

Greening the Chemical Industry

Workshop Het Element, 8 November 2007, Delft



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Example monopoly slides

Workshop objectives

- Examine how “Green” is affecting the chemicals industry:
 - Understand why the chemical industry is well-positioned to take advantage of “Green”
 - Identify the long-term development perspectives for the chemical industry
 - Learn expectations from society, as expressed by the Women in Europe for a Common Future (WECF)

Agenda

- **Introduction and welcome** **10h30-10h35**
Dr. Peter Nieuwenhuizen, manager chemicals practice, Arthur D. Little Netherlands
- **What society expects from the chemical industry** **10h35-11h00**
Mw. Sascha Gabizon, Internation Director WECF Netherlands
- **Creating sustainable value from green** **11h00-11h25**
Dr. Peter Nieuwenhuizen, manager chemicals practice, Arthur D. Little Netherlands
- **Long-term perspectives for the chemical industry** **11h25-11h50**
Prof. dr. Gerard Keijzers, Hoogleraar Duurzaam Ondernemen, Nyenrode Business University
- **Plenary discussion** **11h50-12h00**

Speakers for today



Peter Nieuwenhuizen

- Peter is Manager at Arthur D. Little in Rotterdam
- He mainly works in the chemicals sector, with a further emphasis on business strategy, sustainability, and technology & innovation management
- Before joining Arthur D. Little, Peter worked for Akzo Nobel in its chemicals division. He spent 3 years living in the United States
- Peter studied at the Vrije Universiteit in Amsterdam, and obtained a Ph.D. in chemistry from Leiden University, The Netherlands



Sascha Gabizon

- Sascha is International Director of WECF, Women in Europe for a Common Future
- Before joining WECF in 1995, she worked for five years at the Wuppertal Institute, an environmental think tank
- Sascha has a business major from EAP Paris



Prof. Dr. Gerard Keijzers

- Gerard has been professor “Duurzaam Ondernemen” with the Nyenrode Business University since 2001
- He also advises companies on sustainability issues and is member of numerous related international committees, most notably in Asia
- In the past years he has published four books in the field of sustainability & business
- As of 1990 he was director Strategy at the VROM Ministerie for ten years, and he has also worked for the United Nations as an economist in the developing world

Creating value from green

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For the chemical industry, “green” can be a source of value, rather than a threat

Summary

- Green may be a buzzword but it can be understood in straightforward, controllable terms
- The chemical industry is better able to deal with green than it gives itself credit for
- For sophisticated, well-managed companies, green provides an attractive new basis for competition with the rest of the world

Agenda

- 1 Introduction & background**
- 2 Thinking about green for chemicals
- 3 Putting green in practice

Green is all the rage – and chemical industry CEO's have to deal with it

“In Europe and Japan, governments move to ‘green sourcing’...”



...NGO's such as Greenpeace are ranking consumer industries on their greenness, and...

...in the US a company like Dell sets the goal to become the greenest technology company.”



“Green” is not an intuitive topic for the industry ...

Why it's difficult

- The chemical industry has no direct link with the end customers
- The subjective and dynamic nature of green is less compatible with the chemical industry mindset of engineering, science and control of costs and operations
- Recent industry history is one rationalization and efficiency improvements. This has left little creative, out-of-the-box thinking – and green requires precisely such thinking to come up with innovative business and product concepts
- It's a relative concept, not an absolute one, and a moving target
 - Best compared to quality, what's state-of-the-art today, is poor performance tomorrow

... but the chemical industry comes loaded with experience

Lots of experience

- The chemical industry of the developed world is now the safest industry around, and has learned to deal with
 - ever tightening safety and emission standards,
 - ever increasing societal demands and
 - Ever increasing demands for financial return

- This has produced some powerful competencies
 - Innovating products and processes that generate less waste (whether through efficiency improvements or complete process overhaul)
 - Negotiating often contradicting demands of society, the governments and investors
 - Balancing cash generation and return on investment with long-term growth and innovation requirements

Related industries are already using it in their communications

>> Greener. >> Cleaner. >> Quieter. >> Smarter.



Airbus A380.
See the bigger picture.

