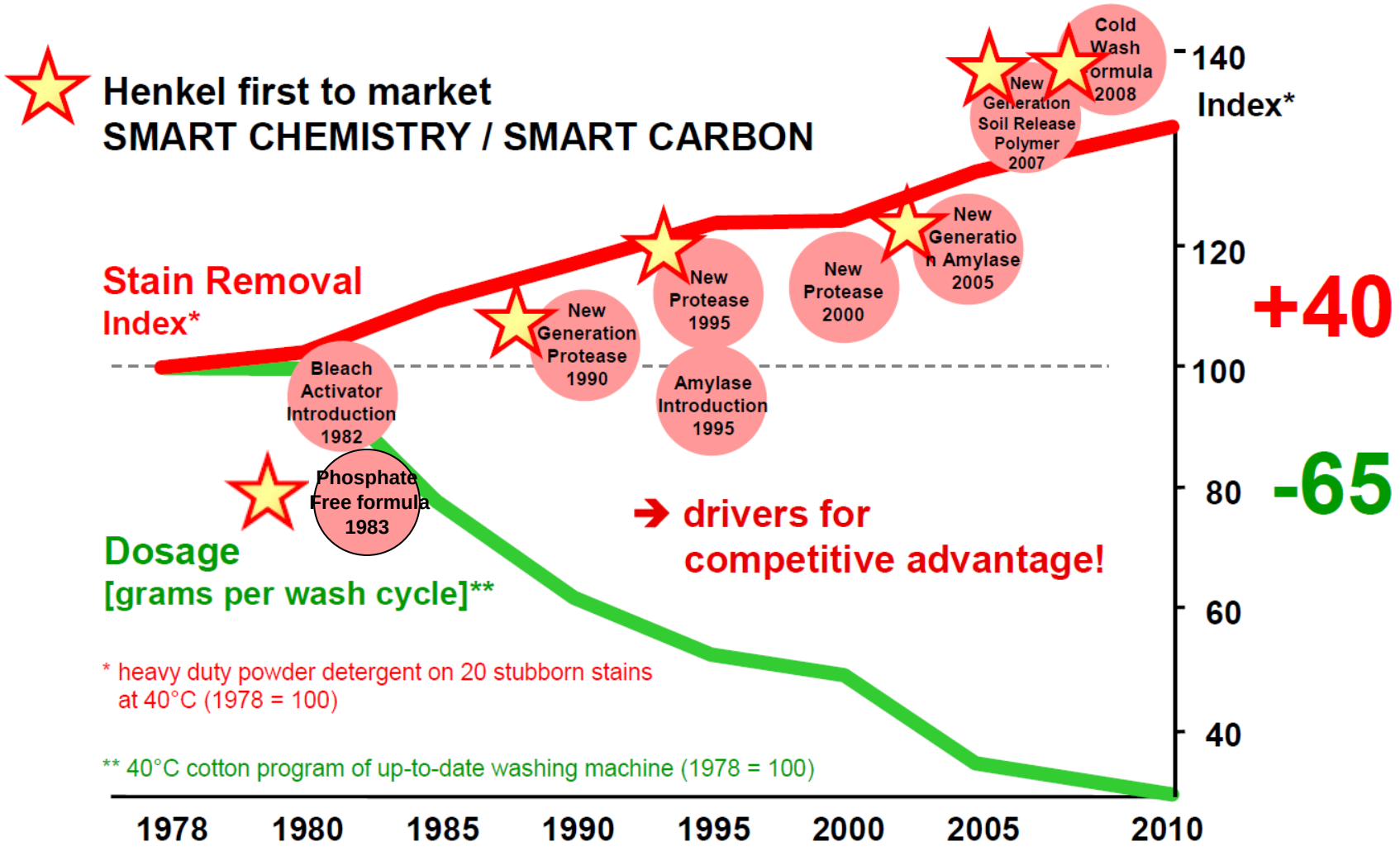
Sustainable Consumption Index

Holistic approach ➔ The matrix



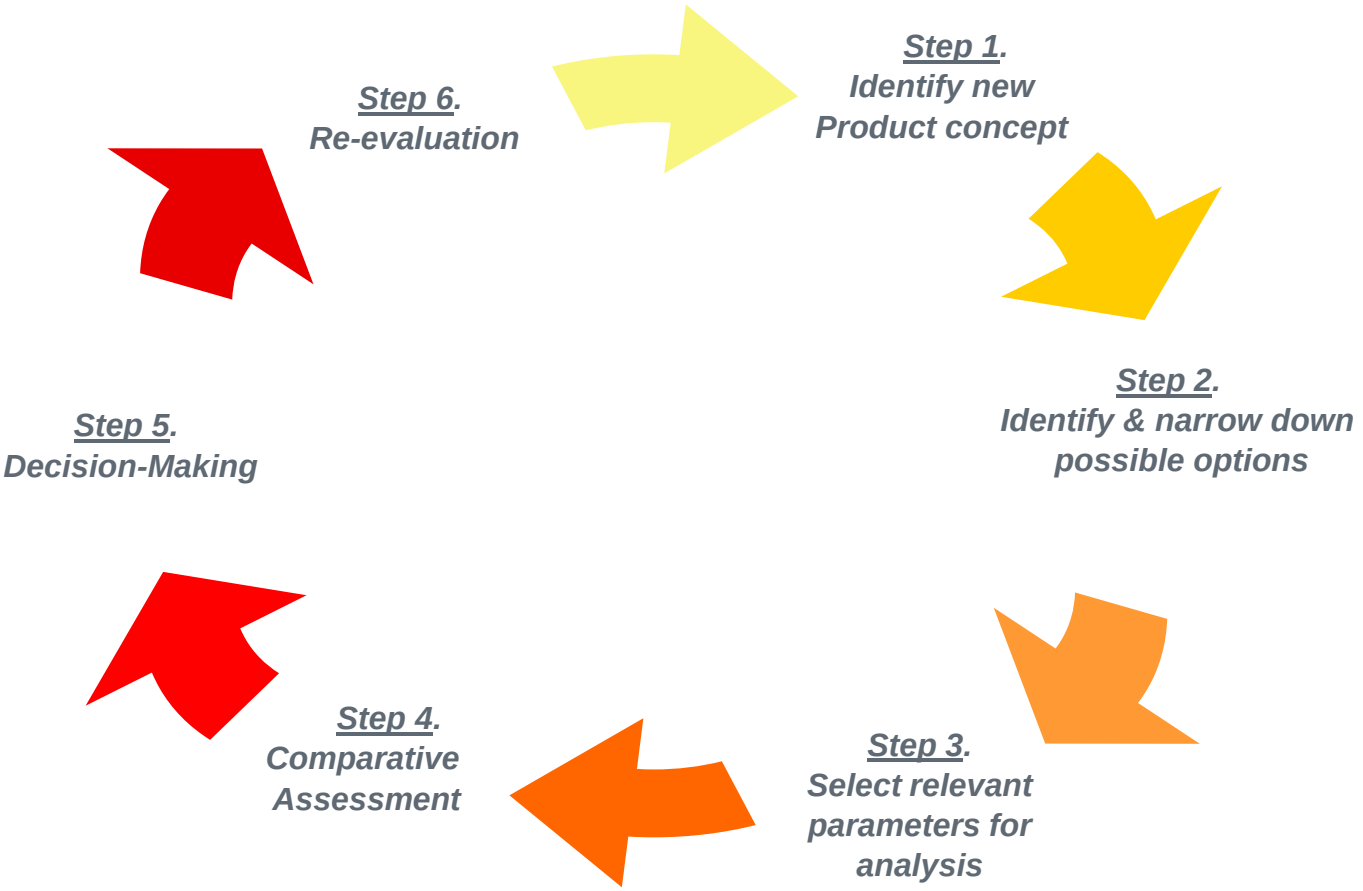
More with Less - Sustainability Innovation History

The Example of Laundry Detergents



Product Innovation and Improvement Process

All about continuous improvement!



