

From Waste to Wealth using Green Chemistry

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We live in a society with an increasing appetite for consumer goods but in a world that has limited resources. Our current linear economic model is based on the extraction of resources from the earth, processing to make articles and then use followed by disposal. Slowly but surely we are transferring our precious resources into environmental burdens - landfills and uncontrolled pollution such as plastics in the oceans. This is not an intelligent use of resources and is not sustainable. We must move to a circular economic model whereby resources are kept in short cycle uses and we must make those cycles efficient and safe. The methods of Green Chemistry should enable chemical reactions to be performed with non-hazardous substances, minimal energy and produce no waste. By combining Green Chemistry with the Circular Economy model we can aspire to achieve a truly sustainable society¹.

The most interesting of the large volume wastes is bio-wastes including forestry and agricultural by-products, and food supply chain wastage. These can be seen as renewable resources and can form the basis of future bio-refineries gradually replacing petroleum-based refineries. To fully exploit the concept and make it widely useful while maintaining environmental advantage, we need to show that Green Chemistry lives up to its promises. This means the right technologies to extract the molecular value from the wastes and ensuring that future products from bio-refineries are genuinely green and sustainable. New, energy efficient green chemical technologies that can convert a wide variety of waste streams into valuable chemicals and energy include low-temperature microwave processing, benign solvent extraction and new bio-based platform molecules. The integration of thermo-chemical and bio-chemical technologies will also become increasingly important as we seek to increase the efficiency of biomass conversion and chemistry on fermentation broths is also an important challenge in this area.

A wide range of projects will be described to help illustrate how we can apply green chemical technologies to the valorisation of wastes. These projects are usually carried out in consortia often involving industry and on many occasions ranging across more than one country^{2,3}. Our new international green chemistry centres network (www.g2c2.greenchemistrynetwork.org) helps create multinational partnerships that can meet new opportunities for tackling global challenges.

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3. De bruyn, M., Fan, J., Budarin, V.L., Macquarrie, D.J., Gomez, L.D., Hallam, R., Farmer, T.J., Ravery, W., McQueen-Mason, S.J. & Clark, J.H., *Energy Environ. Sci.*, 2016, 9, 2571-2574.