

# The Ecological Footprint of the University of East Anglia

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## ABSTRACT

We calculated the ecological footprint of the University of East Anglia. The ecological footprint is normally calculated from how much an entity (e.g. an individual or a country) consumes in terms of bioproductive land. However, because it was not possible within the scope of this study to calculate the consumption ecological footprint of students, we calculate a preliminary production ecological footprint of UEA staff of 7.3 gha. This is 3.5 times higher than a sustainable footprint, or 1.4 times the UK average of 5.3 gha (Ewing et al. 2008). 75% of the footprint is from embodied energy, at least partially because of the university's successful efforts to reduce direct energy use. However, it should be realised that the calculations are incomplete and for instance don't include work-related travel by staff and large uncertainty in the embodied energy. We also discuss what calculating a production ecological footprint implies in terms of responsibility of consumers and producers for achieving a sustainable society.

## INTRODUCTION

Since 1986 humankind has exceeded the carrying capacity of the biosphere (Fig. 1A). Sadly, ecological literacy is so poor that this is normally explained with the equivalent situation in economy: we are not living off nature's interest, but consuming her capital. Indeed, this has led to a decrease of biodiversity, which started already around 1983 (Fig. 1B). There are at least two reasons that could explain why the effect (loss of biodiversity) preceded the cause (exceeding the carrying capacity). First, the measure of human use of the biosphere, the ecological footprint, does not include waste products for which the biosphere has no regenerative capacity (such as nuclear waste). If these were to be included, humanity's ecological footprint would be infinite. Second, human use of the biosphere is not optimally distributed, so that even before 1986, some resources were overexploited, while others went unused. Keeping these shortcomings in mind, we have estimated the ecological footprint of UEA, as a measure of how sustainable it is.

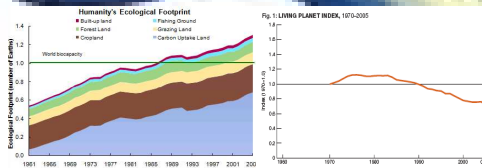


Figure 1: A) Humanity's ecological footprint divided by the carrying capacity of the biosphere (Ewing et al. 2008). B) The living planet index of biodiversity (Hails et al. 2008)

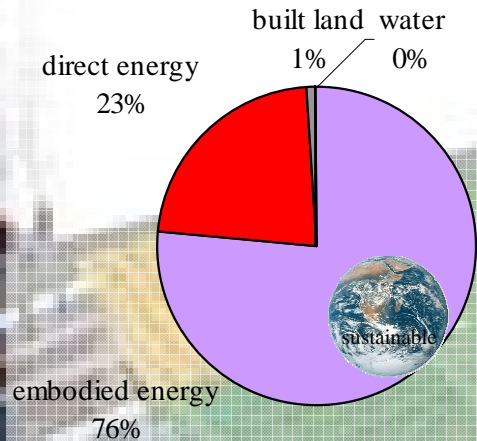


Figure 2: Relative contributions to the production ecological footprint. Please note there were no data for work related transport. The Earth is shown at the size that would be sustainable.

## CONSUMPTION ECOLOGICAL FOOTPRINT

The ecological footprint of countries is calculated as Production + Imports - Exports, which equals consumption. We divide the total ecological footprint of UEA by the full time equivalent number of students (15000). This gives a consumption ecological footprint of 1.7 gha. This is not a complete ecological footprint of UEA students (i.e. it excludes their lives off campus, including their food consumption etc., but includes travel to campus). Thus, this is not comparable to the carrying capacity of the Earth. However, since the biocapacity is 2.1 gha (the per capita share of nature's carrying capacity), it seems unlikely that students would be able to fit all of their other consumption into the remaining 0.4 gha, though some students live on campus, so a higher fraction of their lives is included. On the other hand, UEA is a research intensive university, so allocating the whole consumption footprint to the students would tend to overestimate their educational ecological footprint.

## PRODUCTION ECOLOGICAL FOOTPRINT

The ecological footprint of individuals is normally only calculated from their personal consumption, and not from what they produce in their jobs. While this has the advantage that it prevents double counting, this also implies that no responsibility is attached to what one produces. However, we argue that part of the responsibility lies with producers, i.e. that UEA staff share a responsibility of producing the university's outputs in a sustainable manner. The decision to calculate a production ecological footprint is also based on pragmatic considerations: we wanted to keep within the boundary of direct UEA activities, and a partial footprint of students would not be comparable to the carrying capacity (see above). We divide the total ecological footprint of UEA by the full time equivalent number of staff (3213, including PhD students). Since someone who works at UEA full time would normally not produce anything else, this gives a complete production ecological footprint of 7.3 gha, which is 3.5 times more than the biocapacity.

## FOOTPRINT COMPONENTS

**Embodied Energy:** This is the biggest contributor to the ecological footprint of UEA. It is made up of the consumption of products, such as computers, food and building materials. Because it is difficult to measure this component at the procurement end, it is normally measured at the waste generation end. Over the lifetime of the product, measuring at either end gives the same result.

**Direct Energy:** At 23 %, this is a relatively small component of the ecological footprint. This is because UEA has given considerable attention to reducing direct energy use, e.g. by 1) installing a gas fired combined heat and power plant (CHP), which is more efficient than producing heating and electricity separately, 2) low energy buildings, such as the ZICER building, 3) energy saving campaigns.

**Transport:** No data was available on study and research related travel. We did calculate the ecological footprint of daily travel to the university. This was 1353 global hectares (gha). This was considered to be part of the consumption footprint of students and staff, but not the production footprint of UEA.

**Water and Built Land:** These are small components of the footprint. In the wet UK, the energy and land that is needed to store, purify, and pump water is low. As is usual in ecological footprint calculations, we ignored the ~80% of the campus that is not built up.

## UNCERTAINTY

This was the first attempt to calculate the ecological footprint of UEA. Not all necessary data was available. For instance, there was no data on work related travel. Personal travel to UEA by staff and students was estimated as 1353 gha, or 6% of the calculated footprint.

Only 44% of waste has a defined composition with an associated conversion factor (UK average data). We applied the weighted mean conversion factor to all waste. If we apply it only to the known fraction and use a conversion factor of 0 for the unknown fraction, the ecological footprint decreases to 5.6 gha, still slightly higher than the UK average of 5.3 gha.

If we count PhD students among the consumers rather than the producers, the production ecological footprint increases to 9.9 gha.

## FUTURE

UEA is currently building a 1.4 MW wood fired CHP plant. This will replace an estimated 7.36 GWh of the electricity consumption, decreasing the ecological footprint conversion factor from 143 gha/GWh for average UK electricity generation (Table 1) to 36 gha/GWh for biomass generated electricity, leading to a saving of 788 gha, which is a 3.3% reduction of the total footprint. Savings on heating are unknown at this point, for instance because in summer it will depend on extra demand on distillation cooling which is currently being planned.

Table 1: Components of the ecological footprint

	Consumption	conversion factor	ecological footprint (gha)
Waste (tonne)	landfilled	3539	18001
	recycled	1586	
Energy (GWh)	gas	78.72	5386
	electricity	12.66	
	oil	0.22	
Built land (ha)	25	5.32	133
Water (10 <sup>6</sup> L)	328	0.099	32
Transport (10 <sup>3</sup> km)	car	13051	1353
	air	No Data	
	train/bus	5940	