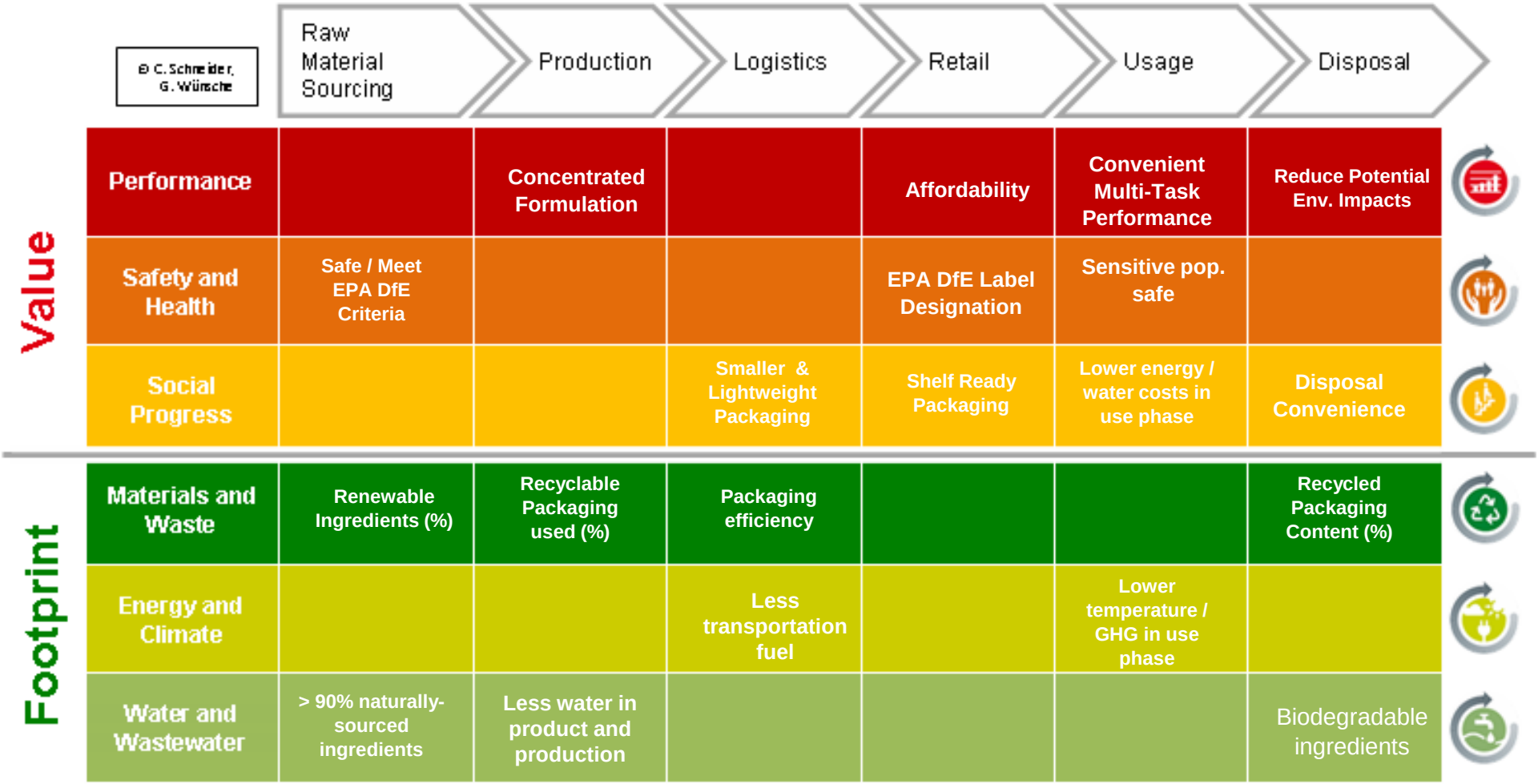
Product Innovation and Improvement Elements are Consistent with the Statutory Criteria of AB 1879 25253(a)

