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9

Household environmental pressure from consumption: an Australian environmental atlas

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Abstract

Modern living means consuming, and consuming causes resource depletion and environmental degradation. Environmental education and action plans for households typically focus on the environmental pressures associated directly with household requirements, such as electricity generation, the direct combustion of fuels and direct water use. Though important, such direct environmental pressures are generally smaller than the indirect pressures associated with the consumption of goods and services by households. These indirect 'requirements' occur in the numerous producing industries of the Australian as well as overseas economies. However, in accordance with Adam Smith's classic statement that 'consumption is the sole end and purpose of all production', these requirements are ultimately being demanded by households. Total household environmental pressure is then the combination of direct and indirect requirements.

By combining detailed census, household expenditure and environmental data with an economy-wide model, we have calculated the total household environmental pressure for over 1300 Australian statistical local areas (SLAs). These estimates of the wider environmental

pressure of average households at a fine spatial scale, represent a new resource for environmental education. We have produced maps of these results, for the indicators of greenhouse gas emissions, water use and ecological footprint, to reveal the sources of environmental pressures in terms of average per capita impacts. Results show that impacts are highly correlated with household expenditure, but that within clear general trends there can be large differences between the average households in different SLAs. The results were transformed into an interactive web-based tool, the Australian Consumption Atlas, which allows users to see maps of environmental performance by SLA, as well as find the typical performance by postcode, coupled with explanations and suggestions for action. The launch of the Atlas was supported by a national media and outreach campaign. The public's and media's response to the Atlas were considerable: interest was both widespread and sustained over many weeks. There was particularly strong interest in the magnitude of indirect impacts as well as the variations between SLAs. It appears that this response is indicative of the public becoming more sophisticated in its understanding of the sources of environmental pressures.

Introduction

There is extensive academic literature on the links between household consumption and environmental impacts (Chen 2007; Christoffersen et al 2005; Munksgaard et al 2005; Turner et al 2007; Wiedmann et al 2007; Wier, McDonald & Forgie 2006;). Most of these studies correctly point out the importance of off-site impacts, which are in addition to direct or on-site environmental impacts which are the normal focus of environmental education campaigns (Lenzen, Dey & Foran 2004; Munksgaard, Pedersen & Wier 2000). Indirect impacts in most developing countries are typically two to three times higher than the direct impacts (Lenzen 2001c). Resource requirements of cities has long been of interest, but on a per capita basis, similar resource requirements are involved in most lifestyles in developed countries (Moll & Norman 2002). Furthermore, indirect impacts are highly related to affluence; so, as the general affluence of households increases, so do the indirect environmental impacts of those households (Lenzen 1998). This is despite the commonly held notion that, as affluence increases, there is more opportunity for households to reduce (direct) impacts by

increasing energy and water use efficiency. This may occur, but in general any reduction in direct environmental impacts are more than countered by an increase in the wider, indirect impacts associated with increased spending. This is particularly the case if trade effects are included: the embodiment of environmental impacts in the products purchased by developed countries (Ghertner & Fripp 2007). In short, there is increasing evidence to suggest that globally the Environmental Kuznets[1] curve does not hold, particularly for greenhouse gas emissions (Ghertner & Fripp 2007).

Public knowledge of off-site impacts of consumption has been stimulated by the relatively fast acceptance of the ecological footprint concept, which attempts to measure the total land requirements for supporting a lifestyle (Lenzen & Murray 2001; Wackernagel & Rees 1995). The ecological footprint is fundamentally a communication metric describing the notion that the impacts of lifestyles' spread well beyond their immediate vicinity. Although only about 15 years old as a concept, the word 'footprint' is now in general public usage, though it has been diluted and broadened from the original meaning of the ecological footprint. The analogous term 'carbon footprint' is now also in common usage, and is part of the growing interest in carbon neutrality and the related practice of carbon offsetting.[2] *Environmental footprint* is being used increasingly as a general phrase to mean environmental pressures as measured by a range of indicators, such as water use, pollution, air travel and food miles.

