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## Green IS in Teaching: Specialist or Generalist?

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## Green IS in Teaching: Specialist or Generalist?

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### Abstract

It is becoming recognised that the question of "sustainability" or ("green-ness") has a significant role to play in the teaching of information systems in higher education. In response, some institutions have developed specialised courses, typically at graduate level, either as components of wider programmes, or in their own right. Others have integrated the topic into undergraduate teaching, perhaps as a component of systems analysis and design courses, treating environmental impact as a design constraint within a solution. Computer science programmes may use their computer architecture-themed modules to introduce the relationship between hardware design and energy use or the ethics and professionalism strand may be developed through consideration of electronic waste or the legal issues around the need for compliance with legislation. This shows that there is considerable variation possible in breadth and depth of content, and raises the question of appropriateness, suitability of material and targeting at an appropriate level. There also exists considerable potential for variation of emphasis in presentation according to students' motivations: some might respond positively to a focus on cost-saving; others on behaving "responsibly" and environmental sustainability; others may approach the question from the perspective of a sceptical approach to the claims for "green-ness". Of course, these should not be exclusive, but the initial approach to a topic can significantly impact the style of work and themes selected. We consider a grading and taxonomy of material, giving indications of the information, case studies, research and practical activity most suitable for students of differing background and interest.

**Keywords:** Green Computing, Sustainable Development

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## INTRODUCTION

The collection of interest and activities which can be gathered under the umbrella term “green computing” has its roots in efforts to define, and then to reduce the energy consumption of computing technology. These efforts have manifested themselves in various technological initiatives including measurement techniques to assess the Power Usage Effectiveness (PUE) of data centres; technological developments such as virtualisation and thin client technology which aim to reduce the overall power envelope and low power (“sleep”) modes which save energy use from unused devices.

A more recent development has seen the emergence of “green information *systems*” as a topic of study. For the purposes of this paper, we define a green IS as a system which uses computing technology and which should seek to do so in a manner which minimises its energy use, commensurate with doing the tasks required of it. However, we also note that a further area of development is emerging, in which an IS can be deployed to deliver changes in work patterns and organisational processes which are able to reduce the *overall* energy requirement of an organisation (Climate Group, 2008). This is an example of the 2% / 98% (or 10:90%) concept: recognising that “IT” is responsible for 2% of the world’s greenhouse gas production (or 10% of electricity), improvements in IT efficiency itself can impact that 2%. However, the remaining 98% offers a much bigger target, and using a green IS to support activities such as tele-working, electronic data exchange and storage, environmental control in buildings etc. offers opportunities to reduce that element, with potentially much greater benefit.

## GREEN IS IN THE UNIVERSITY CURRICULUM

There are a number of reasons why green IS has a role in the curriculum for IS / CS:

- It offers a potential employability advantage: The previous U.K. government’s report *jobs of the future* (HM Government, 2009) stated that “... [the] transition to a low carbon, resource efficient economy ... could support the creation of hundreds of thousands of skilled, green jobs for workers in this country. ... Emerging trends in the IT and telecoms sector including social computing, green IT and growing convergence of communications, computing and content platforms are likely to be further drivers of employment growth ...”
- It meets universities’ aspirations to behave responsibly and ethically in their dealings: by introducing students to the environmental effects of their use of IS, a range of issues can be discussed and debated. In addition, by raising awareness of potential solutions, universities are playing their part in enhancing overall sustainability
- It is an area of student interest: 2010 is the mid point in the United Nations’ “decade of education for sustainable development” (United Nations, 2002), and, as the UN world youth report observes “young people” (who continue to form the bulk of our student intake) “...continue to have a strong interest in protecting ... the planet’s resources” (United Nations, 2005).

Green IS also offers a number of possible avenues for case study examples which can draw from other curriculum areas, giving those real context and interest. We will discuss those in more detail later in this paper.

## FINDING A PLACE

The “best” location for a consideration of green IS in any general curriculum is an area for ongoing debate, and is very much dependent on local requirements and context. The various

possible locations, and the arguments for and against each of them, are similar to those for other specific topics:

- A part of the introductory sessions to set an overall flavour for the course, allowing green issues to pervade other areas, but potentially diluting the effect as one of a number of “important considerations”
- Within a “sustainability” module, allowing in-depth treatment by faculty with specialist interest and enthusiasm, at the risk of it being isolated within that module.
- Discussed in some detail within other modules as appropriate to the specific issues being addressed, offering the chance to fully contextualise the ideas, but the risk of being considered as a chore (Gordon, 2007).