Across all Product Lifecycle Stages

AA STATUTORY CRITERIA (A-M LIST)
(i) Safety (Human and Environmental) (K) - Public Health Impacts, incl. sensitive subpopulations (L) - Environmental Impacts (E) - Water quality impacts (F) - Air emissions (I) - Green house gas (CHG) emissions (J) - Waste/End-of-Life Disposal
(ii) Performance and Cost (A) - Product function/performance (B) - Useful Life (M) - Economic impact
(iii) Lifecycle/Resource utilization (C) - Material/Resource Consumption (D) - Water conservation (G) - Energy inputs (Production, In-use, and transportation) (H) - Energy efficiency
(iv) Additional Considerations - Integration of smart chemistry & sustainable consumption - Availability/sourcing - Manufacturing capability - Regulatory compliance - Claims substantiation - Consumer acceptance

Step 1 - Green Chemistry Innovation is Driven by the Matrix

Example: Henkel laundry detergent innovation efforts throughout a product life cycle toward more sustainable consumption (value up & footprint down).



Safety Assurance is Integral part of Product Life Cycle

During innovation, existing use & product improvement evaluation

Safety Review of Ingredients and Formulas Typically Occurs Several Times During a Product Life Cycle

- New raw materials
- Prototype formulations
- Clinical safety evaluations
- Consumer use tests
- Market Introduction
- Post-Market Surveillance
- Reformulation

Step 2 – Typical Screening Process for Raw Materials & Possible Product Improvement Assessments

All Product Raw Materials

Safety/Regulatory Review & Approval

RAW MATERIAL DATA

- **General Information**
- **Sourcing Information**
- **Chemical Composition**
- **Impurities**
- **Intellectual Property Data (e.g., patents)**
- **Microbiological Specification**
- **Ecological Toxicity Information**
- **Human Toxicology Data**
- **Listing on Global Chemical Inventories**
- **MSDS/Product Data Sheets**
- **Storage Requirements**
- **Other**

Raw Material Risk Assessments

- Establish acceptable use or exposure limits

Step 3 – Aspirations & Parameters for Green Chemistry Innovation

General Metrics for “Green” Chemistry in Home and Personal Care Products

- Higher levels of sustainable, easily renewable resources
- Use of ecological-friendly chemicals
- Better Safety and Toxicity Profiles

Step 3 (cont.) – Examples of More Specific Elements and Parameters Targeted During Product Innovation or Improvement Process

Consistent with “A-M” statutory criteria of AB 1879 25253(a)

Example: Development of Home & Personal Care Products with Bio-Preferred Surfactants and/or Naturally Sourced Ingredients

- Derived from “renewable” feedstock sources
- Does not represent a human health risk under use conditions
- Undergoes rapid & extensive biodegradation
- Acceptable level of aquatic toxicity
- Does not accumulate in any environmental compartment
- Complies with pertinent regulations and readily available in desired quantities
- Acceptable formulation compatibility/performance/cost
- Acceptable from consumer and claims perspective
- Other (e.g., recycled package content, more concentrated, smaller package, etc.)

