Complete Campus Engagement via Embedding Ecological Footprinting Curriculum

Richie Howitt  
*Department of Environment and Geography, Macquarie University*

Sara Rickards  
*Department of Environment and Geography and Property, Macquarie University*

Recommended Citation


Complete Campus Engagement via Embedding Ecological Footprinting Curriculum

Richie Howitt  
Department of Environment and Geography, Macquarie University

Sara Rickards  
Department of Environment and Geography and Property, Macquarie University

A central sustainability goal in the tertiary sector is to equip and engage current and future generations with an understanding of interdependencies between individuals, society, environment and the economy, and to enable students to apply this understanding to their own decision-making in a resource constrained world. The Ecological Footprint has emerged as the world’s premier measure of humanity’s demand on nature. This approach provides an understanding of how much supply is available, how much is used and who uses what. In order to investigate environmental educational outcomes, a four stage (Year 1, 2, 3 and alumni) two-tiered learning strategy has been developed. The first tier engages students in a personal Ecological Footprint assessment at commencement, which is repeated at intervals through the degree and into Alumni. The second tier will engage students with a Campus Ecological Footprint analysis whereby students evaluate a Faculty’s base-case and make recommendations to reduce the impact of Faculty operations. This exercise will assist Macquarie University’s future planning for a more sustainable campus. The research hypothesis is that this pedagogical intervention will increase the students’ likelihood of taking conscious and deliberate actions to mitigate the ecological impact of their personal and business activities and show a permanent shift to this type of behaviour. This paper presents the methodological approach, examples of the program’s design and promising early stage results. Evaluation of outcomes will continue and provides the opportunity for a unique longitudinal study of how such curriculum supports students to contribute to the one planet goal.

Keywords: Ecological Footprint, Curriculum Effectiveness, Student Engagement, Campus, Faculty

Introduction and Background

Does tertiary environmental education change the behaviour of students? Faced with this key question, Macquarie University’s Department of Environment and Geography teamed up with the University’s Sustainability Team to embed ecological footprinting (EF) into the environmental management curriculum. In turn, this will provide students with tools for understanding the value of footprinting in a range of settings. The EF curriculum project is part of a wider research agenda to investigate the effectiveness of the environmental management curriculum, in changing the behaviours that increase students’ ecological footprints, and to better understand the institutional footprint of the university as a whole. The pedagogical approach used in this project sees the students involved in an investigation of and consideration of the transparency of campus operations in environmental terms and examines the EF’s of individual Faculties. This approach uses the Campus operations as a living laboratory and allows for cross disciplinary collaboration.

The 2001 Universities of Australian Ecological Development Charter declares that universities are responsible to act as role models for the broader community. It is recommended that this is achieved through the education of future generations about sustainability practices and incorporation of such practices, into their own university operations (National Union of Students, 2001; McNamara, 2010; Collins, 2012). Rather than pursuing these goals in isolation, Segalas, Ferrer-Balas & Mulder (2010) argues that using universities as experimental laboratories, will create ecological learning environments, and allow for monitoring of the effectiveness of universities in terms of ecologically sustainable development (ESD).

Environmental educators optimistically anticipate that their engagement with students will produce sustained improvements in the environmental behaviours of their pupils. Graduates of the best educational institutions, however, are amongst those responsible for leading the world down the current unsustainable path (Cortese, 2003). It is widely acknowledged that intention is a key determinant of behaviour (Austin & Vancouver, 1996; Eagly & Chaiken, 1993; Gollwitzer & Moskowitz, 1996; Maddux, 1999; Conner & Norman, 2005; Web & Sheeran, 2006). Empirical research on the effectiveness of environmental education in actually changing the intentions of students and subsequent personal & business behaviours over a sustained period of time is extremely limited. This project is developing a long-term framework for investigating Macquarie students’ environmental behaviours over time. Macquarie’s environmental management program has been characterised by a curriculum that supports students in framing a professional literacy in reading the complex landscapes of environmental decision making and offers them:

… opportunities to construct a conceptual toolkit relevant to their own professional needs and include the development of their own capacities to see, think about and practice ‘better’ resource management. Students are guided beyond their comfort zones, with taken-for-granted technical and scientific facts put into new contexts through consideration of cultural perspectives, alternative philosophical positions, ontological pluralism and unanticipated outcomes. Through reading, discussion, role-plays and reflection on field-based experience we challenge students with a range of learning experiences, which insist that they frame and reframe key issues (Suchet-Pearson & Howitt 2006, p. 122).

