

Design for the environmental emergency: Plastic chairs and the transition to low-carbon product design

by Geoff Isaac

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Geoff Isaac, declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Design, Architecture and Building at the University of Technology Sydney.

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List of abbreviations

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AM	Additive manufacturing
APCO	Australian Packaging Covenant Organisation
BPA	Bisphenol A
CAGR	Compound annual growth rate
CMHR	Combustion modified high resiliency
ERPR	Environmentally Responsible Product Rating
ESG	Environmental, Social and Governance.
EU	European Union
Fibreglass	Fibreglass reinforced plastic (usually epoxy or polyester)
GMOs	Genetically modified organisms
HDPE	High density polyethylene
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LCA	Life-cycle assessment
LDPE	Low density polyethylene
MLP	Multi-level perspective
NSW EPA	New South Wales Environment Protection Authority
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
PB	Planetary boundaries
PBAT	Poly(butylene adipate-co-terephthalate) – a starch-based biodegradable composite,
PBS	Polybutylene succinate - poly(butylene succinate)
PC	Polycarbonate
PE	Polyethylene
PET	Polyethylene terephthalate - a polyester thermoplastic
PFAS	Per- and polyfluoroalkyl substances sometimes used as a grease and water repellent in food packaging – especially PLA
PHA	Polyhydroxyalkanoates – for example, poly- β -hydroxybutyrate (PHB), the first of the biodegradable plastics made through a fermentation process
PLA	Poly(lactic acid) – a polyester thermoplastic derived from renewable resources
PMMA	Poly(methyl methacrylate) acrylic glass often known by the trademark names Plexiglas, Lucite or Perspex
PP	Polypropylene
PU	Polyurethane
PVC	Polyvinyl chloride
RIC	Resin identification code
SKU	Stock-keeping unit
VCM	Vinyl chloride monomer – an ingredient of PVC
UN	United Nations
WWII	World War II

Abstract

Analysing the intersection between plastics, environmentally-conscious design, and consumption through a focussed study of plastic chairs, this dissertation casts new light on best practice for sustainable furniture design. Plastic chairs are ubiquitous but remain objects of constant innovation and experimentation by designers. With reference to historical and contemporary developments, I examine the shifting cultural attitudes to plastics. Product designers and furniture manufacturers are responding to mounting environmental concerns by experimenting with renewable carbon plastics (recycled plastic and bioplastics). My interviews with international contemporary designers and representatives from industry are critically evaluated, alongside case studies of recent plastic chairs made using renewable carbon plastics. Findings from that research led me to develop a quantitative eco-audit tool to enable a comparison of these designs and demonstrate that the best outcomes for sustainable design incorporate existing materials (recycled plastics) and traditional moulding technologies. This tool is presented in this dissertation as both a structural part of the research methodology, and as an output for the instrumentalisation of the study's findings.

Much research has been undertaken on sustainable design and there have been many calls for design-led societal change. But few studies have focused on how such change actually manifests, or identified the areas of research required to bring about transformation. In other words, what does it really take to shift design and manufacturing practices, at scale, across complex supply chains? The multi-level perspective (MLP) transition framework is used to identify strategies to scale-up the use of renewable carbon plastics in design. Providing a methodology for designers to embrace a more sustainable approach to the design of plastic products, this dissertation is also a call to arms for urgent action to mitigate the most devastating impacts of the environmental emergency.