Step 3 (Cont.) – Additional Elements and Parameters Targeted
For select products designated as EPA DfE

Meets DfE Criteria for Direct Release Surfactant Product

	Acute Aquatic Toxicity Value (L/E/IC50)[1]	Persistence (Measured in terms of rate of biodegradation)	Status
1	≤10 ppm		Not acceptable
2	>10 ppm and <100 ppm	Biodegradation occurs within a 10-day window without products of concern[3]	Acceptable
3	≥100 ppm	Biodegradation occurs within 28 days without products of concern	Acceptable

Source: DfE's Standard and Criteria for Safer Chemical Ingredients http://www.epa.gov/dfe/pubs/projects/gfcp/index.htm#Toxicity

Step 4 – Generic Comparative Assessment

Factors Considered in Screening & Comparative Assessment of Potential Candidates

Universe of Possible Bio Surfactants & Naturally Sourced Ingredients

Initial Screening

SAFETY ASSESSMENT

• **Human Toxicity**
  • *Acute (LC_{50}):* oral, dermal, inhalation, sensitization
  • *Chronic (NOEL):* mutagenicity, reproductive, developmental, or carcinogenicity

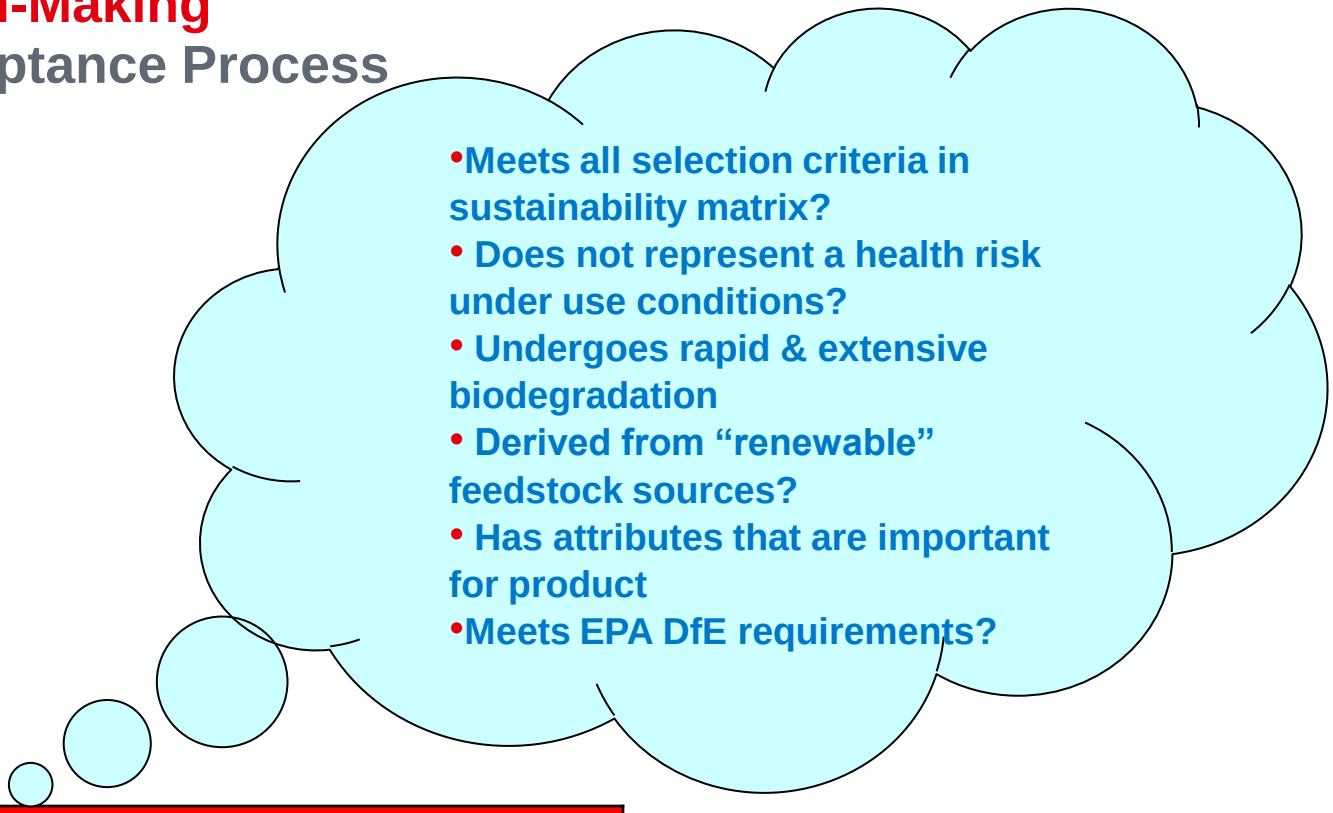
• **Aquatic Toxicity**
  • Acute (vertebrate/invertebrate)
  • Chronic

