# Q1

quickstart

Issue 1 > September 2008

## Design for sustainability with plastics

This is the first in a series of Quickstarts on design for sustainability (D4S) with plastics. It provides an overview of the principles behind D4S, and suggests strategies that can be used to design a plastic product based on these principles. Future Quickstarts, which will be published as electronic documents on both the PACIA and Sustainability Victoria web sites, will cover more specific topics such as:

- the environmental characteristics, benefits and impacts of plastics;
- new technologies and sustainability;
- design for recycling;
- specifying recycled plastics;
- packaging design;
- building products;
- furniture design; and
- designing with degradable plastics.

The aim of the Quickstart series is to promote the design of products and services that are sustainable - that is, products and services that contribute to social progress and economic growth, as well as providing ecological benefit, throughout their life cycle. The sustainability of a product is largely locked in at the design phase, which is why D4S is so important.

The Quickstarts are written for practitioners at every stage of the plastics product chain, including designers, polymer suppliers, product manufacturers, brand owners and specifiers.

The series also supports the implementation of PACIA's Sustainability Leadership Framework (2008), which promotes a whole-of-life approach to product innovation and stewardship and the need for step-change 'transformations' in material and resource use.

There are several principles which underpin D4S, including the triple bottom line, a life cycle approach and step-change transformations. These principles should be integrated within existing design processes.

# Principles of design for sustainability

**Triple bottom line sustainability**[1]

D4S requires a balanced approach which considers the environmental benefits and impacts of the product along with its cost, function, performance, durability, availability and safety. This is consistent with the triple bottom line approach to sustainability:

- Social and ethical progress - the product should be beneficial in use without generating any harmful side-effects on human health or quality of life;
- Economic growth - the product should be technically and commercially feasible and preferably offer lower life cycle costs to the consumer; and
- Ecological benefit - the product should promote environmentally responsible behaviour while minimising impacts on the natural environment.

**Life cycle approach**

While the focus of this series is on design for sustainability with a specific group of materials - plastics - this can only be achieved by considering the benefits and impacts of materials within the context of the manufactured product and its total life cycle (see Figure 3 on page 5). For example, most plastics are technically recyclable in their pure form but their combination with other materials and their design and composition may affect recyclability. Products therefore need to be carefully designed to maximise recyclability. Systems also need to be established for collection and recovery if a product is to be recycled.

**Step-change transformations**

Based on current trends in population and economic growth, global consumption of natural resources and emissions to the environment are not sustainable. Research indicates that a significant improvement in efficiency is needed in order to become ecologically sustainable in the medium to long term[2]. PACIA's Sustainability Leadership Framework encourages businesses to identify opportunities to transform the way products and processes are designed. Designers can support this process by developing new and innovative ways to deliver product value with significantly less impact, for example by:

- using new technologies to radically reduce material quantities for production;
- transitioning to feedstocks and energy from renewable sources;
- adopting and integrating new business models, such as providing services as well as products; and
- developing new partnerships along the value chain.

A brief list of D4S strategies is provided below, and more detail will be included in future Quickstarts. These strategies relate to different stages of the product life cycle. All stages need to be considered during the design phase because this is when most of the benefits, impacts and fate of the product are 'locked in'.

*House with plastic siding (image supplied by Formplex)*

# Strategies for design for sustainability

**Raw materials and product manufacture**

- Use the minimum number and quantity of materials required for functionality
- Use recycled materials where this does not compromise purpose and functionality (e.g. durability) and provides environmental benefits
- Assess potential risks associated with additives, adhesives and finishes to minimise any ecological and health and safety impacts during manufacture or use
- Design products which are more energy and water-efficient to manufacture
- Encourage recycling of production wastes

**Product use**

- Ensure that the product meets all health and safety regulations
- Design for durability where relevant to the product use, including easy maintenance, repair and upgradeability
- Products containing toxic substances should be labelled with instructions for safe use, storage, handling, decontamination and disposal in line with regulatory requirements
- Design products which:

- eliminate or minimise stand-by power
- are able to use renewable energy, e.g. solar, wind or kinetic power

- Design products and packaging which are lighter and more efficient to transport
- Encourage consumers to use products more efficiently to minimise energy and water use, e.g. through an improved user interface or product instructions