We also note that there is the opportunity for specialist courses and curriculum, where students focus on issues of sustainability. An example is the MSc Green Computing program at Leeds Metropolitan University, where students study a set of modules covering measurement and assessment of IT systems; technological improvements to reduce energy use; opportunities for using IT/ IS to address organisational energy use; related legal and regulatory matters; strategy development and leadership (Pattinson, 2010).

### FINDING A FOCUS

As with location, the focus of treatment also offers a number of options, both in terms of the material and examples, and the motivation of the teacher. We suggest that the scientific, open minded approach to these matters is the one most likely to yield results, an overly sceptical or overly enthusiastic approach will probably be counter-productive, the nature of the material, offering opportunities to debate the underlying science, social and societal drivers, legal and organisational frameworks as well as matters of measurement and “harder” computing developments allow interest to be generated from a number of perspectives. This can also include a focus on the business case for such content, with a focus on return on investment and as a pro-active response to wider pressures such as carbon taxes and the requirements of some organisations to become carbon neutral. Such motivation mitigates any contentious issues around the validity or otherwise of global warming and environmental controversy. We do believe that the twin approach which sees IS both as problem, through inefficient use of technology, and as solution, by enabling energy-saving changes in other activities is essential, and certainly fits with current research trends. We also suggest that this concept is so fundamental that it should find a place in all IS curricula, with specialist study as appropriate to likely future employment and motivation. Taking server virtualisation as an example: it is likely that many (most) newly-developed ISs will be deployed in a virtual environment, therefore IS designers need to be aware of any opportunities and restrictions arising from such deployment; those responsible for implementing and maintaining the IS will have to understand how virtualisation works; those who develop the system will need to create applications which exploit it and those who create the technology platforms must be able to deploy, manage and delete virtual instances appropriately.

### EXAMPLE CASE STUDIES

As noted above, a number of normal IS issues lend themselves very well to consideration of matters of green-ness or sustainability. We give examples of some which we have used at Hull and Leeds Met.

In IS teaching many examples of environmental impact can be found – such as the environmental cost of regular and on-going upgrading of hardware. Software also has a cost –

including both the direct through running the software (noting that processor intensive programs increase power usage) and the indirect, such as the cost of having to replace hardware in order to run the latest release of an operating system and/or an application. The financial and social cost to individuals, institutions and nations of these examples offer opportunities for teachers to explore numerous topics, and to develop this awareness in learners. These provide good cases to develop discussions on ethical, social and professional and legal topics. Such explorations may include considering different approaches – such as developing less resource intensive systems or perhaps open source solutions. Teaching resources - such as photos of piles of obsolete keyboards, or of children in third world countries recovering wiring and chips from pc motherboards which organisations such as Greenpeace (2008) provide can illustrate to students the wider impact of IS. This material links with professional development and awareness (Gordon, 2009) – for example, within computing material can be linked with the I.T. industry codes of practice for data centres (European Union, 2009) and other guides which have a growing emphasis on sustainability. The case for including such material would be strengthened if there was an IS equivalent to the Leadership in Energy and Environmental Design certification that is available to recognise green building design, that is a benchmark for Green IS that could be applied to IS and could be supported and taught through courses.

Regarding the teaching and developing of material on green IS, projects, dissertations and industrial placements all offer effective ways of delivering it. Final year projects and industrial placements in particular both potentially offer specific links with industry and allow real world problems and issues to be dealt with by students. Projects are particularly suitable to charity and developmental ideas, where sustainability has an important role, and yet may lack the funding or support for traditional funding and development routes. Some examples of projects which have run in our courses include:

- A student group (undergraduate BSc Information Systems) who carried out a full assessment of the energy use and potential savings for a local charity office
- MSc students dissertation project work: addressing the issues in applying ISO 14001 within an organisation; developing a model for a voluntary carbon trading scheme between non-business organisations
- Undergraduate and postgraduate projects: developing a low-cost, low-energy wireless LAN server; modelling power saving within a data network; the distribution of energy across the cloud; modelling thin client technology

## CONCLUSIONS

We believe that sustainability (or green-ness) should be a significant element of the IS curriculum, equal in importance to areas such as professionalism and ethics, but distinct from those. It should be addressed at levels appropriate to the students' requirements and those of the specific course. The variety of topics, levels and approaches available mean that it is a rich source of examples and discussion materials.

Belief and active demonstration of the importance of sustainability by teaching staff is essential if students are to be likely to take this on board as part of their own learning. In the modern HE environment, where students are often assessment driven, sustainability may most effectively be promoted by ensuring that it is included in materials that are assessed. This does not guarantee that students are convinced of the need and the arguments, but would at least ensure they were aware of the issues. Such content would be strengthened through the development of benchmarks for green IS and for a recognition of that in benchmarks for the teaching of IS.

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