A central sustainability goal in the tertiary sector is to equip and engage current and future generations with an understanding of interdependencies between individuals, society, environment and the economy, and to enable students to apply this understanding to their own decision-making in a resource constrained world (Cooper and Scott, 2009). Due to these issues transcending disciplinary boundaries, the approach required to achieve this goal requires cross-disciplinary collaboration and corporation (Cortese, 2003). To break down the disciplinary barriers created by the traditional framework of universities, complete campus engagement for the common goal of a “one planet” campus is proposed.

It is widely acknowledged that the environmental impact of human behaviours is unsustainable (Haberl, Wackernagel and Wrbka 2004; Kitzes et al., 2007; Reese 1996; McNichol, Davis & O’Brien 2011). Species extinction, deforestation and global warming indicate that humanity’s demand on nature is exceeding the regenerative and absorptive capacity of the biosphere (Borucke et al., 2013). In order to address overconsumption there is a need for practical approaches to measure how much is consumed by people, products and services, and also determine what level of consumption is sustainable at a variety of scales (Pearce and Uhl, 2003).

EF has emerged as the world’s premier measure of humanity’s demand on nature (Chikoti, 2012). This approach provides an understanding of how much supply is available, how much is used and who uses what (GFN, 2013). EF analysis is an easy-to-understand tool, which calculates a study population’s demand on nature in terms of bio-productive land and water (Rees 1996; Wackernagel and Rees 1996). The impact results are reported in terms of global hectares (gha) per annum, per functional unit (Wackernagel and Rees, 1996). Using the National Footprint Accounts (NFA) to measure human appropriation (EF) and the biosphere’s supply (biocapacity) humanity’s current demand on the planet is 1.5 planets (in 2008) (Borucke et al., 2013).

EF methodology has been applied to University Campuses in China (Li et al., 2008) (Gu et al., 2005) the US (Venetoulis, 2001; Conway et al., 2008; Klein-Banai & Theis, 2011) and Australia (Flint, 2001), just to name a few. These methodologies have largely been one off assessments focusing on operational expenditure. Ongoing and more in-depth assessments have probably been avoided due to the time consuming nature of reporting (Graymore, Sipe & Rickson, 2008). However, the recently developed campus calculator by The Footprint Company™ has reduced the time and therefore cost involved in undertaking these analyses and allowed Macquarie University to utilise the methodology in both operations and learning and teaching.

Using a scaffolded approach to the undergraduate curriculum in the Environmental Management major (available in the BA, BSc and BEnv), the EF curriculum project utilises footprinting at 100-, 200- and 300-levels (first year, second year and third year) to measure individual footprints in students’ first
and final years of undergraduate study and to undertake a campus-based building footprint exercise in second year. The project will thus produce longitudinal information on individual’s footprints and longitudinal information on institutional footprints, as well as an understanding of what impacts the footprints of individuals, social groups, buildings and institutions. It is anticipated that work with the program alumni will allow investigation of the extent to which reduced footprints are maintained over time by graduates.

Through this pedagogical intervention, students explore and measure their own EF’s on entry to and exit from their program of study, and create a database for student and staff research activities. In addition, students will investigate the EF’s of each of the universities four faculties and model scenarios to assist Macquarie University in determining the key drivers of their campus EF on both a consumption category (biocapacity, energy, water, buildings, non-building items, operational items and transport) and Faculty level. Overall, this pedagogical approach has been designed as a sustainable on-going project.