Airbus:

“Gentle green giant the greenest aircraft flying today”

Toyota:

“Zero emissions”

*General Electric
CEO Jeffrey Immelt:*

“Green is now becoming pervasive. It is becoming universal”.



Zero Emissions. Toyota



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How can it be defined (1/2)

Twelve principles of green chemistry

- **1. Prevention** – Prevent rather than clean waste
- **2. Atom Economy** – Use synthetic methods to maximize incorporation of all products
- **3. Less Hazardous Chemical Syntheses** – Design synthetic methods to generate low-toxic substances
- **4. Designing Safer Chemicals** – Design chemical products to effect their desired function while minimizing toxicity
- **5. Safer Solvents and Auxiliaries** – Use of auxiliary substances should be made unnecessary when possible
- **6. Design for Energy Efficiency** – Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized
- **7. Use of Renewable Feedstocks** – A raw material or feedstock should be renewable rather than depleting whenever practicable
- **8. Reduce Derivatives** – Unnecessary derivatization should be minimized if possible
- **9. Catalysis** – Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
- **10. Design for Degradation** – Design products so that at the end of their function they break down into innocuous degradation products
- **11. Real-time analysis for Pollution Prevention** - Analytical methodologies need to be further developed
- **12. Inherently Safer Chemistry for Accident Prevention** – Substances should be chosen to minimize the potential for chemical accidents

Source: American Chemical Society

How can it be defined (2/2)

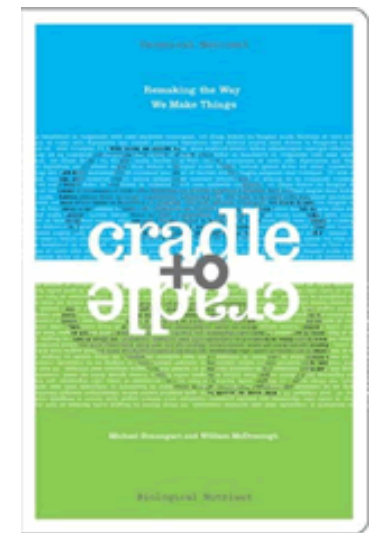
Cradle-to-cradle

- Put forward by McDonough and Braungart:
- Design business in terms of biosphere and technosphere:
 - Biosphere (textiles, paper)
 - 100% biodegradable
 - Provide healthy food for other organisms
 - Technosphere (metals, concrete)
 - 100% recyclable
 - Lease, don't sell
- Everything that cannot be recycled or biodegraded should be phased out



Economic framework

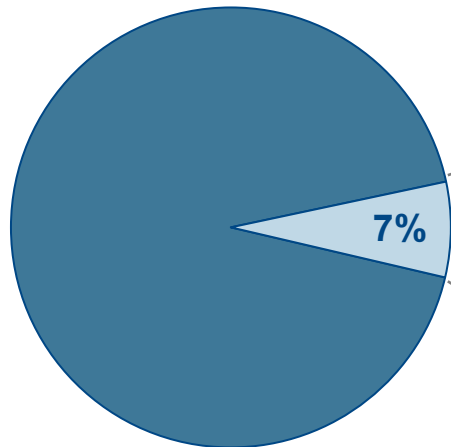
- The economic framework views any form of waste as an opportunity to reduce costs. Such costs come in two forms:
 - (a) endogenous costs, which can be reduced by using the material more efficiently during manufacturing;
 - (b) exogenous costs, when the waste degrades the environment or life, and/or causes clean-up costs afterwards.



