Ecological footprint

Fact Sheet by Tim Baynes posted 15 May 2008

The ecological footprint or 'eco-footprint' is a tool to measure our ecological performance. It tracks how much individuals, organisations, cities, regions and a nation consume and compares this amount to the resources nature can provide.

•Categorised under:

- Feasability, Planning, Completion,
- Greenfield Development,
- Site Ecology, Climate Change Adaptation & Mitigation, Sustainablity Management,
- Developer, Designer,

Introduction

For a development, the eco-footprint is often much more than the actual footprint of the buildings. It also includes the area of the environment disturbed by construction and the "carbon footprint" which is the area needed to absorb the greenhouse gases generated in the production of building materials, construction activity and the day-to-day use of the development after completion. In fact, the definition of an eco-footprint is the area of biologically productive land and water people would need to produce all the resources they consume and to absorb all their waste. Having said that, we can still look at the parts of an eco-footprint that are attributable to, for example, transport, housing or energy use in a development.

Since people use resources from all around the world and their waste (including greenhouse gases) also ends up dispersed globally, the eco-footprint area is measured in "global hectares" (gha). This represents an average hectare of bio-productive land on Earth. With a population of 6.2 billion people in 2003, there was 1.8 global hectares available for every person on the planet (Global Footprint Network).

Some countries have a lot of productive land and not a lot of people and some countries have large population but they don't consume very much, however, the eco-footprint for the average person on Earth in 2003 was 2.2 gha, that's 22% more global hectares than what is available. This is an indicator that, over all, the global population is living beyond its means.

The requirement for the complete lifestyle of the average Australian person in 2003 was 6.6 gha (WWF 2006). Although Australia has a vast amount of land and a small population, the implication is that we would need more than three and a half Earths if everyone was to live as Australians do.

The direct impact of housing accounts for about 10-20% of the average Australian's eco-footprint (Simpson 2000, EPA Victoria 2005) but the developer can have much more influence on the total footprint beyond the size of the block, choice of materials and land disturbed through construction. Over the lifetime of the development, how people operate their houses and their lifestyle, have far more significant impacts on the total eco-footprint. Good planning and design can influence this day-to-day operation of the finished development, through such factors as

- Gas, electricity or solar energy for heating water
- Whether or not people can walk to amenities, schools and shops in and around the development or whether they have to drive
- Whether people have the opportunity to make the most of designs for passive heating and cooling

Choices made during development can result in lasting reductions in the ecological footprint for the completed development and its community.

This fact sheet provides an introduction to the concepts, methods and components of ecological footprint assessment and highlights key aspects of undertaking and using eco-footprints. Examples of the choices that can be made during phases of development and their effect on the eco-footprint are also provided.

Location, location, location?

Ecological footprint values can vary between about 5 to 8 gha per person depending on where you are in Australia (Weidman et al 2007, Lenzen and Murray 2003). How this is broken down into components of consumption also depends on location. In Victoria the average ecological footprint is 8.1 gha per person: 18% of this is due to housing, 36% from food consumption, 11% because of transport and 35% due to the goods and services consumed.

Much of this is due to the energy needed in transport and in the production of food, goods and services. In fact, about half of the Australian Ecological Footprint is from carbon dioxide emissions via the use of fossil fuels for energy production (EPA Victoria).

Not all forms of energy have the same eco-footprint impacts. Renewable energy from solar or wind power has a very small or negligible footprint whereas energy from burning fossil fuels has a larger eco-footprint.

Some considerations for developers are: how much could residents generate their own energy (this depends on latitude and orientation) andÂ how far away are food, goods and services that might have to be transported to the de velopment ?

According to the ABS (2003) about 12% of trips are made on public transport. If your development can encourage a higher rate of public transport use then this will translate into a lower eco-footprint for residents or tenants.

Eco-footprints are only part of sustainability

Lifestyle is an important factor and it useful to consider several scenarios of how the planning and design of the development will affect how people will live there. Lifestyle will influence several factors that will be measured as part of an eco-footprint but lifestyle will also affect factors that the eco-footprint does not take into account such as impacts on biodiversity, local land disturbance, erosion or salinisation of soils. Eco-footprints generally will not measure pollutants other than CO2 such as PCBs, dioxins or heavy metals nor are the social or economic aspects of sustainability accounted for.

Direct ways to reduce footprint

Choice of materials is a direct way to reduce the eco-footprint and materials needn't be more expensive. Using recycled materials and some green materials may well be a less expensive way to choose construction components .

Energy efficient design means selecting energy efficient appliances and lighting, installing insulation, having building designs and orientation to maximise exposure to sun in winter but minimise it in summer and also considering the day-to-day operation of a building. For example, in residential houses you can reduce energy consumption by up to 60% by installing solar hot water boosted with gas (Centre for Design and GFN). On average, 39% of energy consumed in Australian homes is space heating and cooling (ABS 2005 p48). Using passive solar design can dramatically reduce this figure.