Ecological footprint analysis (EFA) tools will improve student understanding and engagement with environmental impact at several scales (personal, communal and institutional). The campus environment and curriculum is responsible for shaping how students choose to live and in turn, how they will change and shape work places, neighborhoods and cities as graduates (Hyuuan and Yang, 2012)

Overall, EF provides a powerful tool for illustrating, assessing and engaging students, staff, faculties, campuses and communities, with the hope of achieving the common goal of “one planet” consumption.

Methodology

The study site

Macquarie University Campus is 113 hectares located in North Ryde, Sydney. In the 2011 baseline year, there was 3488 full time equivalent (FTE) academic and support staff and 27084 FTE students. The university has four academic faculties (Arts, Science, Human Sciences, Business and Economics). The campus currently has a “One Planet 2030 Masterplan” strategy in place. This initiative has fueled the incorporation of EF into curriculum, to ensure complete campus engagement of the project.

One Planet 2030 strategy

At present 30% of Macquarie University is ‘built-on land’, with plans for growth and development to accommodate more students, as well as research and development partnerships. In order to achieve this growth and ensure that the impact on the planet is kept to a minimum, Macquarie University has teamed up with The Footprint Company™ to utilize their existing building calculators, in addition to creating a campus calculator. Together these calculators allow Macquarie to measure its whole-of-institution impact upon the environment.

The initial stages of the project involved assessments (and recommendations for the future management and development) of existing buildings and buildings in the design pipeline. This progressed to the calculation of the campus EF and the individual primary buildings. In order to implement the “One Planet Strategy” complete campus engagement was determined to be essential. Therefore, future property developments will undergo EF assessments to ensure new buildings achieve the same or more using less. While the design and construction of new and refurbished buildings is largely a concern for the campuses property management department, the day-to-day operations of learning and teaching are the responsibilities of the faculties. As such, a key target of the 2030 strategy roll out was engagement with faculties with regards to operational activities and consumption (Figure 1).
Pedagogical approach

In order to investigate environmental educational outcomes, a four stage (Year 1, 2, 3 and alumni) two-tiered learning strategy has been developed for incorporation into the Bachelor of Environment program, specifically students majoring in Environmental Management (Table 1). The development and incorporation of EF modules, into the compulsory units of study has established a common thread through the Environmental Management major curriculum.

Table 1: Summary of Embedding Eco-Footprinting into Curriculum

<table>
<thead>
<tr>
<th>Year</th>
<th>Pedagogical Strategy</th>
<th>Tier</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Lecture: Background development, global and Australian contextualisation</td>
<td>1</td>
<td>Personal</td>
</tr>
<tr>
<td></td>
<td>Tutorial: Personal EF calculation and questionnaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>Lecture: Campus contextualisation</td>
<td>2</td>
<td>Cross disciplinary collaboration and business context</td>
</tr>
<tr>
<td></td>
<td>Tutorial: Software demonstration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research Assignment: Environmental report and presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td>Lecture: Investigation of EF system, limitations and assumptions</td>
<td>1</td>
<td>Personal</td>
</tr>
<tr>
<td></td>
<td>Tutorial: Personal EF calculation and questionnaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alumni</td>
<td>Web Forum: Personal EF calculation and questionnaire</td>
<td>1 &amp; 2</td>
<td>Personal and business self</td>
</tr>
</tbody>
</table>

Primary point of engagement

Campus = Overall EF
Faculties = EF of campus
Sections = EF of portions of sections
Buildings = EF of campus

Figure 1: Conceptual image of implementation of One Planet 2030 Master plan via Environmental Management curriculum
Tier one: Personal EF calculation

The first tier engages students in a personal EF assessment at commencement, which is repeated at intervals through the degree (Year 1 and 2) and into Alumni. This process involved the introduction and background to EFA and its global and Australian context, in the first year. In the final year students are provided with a more in depth knowledge of how the EF “system” is modelled, which allowed for assumptions and limitations to be discussed. Orr (1992) emphasises that environmental graduates should be empowered with the ability to apply systems thinking, while also recognising limitations and challenging the presented model.