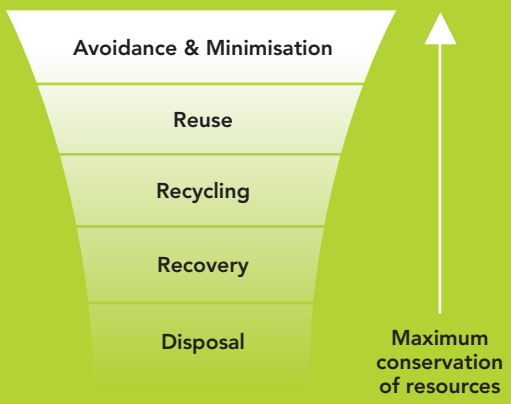
**Product recovery**

- Identify and design for the most appropriate strategy for recovery at end-of-life, i.e. reuse, remanufacture, mechanical recycling, biological recycling (e.g. composting) or energy recovery, based on how and where the product will be consumed, the sustainability impacts and benefits, and available recovery systems
- Aim to maximise the conservation of resources over the product life cycle by following the waste hierarchy (Figure 1)
- If the product is to be reused: design for durability, ensure that a system is in place for recovery and provide instructions for the consumer
- If the product is to be recycled: select recyclable materials, minimise the number of materials used, use materials compatible in recycling, ensure that complex products can be easily disassembled, avoid finishes which can't be recycled, label all plastics components with an identification code, ensure that a system is in place for recovery and provide instructions for the consumer
- If the product is to be composted: select a material which is certified to a composting Standard[3], ensure that a system is in place for recovery, avoid additives which could contaminate the compost, and provide instructions for the consumer
- Design products which are more energy efficient to collect and recycle
- Encourage consumers to reuse, recycle or compost products or packaging where systems are available
- Label plastic components according to the Plastics Identification Code or ISO 11469
- Promote the sustainability benefits of products and packaging but ensure that claims and labels are accurate and not misleading, in compliance with AS/NZS ISO 14021 and the Trade Practices Act

**Product transformation**

- Design new and innovative products to solve environmental or social problems
- Rethink the business model, e.g. replace a product with a service
- Create products and services which minimise the need for energy or water
- Design products from materials with the lowest environmental impacts over the life cycle
- Close the loop on a supply chain to recover material for reuse or recovery

**Figure 1: The waste hierarchy**[4]



There are many different groups that can influence the sustainability of a plastic product, including raw material suppliers, product manufacturers, designers, specifiers, consumers and recyclers (Figure 2). Collaboration and communication between all stakeholders in the product chain is essential to maximise the product's contribution to social progress, economic growth and ecological benefit during the product life cycle.

# The design & procurement process

**Figure 2: Decision makers and their contribution to D4S**

| | |
|---|---|
| Polymer supplier | • Support R&D to continue enhancing the sustainability and efficiency of polymer solutions<br>• Provide sustainability information to the product chain |
| Product manufacturer | • Minimise and recycle plastics waste<br>• Maximise energy and water efficiency |
| Consultant designer | • Specify and meet D4S requirements in the design brief<br>• Continually investigate sustainable materials / technologies |
| Brand owner | |
| Product development | • Work with the marketing group and consultant designer to specify and implement D4S requirements |
| Production | • Maximise energy and water efficiency<br>• Recycle in-house waste |
| Marketing | • Specify D4S requirements in the design brief<br>• Promote sustainability benefits of the product<br>• Promote sustainable use and recovery of the product and packaging |
| Corporate affairs / environment | • Work with governments and recyclers to establish recovery systems |
| Customer (e.g. building specifier, retailer) | • Specify D4S requirements in procurement guidelines or tender documents |
| End user | • Reuse, recycle or compost waste products |
| Federal, state and local governments / recyclers, composters | • Expand recovery systems for plastic products |

**Regulations and standards**

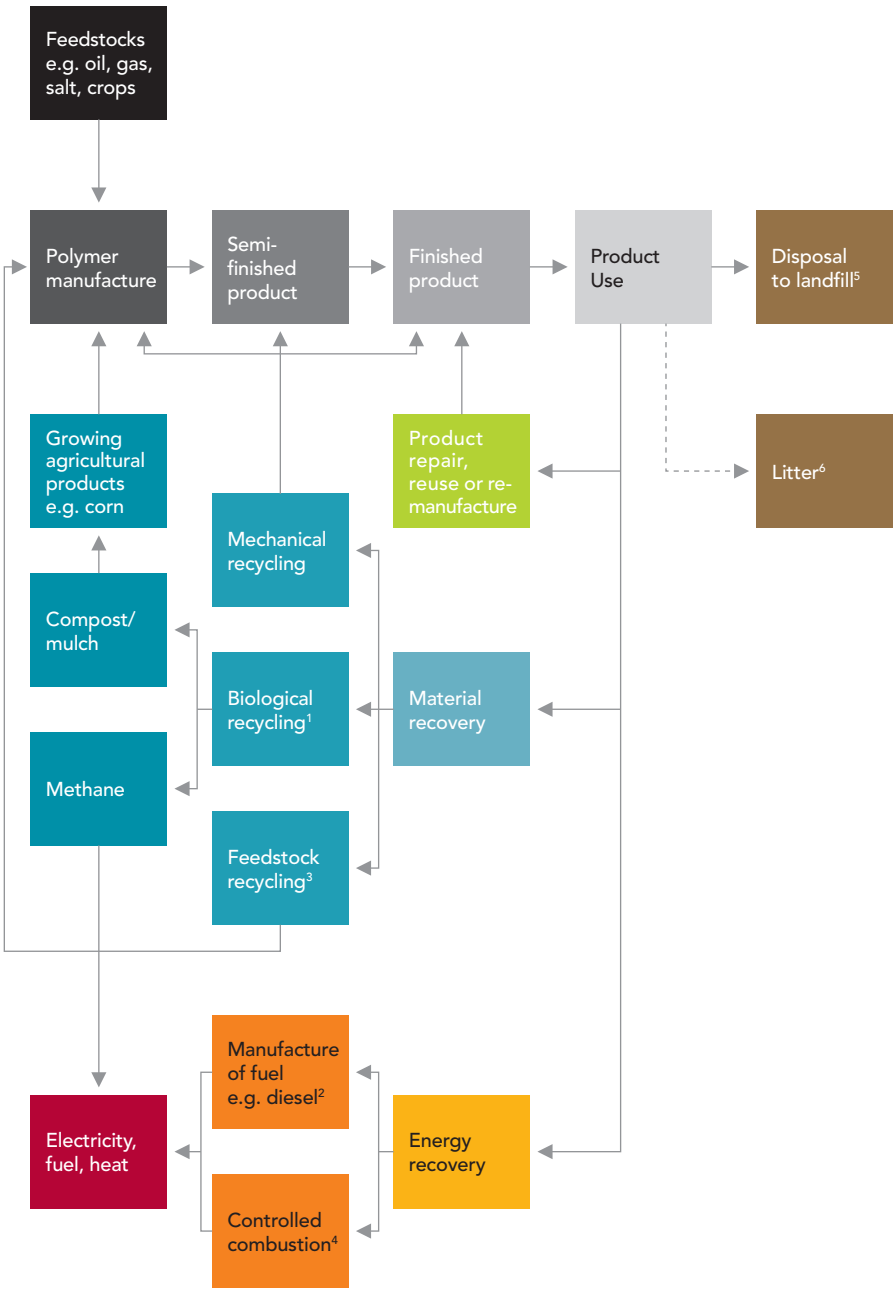
Designers, manufacturers, brand owners and retailers need to ensure that they comply with all relevant regulations and standards which promote the safe and sustainable use of plastics. A guide to D4S regulations and standards is available on the PACIA web site.