Energy efficiency ratings for dwellings are usually determined using the 'AccuRate' computer program by an accredited assessor . Other ideas can be found at the Your Home website.

Potable water consumption can also be reduced by 45% with third-pipe recycled water and AAA efficient water fixtures .

Concrete solutions

The use of cement is likely to be the major contributor to that part of an ecological footprint associated with materials in construction. This is associated with concrete that has a high proportion of cement. 1 ton of CO2 is emitted for every ton of cement produced.

It is very hard to avoid using concrete in construction but there are ways of reducing the need for more cement. Recycled concrete might be used in non-structural components. The development in Rouse Hill, north-west of Sydney sourced 50% of the non-structural concrete from recycled material. Ground granulated slag can be used in concrete in combination with cement as part of a blend. This reduces the proportion of cement in the concrete and therefore reduces the ecological footprint. Substituting 50% of Portland cement with slag reduces energy consumption by around 45%. Concrete containing ground granulated slag is also more durable as it develops strength over a longer period and is less permeable. Since the unit volume of cement will also be reduced,

concrete is less vulnerable to corrosion (US Concrete 2007 and .

One way to reduce footprint is to use your feet

Encouraging walking and cycling around the development and, if possible, ensuring walking-distance access to public transport nodes can reduce the transport component of residents' eco-footprint. Proximity to rail and bus routes is not always within the control of a developer but the provision of cycle and walk ways and information about public transport are. One possibility is to partner with cycling organisations (like Bicycle NSW or Bicycle Victoria) to design in features for walking and cycling. Welcome packs for new residents or tenants might provide a guide to lowering the transport component of the eco-footprint.

Walking (and cycling) is particularly encouraged by pathways that conveniently link places with different functions. Pathways between houses are useful but pathways between houses and playgrounds or pathways between houses and shops and schools will get used often (Salingaros 2005). Read the connectivity factsheet.

Tools online

The Victorian Environmental Protection Authority (EPA) and General Property Trust (GPT) have constructed an eco-footprint calculator for residents and tenants.

GPT has also continued to expand the capability of the Calculator and is using it as a primary reporting tool for the A$480 million Rouse Hill Town Centre retail development in New South Wales. The GPT Group are engaging tenants in sustainability by incorporating application of the Calculator into leasing agreements. A public version of the Ecological Footprint Calculator for Retail and Retail Tenants is available at EPA Victoria's website.

Case Study - Aurora, Epping North, Victoria

Aurora development is a 670 hectare site for 8500 homes in Epping North, 20km from Melbourne. It has been designed with the intent of minimising the ecological footprint without compromising the lifestyle of the inhabitants. Aurora incorporates sustainable design features such as 6 star energy rated houses, walk-ability in urban planning, water sensitive design, third pipe systems and a major water recycling project. According to the eco-footprint study done on Aurora, the housing and transport part of the eco-footprint was 1.1gha for the average house in the development compared to 2.1gha for a conventional 2-3 star home in Victoria.

BedZED

The Beddington Zero Energy Development, or BedZED, is the UKâ€™s largest eco-village. Initiated by BioRegional, B ZED was developed by the Peabody Trust in partnership with BioRegional Development Group and designed by

Bill Dunster Architects. Located in Wallington, South London, BedZED comprises 100 homes, community facilities and workspace for 100 people. 15% (3,404 tons) of the construction materials used at BedZED were reclaimed or recycled. 52% of the construction materials used at BedZED was sourced from within a 35 km radius of the construction site. Choosing timber over uPVC window frames for the BedZED scheme saved nearly 800 tonnes of CO2 emissions, some 12.5% of the total embodied CO2 for the scheme. Residents have been living at BedZED since March 2002.

Key Issues

Benefits

- Can demonstrate the 'green' value of the development in comparison with other development types.

"'Through this process GPT found the Footprint concept and calculators helpful in communicating the business and environmental benefits of incorporating sustainable design principles and materials in the redevelopment of its shopping centres, including Melbourne Central."
Mark Fookes - Head of Retail, GPT Group

- Eco-footprint is a sustainability measure that can be broken down so that you can see what components of the development construction and operation contribute most to the environmental impact.

Risks

- Eco-footprint gives a good indicator of sustainability but is not a tool for fine tuning.
- Inclusion of all consumption by households can seem to diminish the impact of improvements to the buildings and urban design. For example, the housing and transport part of the eco-footprint is 1.1gha for the average house in the Aurora development compared to 2.1gha for a conventional 2-3 star home in Victoria. This sounds like a considerable improvement (and it is) but if you consider total consumption by households, the eco-footprint of the average resident in Aurora is 7 hectares and the average citizen of Victoria has an eco-footprint of 8.1 hectares.