At these designated times, students performed two tasks, which allowed for quantitative and qualitative data collection. The first task involved using the Global Footprint Networks (GFN) personal footprint calculator to determine the student’s current EF. The second task is a questionnaire, which allowed for data tracking of the student’s own reported behaviours and contextual changes that might affect their EF. This approach was chosen, due to raw data driven approaches without additional qualitative insights having the potential to be less instructive of the situation (Eckel, 1999). It should be noted that the study population changes from year to year due to enrolment and exchange etc. Therefore, the students are tracked using their student number, to allow for the comparison of their personal EF and behavioural reflections.

The Global Footprint Network personal calculator

The GFN personal EF calculator utilises data from the NFA’s and the calculator matrix methodology is in accordance with the international EF standards (Borucke et al., 2013). In order to determine a personal EF, different categories (food, shelter, mobility, goods and services) are allocated to land types (forest, crop, grazing, energy, and fishing), resulting in a matrix, which utilizes a countries average consumption profile. The personal EF calculator increases or decreases the personal EF matrix, in response to answering questions related to the stated categories, relative to the national average behaviour (GFN, 2013). For in depth details on EF methodology and calculations see Borucke et al., (2013).

Tier two: Campus and Faculty EF calculation

The second tier will engage students with a Campus Ecological Footprint analysis whereby students evaluate each Faculty’s base-case and make recommendations to reduce the impact of Faculty operations.

The system boundary of the Faculty’s is represented by the physical site boundary of the buildings. This assessment considers the capital formation (the base building materials and infrastructure) of the Faculty and one year of operational requirements. Operational impacts per annum associated with energy, water, transport, tenancy and operational consumption are considered within the system boundary.

The aspects and activities within the dotted red line shown, define the system boundary considered within the calculation methodology (Figure 2). The primary data coverage and boundary is highlighted in Table 2.
Table 2: Primary Data Coverage and Boundary

<table>
<thead>
<tr>
<th>Footprint Aspect</th>
<th>Coverage and Meaning</th>
<th>Boundary and Inclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed Area</td>
<td>The ecological value of land removed from service through the construction of the building net of any “credit” for on-site ecological additions or improvements.</td>
<td>The ground plane footprint area of the proposed building(s).</td>
</tr>
<tr>
<td>Energy</td>
<td>The ecological value of carbon emissions arising for stationary energy</td>
<td>Base building energy requirements as entered and covering scope 1, 2 &amp; 3 emissions.</td>
</tr>
<tr>
<td>Water</td>
<td>The ecological and carbon footprint of water consumption by source, arising from operational requirements.</td>
<td>Incorporates all tenant / occupant use.</td>
</tr>
<tr>
<td>Buildings</td>
<td>The ecological impact of and carbon footprint of all materials required to create the building as measured finished in place.</td>
<td>The ecological and embodied carbon impacts from the site all the way upstream to the point of extraction of natural resources including all intermediate processing and transport. “Approximate” buildings are based on Australian national averages.</td>
</tr>
<tr>
<td>Construction Materials*</td>
<td>The ecological and carbon footprint of all materials required to create the building as measured finished in place.</td>
<td>The ecological and embodied carbon impacts from the site all the way upstream to the point of extraction of natural resources including all intermediate processing and transport.</td>
</tr>
<tr>
<td>Other Capital items</td>
<td>The ecological impact of and carbon footprint of all materials required to create the other capital items as measured finished in place.</td>
<td>The ecological and embodied carbon impacts from the site all the way upstream to the point of extraction of natural resources including all intermediate processing and transport.</td>
</tr>
<tr>
<td>Operational Items</td>
<td>The ecological impact of annual operational consumption.</td>
<td>Operational items such as IT &amp; electronics, paper &amp; print services, consumables, food &amp; drink and</td>
</tr>
</tbody>
</table>
Transport | The ecological impact of all occupant and user related transport to access the site. | All tenants/occupants on the basis of trip mode and vehicle kilometers travelled**.