Sustainability can only be achieved by considering the benefits and impacts of materials within the context of the manufactured product and its total life cycle.

*Satchel bag produced from recycled billboard sign*

# Design principles - the plastics life cycle

**Figure 3: Life cycles and material flows for plastics**




Notes:
1. Commercial composting is still in its infancy in Australia
2. Pilot plants exist overseas but not currently in Australia
3. This technology is used on a small scale overseas but not currently in Australia
4. This technology is commonly used overseas but not currently in Australia
5. Whilst landfill is used, it is a least preferred destination
6. Litter is a problematic reality for some product types and needs to be eliminated

The Quickstart series is part of the 'Design for sustainability with plastics' program managed by a collaborative partnership between Sustainability Victoria and PACIA. The Quickstart series can be downloaded from www.pacia.org.au.

*Image supplied by Schiavello*

**Further information**

***Books and reports***


Lefteri, C. 2001, *Materials for inspirational design: plastics*, Rotovision, Hove, East Sussex.

PACIA (2008), *Sustainability leadership framework for the plastics and chemicals industries*, Melbourne

PACIA (2007), *Using degradable plastics in Australia - a product stewardship guide and commitment*, Melbourne

PACIA (2003), *Plastics identification code*, Melbourne

PACIA (1992), *Know your plastics*, Melbourne

Plastics New Zealand (2006), *Design for the environment guidelines*, Auckland (http://www.plastics.org.nz)


***Organisations and web sites***

PACIA
(for the D4S toolbox and further information on plastics):
www.pacia.org.au;
phone 03 9429 0670 or
email to info@pacia.org.au

Sustainability Victoria
(to download a range of D4S resources):
www.sustainability.vic.gov.au

**Publication details**


*Quickstart: design for sustainability with plastics* was prepared by Helen Lewis Research for Sustainability Victoria and the Plastics and Chemicals Industries Association (PACIA) with input and advice from practitioners and others involved in the sector.

Printed on synthetic Yupo Ultra stock which is manufactured from polymer composite.

Product stewardship program:
This brochure is recyclable by returning to PACIA at P.O. Box 211, Richmond, Victoria 3121


**Footnotes**

1 The 'triple bottom line' metaphor was originally used by John Elkington (1999) in Cannibals with Forks: The Triple Bottom Line of 21st Century Business, Capstone Publishing, Oxford. The concept has since been applied to sustainable design—see Ursula Tischner and Martin Charter (2001), 'Sustainable product design', in Charter, M. and Tischner, U. (eds.), Sustainable Solutions, Greenleaf, Sheffield, pp. 118-138.

2 Useful references include Weaver, P., Jansen, L., van Grootveld, G., van Spiegel, E. and Vergragt, P. 2000, Sustainable technology development, Greenleaf Publishing, Sheffield; Schmidt-Bleek, B. 2000, Factor 10 manifesto, http://www.factor10-institute.org/files/F10_Manifesto_e.pdf; and von Weizsacker, E., Lovins, A. and Lovins, H. 1997, Factor 4: Doubling Wealth - Halving Resource Use, Allen & Unwin, Sydney.

3 Refer to the 'degradable polymers' web site at www.pacia.org.au.

4 Wastenet, www.wastenet.net.au/System/images/waste_hierarchy/view?searchterm=waste%20hierarchy.