Savings

- A relatively inexpensive way to communicate the sustainability credentials through a metric that's generally well accepted.
- Going green isn't necessarily a more expensive option. In the process of choosing materials and designs to reduce the eco-footprint there are concurrent savings in construction costs, for example where recycled materials can be sourced and used.

Costs

- It's not like undertaking an environmental impact study. With knowledge of the materials and energy needed to construct the development and some idea of the day to day living within the development you can readily calculate an eco-footprint.
- Eco-footprint calculators are available online from the Victorian EPA

Barriers

- Ecological footprint is widely accepted as an indicator of environmental sustainability but it should be emphasised that it is only one measure of sustainability. The Global Footprint Network (GFN) recommends that: *'decisions regarding biodiversity, resource management, social well-being and other sustainability dimensions require consideration of factors beyond the footprint. Footprint reports need to state clearly that footprints are not complete sustainability measures'.*

Benchmarks

A few ecological footprint studies have been conducted for developments in Australia. The example of Aurora has been presented on this site and the summary and complete eco-footprint assessment can be found here.

GPT and EPA Victoria have developed online tools for residents and tenants to calculate their eco-footprint. GPT's research activities with the Global Footprint Network and EPA Victoria suggests that the eco-footprint of an average Australian retail shopping centre could be more than 2.2 gha for every 10m2 of gross leasable space (GLS) - and this could be reduced by 20-40% by adopting a variety of measures in design and operation.

There is a draft document Ecological Footprint Standards 2006 available at www.footprintstandards.org but the development of these standards is still in progress. Until this is complete the benchmark eco-footprint for a development is industry best practice.

Development phase actions

Feasibility

Eco-footprints could be used at this stage to set goals for the development e.g. how much do you want to reduce the environmental impact of the development? The size of the site will not have as big an impact on the eco-footprint as the day-to-day activities of the people who will live there. If the intention is to have a development with a reduced ecological footprint, then this has to be feasible in the context of the operation of households and the lifestyle of the inhabitants. Some important considerations are the location of the site relative to schools, shops and major centres where people will travel to and the intended final residential population.

Planning

The planned layout of the development, the density and type of dwellings and transport options within the development are important. An eco-footprint measure would aid in the setting of the broad parameters. For example, do you want homes or retail spaces to be "zero-emission" when they are operating? Some other

parameters to consider are: what is the proximity to amenities like parks and playgrounds as well as to activity centres and public transport links. For example, In the Aurora development most homes are within 200m from parks, 400m from bus stops and 800m from shops and schools. Such criteria may increase the actual land area used but in the end reduce the need for car travel and result in a net reduction in the eco-footprint.

Design

Eco-footprints at this stage can be used to shortlist material choices and designs. Usually the largest single contributor to the housing footprint is the energy of household operation. This is especially so where this operation depends heavily on electricity from coal-fired power stations. Design for passive lighting, heating and cooling as well as choosing more efficient space conditioning technology. Roughly, about 40% of an average house's energy budget is heating or cooling the space and 25-30% is for heating water (ABS 2005 p48 and Your Home website). In Aurora the single largest contributing factor to the reduction in the housing operation part of the eco-footprint was the substitution of electric hot water with solar hot water with gas back-up (see graph below). Incorporating passive design for heating and cooling spaces is also important for reducing eco-footprint.

The contribution to ecological footprint from household construction, operation and maintenance. From Figure 11 in Ecological Footprint Analysis of Aurora Residential Development (Centre for Design at RMIT and GFN)

Construction

The energy used during construction can be a large contributor to the construction component of the ecological footprint (and about 10% of the overall footprint). It is also helpful to choose materials derived from renewable sources and, where possible, using recycled materials especially reduces the eco-footprint associated with construction.

Lot Creation

Orientation of the block to maximise opportunities for passive heating and cooling.

Completion

After everything has been built there is still plenty of opportunity to reduce the eco-footprint of the development, for example, planting trees to provide shade and provision of some area to grow food. GPT planted some 130 000 trees and plants at their Rouse Hill development with a judicious mix of indigenous (80%) and non-invasive deciduous species to improve the passive design of public spaces. At BedZED in the UK, space was specifically designed in for communal gardens and composting of waste.

Another example of a developer's post-construction interaction with new residents and tenants is how GPT is using their eco-footprint calculator for ongoing monitoring and involvement with the tenants in the Rouse Hill Town Centre development.

Links

- EPA Victoria Footprint calculators for homes, retail spaces and commercial buildings
- The Global Footprint Network
- Green Building Council of Australia
- General Property Trust (GPT) Group's retail eco-footprint calculator
- GPT's case study of the application of eco-footprint
- BioRegional Development Group
- Eco-friendly concrete factsheet

Link to Content

- http://yourdevelopment.org/factsheet/view/id/23