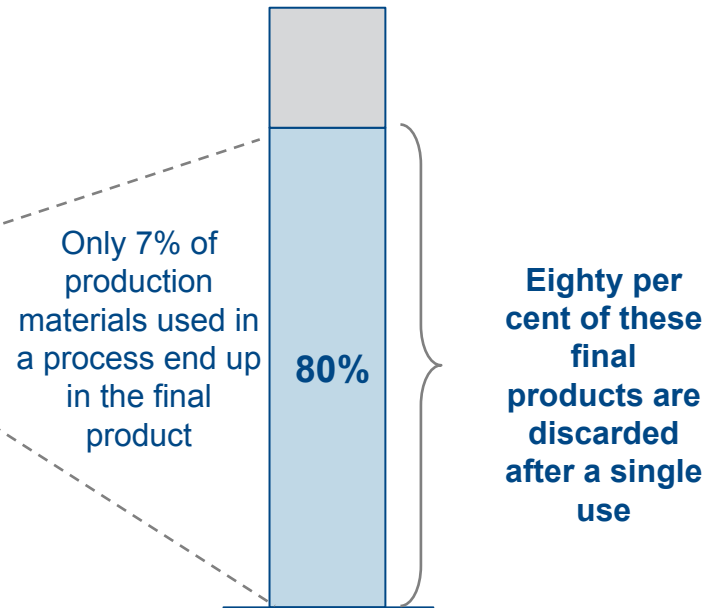
It's mostly about waste, and then it's actually rather simple

Use of production materials and end-product

All material necessary to create a single product



Ratio single/multiple use of products



We must change

“It is essential, therefore, that we seek to reduce material resources and ensure that any materials released to the environment are not toxic, harmful or persistent”

- Crystal Faraday partnership
(set up by the Chemistry Innovation Network)

The case for “green” behavior is getting more compelling

	Description	Examples
First-mover advantage	Attack is the best defence <ul style="list-style-type: none"> ■ Lower risk to be left behind ■ First-mover advantage, to set standards ■ Price or profit premium for greener alternatives 	<ul style="list-style-type: none"> ■ Cereplast’s plant-based plastics are used in GreenToys™ in the US (with Cargill) ■ DuPont cooperates with Plantic on renewable packaging
Ensure customer and investor loyalty	The costs of less green alternatives are going up <ul style="list-style-type: none"> ■ Testing and certification ■ Investors becoming wary of risks 	<ul style="list-style-type: none"> ■ Shareholders resolutions dealing with toxic risks are up <ul style="list-style-type: none"> – Apple, Sears, CVS, DuPont and DOW
Up the ante for the competition	Green requirements amount to an entry barrier for competitors that are less able to navigate these seas <ul style="list-style-type: none"> ■ Good way to deal with cheap competition from India and China 	<ul style="list-style-type: none"> ■ Great Lakes (now Chemtura) got the EPA to endorse a flame retardant alternative

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We distinguish three kinds of behavior

Green behaviors for the chemical industry

- Minimize production-related emissions
- Raise the greenness of the business, product, and technology portfolio
- Create partnerships with external stakeholders

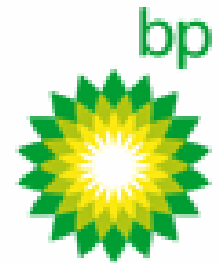
Green behaviors for the chemical industry – (1) Minimize production-related emissions

What

- Sticking to emission permits is expected behavior
- Green requires an absolute and proactive commitment to minimization of production-related emissions

