

## Chapter 19

# Teaching of Sustainability: Higher Education (HE) Case Studies

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### ABSTRACT

*Following a discussion of the means of introducing sustainability and sustainable design into the engineering curriculum, this chapter provides examples of the approach taken when teaching these subjects through the use of case studies at a traditional research-intensive higher education institution in the UK: Newcastle University. This chapter demonstrates the range of topics that have been addressed through examples of case studies and discusses the methods of delivery and assessment within the curriculum. The result of a cross-curriculum mapping exercise is presented, showing how sustainability teaching can be incorporated into a variety of undergraduate and postgraduate programmes.*

### INTRODUCTION

The traditional public perception that engineers are responsible more for the problems that inhibit Sustainable Development rather than being potential providers of the solutions (Haile, 1999) is increasingly challenged by the new generation of engineers educated to increase their aware-

ness of the sustainable development principles. In the UK, professional institutions such as the Royal Academy of Engineering, the Institution of Chemical Engineers (IChemE), the Institution of Civil Engineers and the Institution of Mechanical Engineers require that the Higher Education (HE) providers seeking accreditation of their courses demonstrate sufficient provision of embedded teaching of Safety Health and Environment (SHE), Sustainability and Ethics. However, challenges in covering these issues and engaging students within

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a time-constrained curriculum already demanding delivery of many fundamental engineering concepts can lead to sub-optimal solutions.

The importance of incorporating sustainability and sustainable development into engineering curricula has been widely argued (e.g. Garcia-Serma et al., 2007; Conlon, 2008; Bryne & Fitzpatrick, 2009; Hall & Howe, 2010) with Bryne and Fitzpatrick (2009) arguing that "...because engineers will ultimately help design any new society, they bear a moral and ethical responsibility to play an active and indeed central role in its development. Therefore, a new engineering paradigm is required, whereby sustainability becomes the context of engineering practice."

Within the UK, extensive support is available to engineering educators from the Royal Academy of Engineering, e.g. through a "Visiting Professor in Engineering Design for Sustainable Development" Scheme (RAE, 2013) which started in 1998 and benefited a number of HE institutions. Under the scheme to date, 28 visiting professors, usually from industry, have been appointed at 26 Universities across the UK. Additional support is also available through the RAE support of the Teaching Fellows under schemes supported by Shell and ExxonMobil and through literature reports on case studies as a means of delivery of sustainable development, e.g. Norman et al. (2002), Hall and Glendinning (2012). In the case of the chemical engineering programmes specifically, the IChemE's Education Special Interest Group regularly organises workshops and webinars with sustainability and ethics as a major theme. At the most recent workshop (IChemE, 2013) a group of academics, industrialists and students met to discuss further innovative ways of incorporating sustainability into chemical engineering curriculum right from the early stages of the degree programme, focussing on the use of industry based case studies. The presentations from Aston University and Newcastle University in particular described the potential benefits of

such an approach in achieving opportunities for integration across the curriculum (IChemE, 2013).

The question of the most appropriate methods of delivering sustainability related topics within an overstretched technical curriculum of engineering programmes has been debated extensively in the literature with varying protagonist ideas (Hall & Howe, 2010, Mulder et al., 2012). The study of Allen et al. (2009) to establish how sustainability is being incorporated into the US engineering curriculum reviewed 366 engineering colleges. The survey identified 155 courses across all the engineering disciplines including civil, environmental, mechanical and systems engineering and also chemical, bio and materials engineering. The authors then discussed four main strategies for incorporating sustainable engineering into engineering curricula: dedicated sustainable engineering courses in any of the major disciplines, integration of sustainable engineering concepts into existing courses to raise awareness of students, focus on technologies which will be important in sustainable engineering and mixed teaching strategy and interdisciplinary courses with non-engineering departments.

Recently, the number of reports in the literature detailing approaches of various higher education institutions around the world to introducing the sustainability and sustainable development into their curriculum has been increasing rapidly. For example Peet et al., (2004) reported the experience of DTU at Delft in The Netherlands, Biswas (2012) detailed the experiences of the Curtin University in Australia with the introduction of Engineering for Sustainable Development (ESD) and similar experiences at the Chalmers University in Sweden were reported by Swanstrom et al., (2012) whilst Holmeberg et al. (2008) compared UPC Barcelona, Spain, DTU Delft, The Netherlands with the Chalmers University in Sweden. These articles also provide useful descriptions of various institutional approaches to embedding sustainability, e.g. the Individual Interaction Method. Additional useful descriptions of sustainability

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