Offsets (Biocapacity) | The ecological value of any activity specific to restoring, protecting or enhancing biological capacity whether on-site or off-site. | Off-site ecological protection or restoration activities are allocated to Offsets. Energy offsets purchased from 3rd parties are noted in offsets.

*Not directly measured in the Campus/Faculty calculation. Construction materials were assessed in the pre-assessment of campus buildings using The Footprint Company™ multi-use calculator.

** Data was only available for the campus, in following years differences between faculties will be investigated.

*The Footprint Company™ campus calculator*

In accordance with the Global footprint Standards, The Footprint Company™ has developed a campus Ecological footprint calculator, which is being used in this project as both a teaching tool and as a way of measuring the institutional footprint of the campus. The university has adopted a strategic commitment to a footprint of 'One Planet by 2030', and the class exercises in this project will provide a useful input to evaluation of that strategy. Preliminary studies determined Macquarie University’s campus and individual building footprints and students work with these data and models in their class activities.

Within the calculators a hybrid life cycle assessment (HLCA) method was employed, which combines lifecycle analysis (LCA) and input-output analysis, which increases study completeness (Crawford, 2008). This is in comparison to standard LCA methodology, which is typically imperfect due to incomplete or unreliable data sources (Kim et al., 2008). In addition, input-output models in isolation don’t have the ability to demonstrate the benefit of more sustainable (which can also mean more expensive) materials (Majeau-Bettez, Strinnan & Hertwich, 2011). The HLCA used in this study, uses actual life cycle cost quantities and where such quantities cannot be identified, the monetary value of an item is used with a gross national carbon intensity of economic end-use substituted (York, 2008).

The methodology considers all impacts from cradle to gate, as well as incorporating all service and consumption inputs through monetary consideration. The key limitation of this technique derives from the use of the input-output model, which is where the monetary value of an item is used with a gross national carbon intensity of economic end-use. For TFP™ methodology summary see Table 3.

**Table 3: The Footprint Company LCA methodology summary**

<table>
<thead>
<tr>
<th>LCA Method Element</th>
<th>Valid for this Report</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle Methodology</td>
<td>Hybrid LCA</td>
<td></td>
</tr>
<tr>
<td>Goal</td>
<td>Quantify anticipated ecological footprint of the registered project</td>
<td>Capital and one year of operations</td>
</tr>
<tr>
<td>Scope</td>
<td>Anticipated ecological footprint as represented in the input parameters for the registered project.</td>
<td>TFP™ can currently investigate individual buildings and campuses as a whole (or area of a campus). Table 2 defines scope</td>
</tr>
<tr>
<td>Scope Exclusions</td>
<td>Waste generated on site during construction and operations</td>
<td>Not covered by footprint methodology</td>
</tr>
<tr>
<td>Boundary</td>
<td>Site boundary and all materials as finished in place for building and fit-out in total terms upstream to the point of</td>
<td>Direct and indirect covered</td>
</tr>
</tbody>
</table>
Results

At this point of the Macquarie project, only preliminary results from a small-scale pilot project carried out in 2013 are available. These were seen as indicative of the value and workability of the approach. In previous years, a first practical activity allowed students to calculate their own footprints using a range of calculators, to discuss the outcomes and consider why results from different calculators diverged. Class discussion also considered what sorts of activities and measurements might be ‘scaled up’ to produce significant and sustainable change. Initial student trials using TFC™ calculators to explore how design, construction and operational matters affect building footprint, and how administrative structures affect the ability to influence sustained changes in behaviour and outcomes has suggested the suitability of this approach for classroom use.