• **Biodegradability**
  • Readily biodegradable
  • Low bioconcentration potential

Narrow Down

FACTORS CONSIDERED IN COMPARATIVE ASSESSMENT OF POTENTIAL CANDIDATES
• **Derived from "renewable" feedstock sources?** • **Meets EPA DfE criteria (selected products)?** • **Compatible with formula and targeted end-use?** • **Readily available and complies with pertinent regulations?** • **Patents?** • **Acceptable cost?**

Step 5 – Decision-Making
Example of Acceptance Process



FINAL EVALUATION & SELECTION

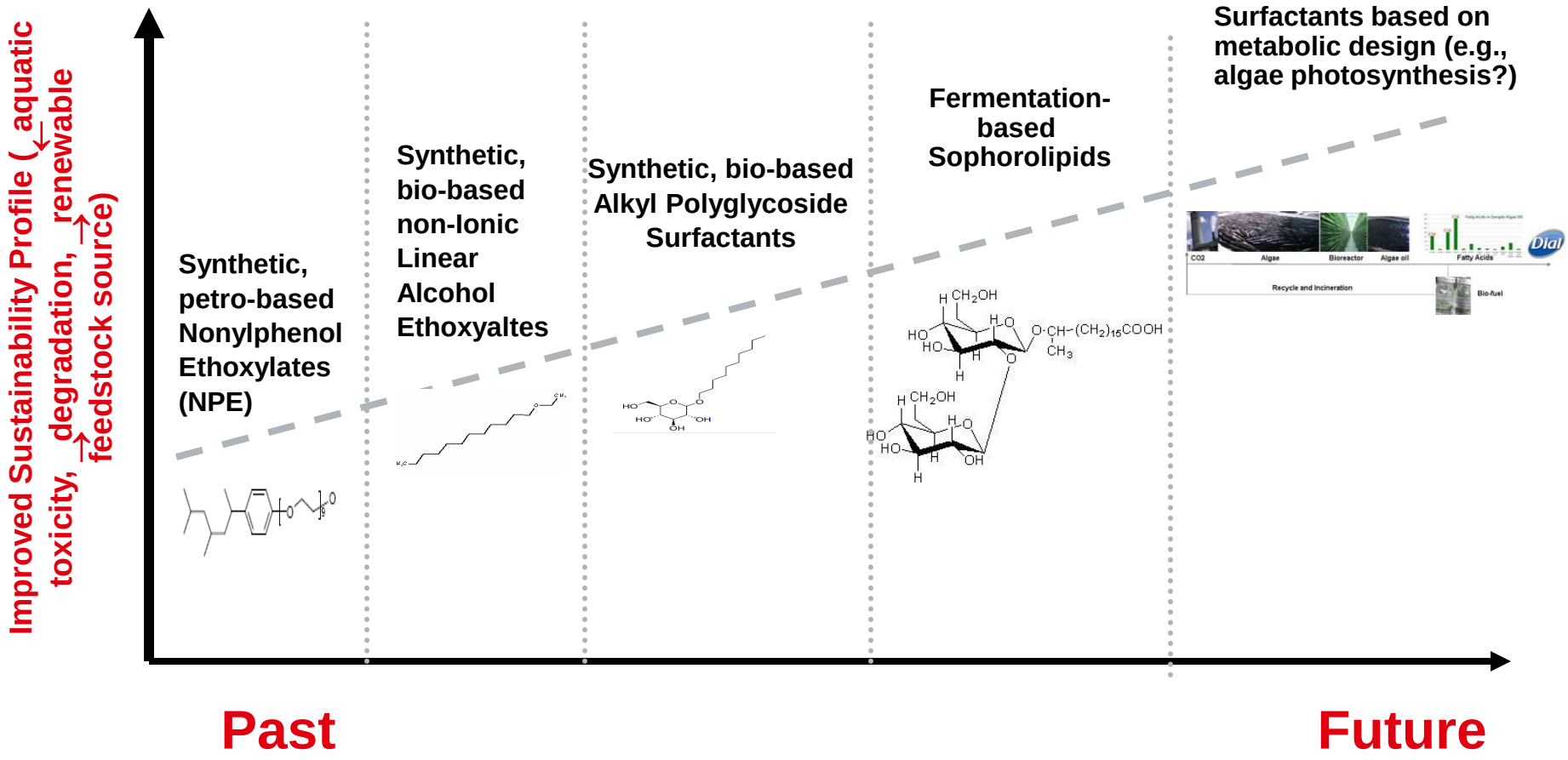
- Incorporate into test formulations
- Test formulations for performance
- Test formulations for human & environmental safety
- Confirm consumer acceptance
- Substantiate claims