Examples

- BP Michigan
- Toyota's "Towards zero emissions" is raising the bar



Zero Emissions. Toyota



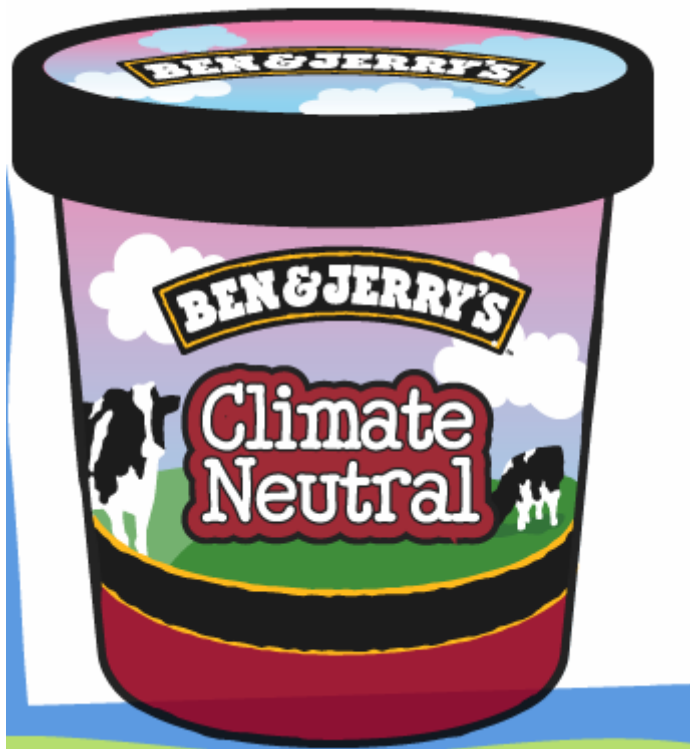
→ Towards zero footprint in production

Green behaviors for the chemical industry – (2) Raise the greenness of the business portfolio

What	Examples
<ul style="list-style-type: none"> ■ Forego business that is not green 	<ul style="list-style-type: none"> ■ Infineum declined to participate in bidding to supply customers with metal-based additives for diesel fuels
<ul style="list-style-type: none"> ■ Develop alternative business models that provide green benefits 	<ul style="list-style-type: none"> ■ Ecover is experimenting with retail drug stores to offer in-store refilling of polyethylene bottles with shampoos, shower gel, etc.
<ul style="list-style-type: none"> ■ Develop and offer non-toxic and/or climate-neutral products <ul style="list-style-type: none"> – Go beyond the obvious win-win of energy and GHG reduction – Proactively consider the business opportunities provided by green 	<ul style="list-style-type: none"> ■ Braskem offers “certified Green polyethylene” ■ Dow cooperates with Brazil-based Crystalsev ■ US-based Cereplast provides fully biodegradable, plant-based plastics that are phthalate-free and not contain any heavy metals, for a new line of toys called GreenToys™ ■ Rohm & Haas are developing additives to improve the properties of polylactic acid as a green packaging material
<ul style="list-style-type: none"> ■ Acquire alternative, green technologies 	<ul style="list-style-type: none"> ■ Ashland recently created a joint venture together with Cargill to develop and produce biobased chemicals

Ben & Jerry's show the way ... the chemical industry is certainly capable of doing the same

Ben & Jerry's first company to offer climate-neutral ice cream



Features:

- Cows are specially fed to release less methane
- Dairy farms have invested in on-site renewables such as biogas, solar panels and wind turbines
- No airfreight used, delivery routes are optimized to cut transportation miles
- Packaging is renewable and recyclable
- Freezing in special refrigerators
- Use of emission reduction certificates

Green behaviors for the chemical industry – (3) Create partnerships with external stakeholders

NGO's are willing to cooperate

- A new model is forming in which business and NGO's cooperate to develop and bring to market green solutions.
 - NGO's objective is to bring greener business into the market place, by co-opting the businesses that are willing to develop them
 - In the process the NGOs help companies by bestowing credibility to actions
 - For companies a way to gain support for more expensive, green solutions
- Not easy; Less than one quarter of all cooperation attempts with WWF actually come to fruition

Examples

- **WWF**-led alliance to create global standards for biofuel production and processing
 - Toyota, **British Petroleum (BP)**, the Dutch and Swiss governments, the UN Foundation, the World Economic Forum, and the University of California at Berkeley
- **DuPont** and Environmental Defense have formed the Nano Risk Framework with Environmental Defense
 - to evaluate and address the potential risks of nanoscale materials
- In China, **Shell** cooperates Friends of Nature and Global Village of Beijing
 - to raise awareness about environmental concerns

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Summary

- Green may be a buzzword but it can be understood in straightforward, controllable terms
 - 12 principles of green chemistry
 - Cradle-to-cradle
 - Economic
 - Crystal Faraday society
- The chemical industry is better able to deal with green than it gives itself credit for
 - Extensive experience with Responsible Care and balancing cash, return on capital, society, and innovation
- For sophisticated, well-managed companies, green provides an attractive new basis for competition with the rest of the world
 - Minimize production-related emissions (towards zero footprint)
 - Raise the greenness of the portfolio
 - Create partnerships with external stakeholders (to help market more expensive green products)