Tier 1: Personal EF calculation preliminary findings

It should be noted that presented data is representative of early stage results from the Year 3, 2013 module trial. Personal EF calculations were determined for a 39-student study group, in the study unit ‘ENV300 Environmental Decision Making’. The class average EF was 5.7 gha, which is lower than the Australian average of 6.68 gha (WWF, 2012). Assuming the current global population is 7 billion people, and the biocapacity is 13.3 billion gha, if everyone lived like the third year Environmental management class, we would still need 3 planets to sustain their current lifestyle.

Summary of key findings:
- 81% of students had calculated their EF before (Figure 4)
- 50% of students expected their EF to be equal to what the GFN calculator calculated(Figure 4)
- 32% of students found their EF to be larger than they anticipated (Figure 4)
- 69% of student said they will try to decrease their EF (more than a little bit)(Figure 4)
- 93% Students found the exercise interesting (more than a little bit)(Figure 3)
- 49% would be willing to participate in the 5-year follow up study (Figure 4)
- Greatest impact categories were food and mobility.
Tier two: Campus and Faculty EF calculation preliminary findings

Prior to the determination of the Faculty EF’s, campus and individual building assessments were carried out to determine a 2011 baseline case for Macquarie University. The campus planet footprint was determined to be 1.44 planets, which is an annual measure. The primary drivers of Macquarie University’s EF were determined to be operational items (34%), buildings (33%) and energy (18%). Biological capacity (0.2%) and water (1%) consumption had the least amount of ecological impact (Figure 5 and Table 4). In addition, the relative importance of operational (energy, water, transport and other operational expenses) and capital aspects (buildings and non-building items) reflects that the operational features of the campus are higher in impact (Figure 6). Due to operational items being of larger overall impact, this supported the curriculum’s structure in targeting the Faculty level of the campus to engage the University, to target reduction of campus EF and individual building EF.
Table 4: Macquarie University campus EF results summary

<table>
<thead>
<tr>
<th>Footprint Aspect</th>
<th>Gha Absolute</th>
<th>Gm²/EFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Capacity</td>
<td>139.9</td>
<td>45.8</td>
</tr>
<tr>
<td>Energy</td>
<td>14318.7</td>
<td>4683.9</td>
</tr>
<tr>
<td>Water</td>
<td>72.7</td>
<td>23.8</td>
</tr>
<tr>
<td>Buildings</td>
<td>26368.9</td>
<td>8625.2</td>
</tr>
<tr>
<td>Non Building items</td>
<td>3268.8</td>
<td>1069.2</td>
</tr>
<tr>
<td>Operational items</td>
<td>27264.3</td>
<td>8918.0</td>
</tr>
<tr>
<td>Transport</td>
<td>8043.7</td>
<td>2631.1</td>
</tr>
</tbody>
</table>

Figure 5: Macquarie University EF vs. Macquarie 2030 one planet goal

The graph shows the estimated EF of all activates for the period of study in absolute global hectares by major consumption/impact category. This graph will be used as an indication of the major driving areas with respect to EF, in order to determine the degree of change required to approach sustainability.
Figure 6: Macquarie University EF by life cycle assessment
Graphical representation of the relative importance of operational and capital aspects and the benefit achieved through the investment of offsetting activities (if there were to be any). Note that capital is shown as 1/25\textsuperscript{th} of its impact.

Complete Faculty assessments for Arts, Science, Human Sciences, Business and Economics Faculties are currently being carried out, using the 2011 baseline year and results will follow in time. The preliminary findings have been that the Science Faculty buildings are of the highest impact in terms of global meters squared required per meter squared of UFA (Table 5). This measurement only considers the 'base building', which includes the materials of the building's physical form only. The energy usage with respect to FTE population was largest for the Science Faculty, followed by Human Sciences, Arts and Business and Economics, respectively. It should be pointed out that the Science Faculty used the least amount of Energy with respect to UFA (Table 6). Therefore more efficient use of the area, through the establishment of collaborative learning space will be a primary recommendation for this Faculty.