Green Chemistry Innovation Accomplishments
Examples

Home & Personal Care Green Chemistry Product Accomplishments
Home care and laundry products: • Bio-based surfactants & naturally sourced ingredients • Biodegradable • Packaging with less plastics and recycled plastics • Concentrated products with less water • Less transportation – saving fuel and GHG emission • Cold water laundry detergent – saving energy in consumer home use
Personal care products: • Cold process formulations – saving energy in production • Naturally sourced ingredients, hypoallergenic and gentle to skin • Novel product design – saving water in consumer home use
Products with EPA "Design for Environment" (DfE) designation

Eco-innovation Towards Greener Chemical Ingredients

Examples: Continuous Improvements for Greener Surfactants



Eco-innovation Towards Greener Chemical Ingredients (Cont')

Example: Effective chemical safety evaluation under HERA risk assessment program based on industry voluntary measures

KPI	REPORTING DATA	2005	2006	2007	2008	2009	2010
Chemicals safety evaluation	% of ingredients covered by HERA* (I&I not included)	64.3 %	68.6 %	72.9%	75.7%	74.7%	75.5%
Participating companies	Companies reporting (number of)	8	19	33	45	59	65
	Manufacturing sites covered	62	78	108	133	152	162
	% vs Total	81.6%	78.8%	84.4%	88.7%	89.9%	92.6%
	Production covered	7.3 m t	9.3 m t	10.5 m t	11.1 m t	11.1 m t	11.6 m t
	% vs Total	86.2 %	86.1 %	92.1%	94.7%	95.7%	97.8%
	Units of consumer products sold (I&I not included)	5,800 m	8,200 m	9,300 m	9,700 m	10,200 m	10,300 m

* A digest from AISE Activity and Sustainability Report 2010-2011:
http://www.aise.eu/downloads/AISE-AR-SR%202010-2011_web-version.pdf

Conclusion & Comments

- Utilization of the Product Improvement Process -
  - ✓ Successfully drives green chemistry & sustainability innovation
  - ✓ Incorporates the A-M criteria of AB 1879 25253(a)
  - ✓ Recognizes trade-offs

- Addition of onerous regulatory elements to the process can result in unintended consequences such as -
  - ✓ Increases in time & resources for new products development
  - ✓ Creation of a non-leveled playing field in the global marketplace

Thank you!

ADDITIONAL SLIDES

EPA DfE Program - Basic Components

- Promote green chemistry
- Understand toxicity
- Life cycle thinking

Continuum of Improvement

Formula Ingredient by Functional Class

Characteristics of Ingredients of Concern

Characteristics of Improved Ingredient

Characteristics of Sustainable Ingredient