Table 5: Summary data collection Faculty ecological footprints in 2011

<table>
<thead>
<tr>
<th>FACULTY</th>
<th>ARTS</th>
<th>BUSINESS AND ECONOMICS</th>
<th>HUMAN SCIENCES</th>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useable floor Area (m\textsuperscript{2})</td>
<td>14767</td>
<td>5878</td>
<td>13929</td>
<td>33730</td>
</tr>
<tr>
<td>Site Area (Hectares)</td>
<td>1.9</td>
<td>0.2</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Academic and support population (FTE)</td>
<td>361</td>
<td>275</td>
<td>445</td>
<td>524</td>
</tr>
<tr>
<td>Student Population (FTE)</td>
<td>6112</td>
<td>10732</td>
<td>4341</td>
<td>4323</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Electricity (kWh/yr)</td>
<td>1853244</td>
<td>1237040</td>
<td>2903512</td>
<td>3158894</td>
</tr>
<tr>
<td>Water (kL/yr)</td>
<td>19672</td>
<td>7576</td>
<td>13116</td>
<td>10175</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Impact (Gm\textsuperscript{2}/m\textsuperscript{2})</td>
<td>377</td>
<td>179</td>
<td>318</td>
<td>892</td>
</tr>
<tr>
<td>Non Building items</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Transport</td>
<td>Campus Report</td>
<td>Campus Report</td>
<td>Campus Report</td>
<td>Campus Report</td>
</tr>
</tbody>
</table>
Table 6: Faculty preliminary findings

<table>
<thead>
<tr>
<th>FACULTY</th>
<th>ARTS</th>
<th>BUSINESS AND ECONOMICS</th>
<th>HUMAN SCIENCES</th>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UFA (m²) per person (FTE)</td>
<td>2.28m² / person</td>
<td>0.53m² / person</td>
<td>2.9m² / person</td>
<td>6.96m² / person</td>
</tr>
<tr>
<td>Annual energy (kWh) per person (FTE)</td>
<td>286 kWh/ person/year</td>
<td>112 kWh/ person/year</td>
<td>607 kWh/ person/year</td>
<td>652 kWh/ person/year</td>
</tr>
<tr>
<td>Annual energy (kWh) per UFA (m²)</td>
<td>125 kWh/m²</td>
<td>210 kWh/m²</td>
<td>208 kWh/m²</td>
<td>93 kWh/m²</td>
</tr>
</tbody>
</table>

Discussion

A primary challenge for organisations wanting to implement changes to an entire campus, isn’t necessarily determining what needs to be done, but how to capture the attention of those whom action is required for the change to occur (Ekcle, 1999). Despite EF not taking into account land erosion, eutrophication, impacts of non-biological resources and future technological advances (Wiedmann & Barrett, 2010). It is still a valuable tool for providing a way to scale sustainability, instead of just guessing what practice is best. By quantifying the effects of consumption patterns, highlighting the categories with the greatest impact, it is easier to determine where it is most appropriate to apply mitigation measures (McNichol et al., 2011).

After the students carried out their personal EF calculations they were asked ‘why was your EF not what you expected it to be?’ A large amount of students responded that they didn’t realise the food (type, amount & source) they consumed had such a large impact on their EF. Therefore, despite the stated shortcomings of EF methodology, it has proven to be an effective educational tool in illustrating the key drivers of increased EF, while at the same time, allowing students to see the benefit (or impact) of changing their behaviours, via hypothetically changing their consumption patterns within the calculator, with the intention of consuming less of the planet’s resources.

It is currently not known what the impact of the students’ contextual changes will have on their EF. For example what will happen when the student transitions from student life to business life and their gross salary increases? It is acknowledged that increased income generally leads to increased EF, due to increased disposable income for consumption (Lensen and Murray, 2003). Segalas et al., (2010) state that it would be of interest to track how sustainability education affects graduates professional activities into alumni, which will be one of the outcomes of this study, in addition to the tracking of the graduates personal activities, as an supplementary investigation.

When comparing citizens of high and low income countries, the higher income countries use as much as 20% more Biocapacity. In addition to this, the countries with the greatest EF also have the highest levels of education (Rees, 2003). Therefore just like undertaking individual and campus EF assessments to determine the key drivers of EF for these assessments, when understanding EF analysis on a global scale it is obvious where the mitigation needs to focus. As cited by Rees (2003) (the inventor of the EF):

The depletion and pollution of the planet is not the work of ignorant people.
Rather it is largely the result of work by people with BAs, BSs, LLBs, MBAs and PhDs.
(Orr 1994, p. 7)

In previous EF studies of other schools and Universities electricity has usually be found to be the main contributor to their EF (Conway et al., 2008; Flint, 2001; Venetoulis 2001; Li et al., 2008; Wright and Grossman 2002). However, due to Macquarie University’s EF calculation also investigating the EF of the capital or embodied cost of its land and built form, it became transparent that the base buildings, which support the operation of the university are of higher impact than energy consumption. It is worth mentioning that due to different EF methodologies campuses adopted, which use different models, campus results aren’t currently comparable on a gha or planet scale. However, in time when the use

of the campus calculator is utilised for other campus assessments, this will allow for comparison and
benchmarking of campus EF’s.

The results of investigation into each Faculty’s EF will not be used primarily to compare one Faculty to
another, as this could be likened to comparing apples to oranges. Instead, it will be used to highlight
each Faculty’s EF drivers, and allow appropriate improvement to occur in the context of the specific
Faculty’s needs, and within the appropriate decision-making and control structures that govern
administrative and operational oversight at the university. It will be valuable tool for tracking the
longitudinal EF of each Faculty, determining the impact of changes achieved annually within individual
Faculties and result in cross disciplinary collaboration through learning from the campus Faculty’s
existing short comings and modifications. Similar to the whole-of-campus EF, this will also allow for
investigation of Faculty benchmarks for universities, and help set guidelines for running more
sustainable Science Faculties for example. This will mean no more guessing what is best, and
assuming the same rules apply for different areas of a Campus.

Conclusions

The EF curriculum activity reported on here offers a foundation for assessing the impact of tertiary
environmental education on the medium-to-long term behaviour of students in environmental
programs. Preliminary evidence from a pilot exercise undertaken in 2013 confirms the short-term
value of the EF exercises in increasing student understanding of the drivers of unsustainable footprint
patterns in their own lives. The initial pilot work done using The Footprint Company™ tools to consider
the EF of individual buildings within the University’s operating processes and of individual Faculties
within its administrative structure, suggests that student involvement in this work will increase
understanding of how to conceptualise relationships between personal EF and the EF of institutions
and structures in which they participate, and to better understand the drivers of and opportunities to
intervene in EF of larger-than-personal EFs. A full trial of the classroom activities for the faculty EF
calculations is underway in second half of 2013, and there will be a review of the curriculum activity in
early-2014. Evaluation of outcomes will continue and provides the opportunity for a unique longitudinal
study of how such curriculum supports students to contribute to the one planet goal.

Acknowledgments

The research presented in this article was funded by a Macquarie University department and learning
and teaching grants. The development of the personal EF modules would not have been possible
without the free and publicly available personal EF calculator provided by The Global Footprint
Network. In addition, the time and effort put into the project by The Footprint Company™ to develop a
campus calculator for this project. This project would not have been gotten off the ground without
the endless help and support of Department of Environment and Geography, Property Sustainability
Department and Macquarie’s Finance team. A special thanks to Sandie Suchet-Pearson, Frank
Thomalla, Tim Ralph, Hilary Bekmann and Caroline Noller in particular, for their time wisdom and
guidance and everything else they contributed to the project.

References

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and
content. Psychological bulletin, 120(3), 338.

for demand and supply of the biosphere’s regenerative capacity: The National Footprint
Accounts’ underlying methodology and framework. Ecological indicators, 24, 518-533.


Press.


http://ro.ecu.edu.au/eculture/vol2/iss1/16