Despite the increasing public awareness of the wider drivers of environmental pressure, there is a need for further education and outreach tools that will stimulate real action (Lenzen, Dey & Murray 2002; Lenzen & Murray 2001a; Lenzen & Smith 2000). Success in this area depends upon a number of factors. Firstly, tools, results and their meaning must be accessible to the general public, make connections with their current understanding and not be loaded with jargon. Secondly,

[1] The Environmental Kuznets curve is the general hypothesis that, as populations develop, they pass over a pollution 'hump' after which further development, in terms of rising income, leads to reductions in environmental impacts.
[2] See ISA report, *Carbon Neutrality – sense and sensibility*, http://www.isa.org.usyd.edu.au/publications/CarbonNeutral.pdf.

education material must still be sufficiently quantitative, independent and reliable to secure the public's trust. Thirdly, sheer volume of information – for example, many individual indicators addressing multiple issues – will not be as effective as a selection of key indicators covering major concerns. Fourthly, communication of results and meanings will be enhanced if there can be personal relevance, such as results related to particular demographic groups, lifestyle factors or locations. Finally, to be ultimately successful, any education campaign should stimulate significant action or behaviour change.

This chapter is not only concerned with the calculation of household impacts, largely an academic exercise for which there is a general convergence of methods and an understanding of the importance of the wider impacts of households.[3] Rather, this work also examines the effectiveness of communication of these issues to the general public, and the response of the public and the media to such issues. The work is the outcome of a partnership between researchers from the Centre of Integrated Sustainability Analysis at the University of Sydney and educators from the Australian Conservation Foundation, a non-governmental organisation with a long history of environmental education and advocacy.

In this chapter we outline the methodology behind the calculation of average environmental pressures across Australia and present a sample of results to illustrate the web-based tool known as the *Consumption Atlas*. We then discuss the responses to the launch and education campaign of the Consumption Atlas, before concluding and discussing briefly ideas for future work in this area.

Methodology

The principle methodology behind this work is well developed and is described elsewhere (Lenzen 1998; Lenzen, Dey & Foran. 2004). The objective of the project was to estimate the total environmental impacts, meaning the direct plus indirect impacts, for typical households down to

[3] However, there is still not yet complete agreement on metrics and scopes of analyses; see, for example, discussions and references in Turner et al (2007) and Wiedmann et al, (2007).

a fine spatial level covering all of Australia. In summary, the work here combines an input–output analysis approach for calculating indirect requirements for households, with household expenditure data for a sample of Australian households, with comprehensive population census data for the whole nation. The work therefore relies on the extensive, publicly-available datasets collected and provided by the Australian Bureau of Statistics (ABS). The methodology is outlined in the following sections.

Input–output analysis

Input–output analysis is a macroeconomic technique that uses data on inter-industrial monetary transactions to account for the complex interdependencies of industries in modern economies. Since its introduction by Leontief (Leontief 1936; 1941), it has been applied to numerous economic and environmental issues, and input–output tables are now compiled on a regular basis for most industrialised, and also many developing countries. To obtain regional results we combine the national Australian input–output tables and national data on resource use and pollution (modified by regionalising some important state-specific impacts such as those from electricity provision and meat production) with regional household expenditure data. The assumption inherent in this approach is that products purchased by regional households are produced regionally and nationally using a similar production recipe. Hence it is a study of national impacts that result from regional consumption. In contrast, regional input–output tables are required for the analysis of regional impacts and inter-regional flows (Tiebout 1960). The technique of combining input–output and household expenditure data has been used previously by a number of authors (see comprehensive reference list in Lenzen, Dey & Foran 2004).

The environmental impact of households is determined via

$$\mathbf{F} = \left(\mathbf{Q}^{\mathrm{emb}} + \mathbf{Q}^{\mathrm{hh}}\right) \times \mathbf{Y} \quad (1)$$

The variables in Equation 1 are in turn:

F Matrix of *household factor requirements*. Its elements $\{F_{ij}\}_{i=1,\dots,f;\,j=1,\dots,g}$ describe the total amount of factor i required by household group j. The term *factor* represents resource and environmental quantities (such as land disturbance, fuel consumption, water use, greenhouse gas emissions and the aggregated quantity ecological footprint). **F** comprises both factors $\mathbf{Q}^{hh}\times\mathbf{Y}$ used directly by the household (in the house or by using private vehicles), and also factors $\mathbf{Q}^{emb}\times\mathbf{Y}$ used by Australian and foreign industries, that are required indirectly to provide goods and services purchased by the household. The latter are also called *embodied factor requirements*. **F** has dimensions $f\times g$, where f is the number of factors (only results for three will be presented here: greenhouse gas emissions, water use and ecological footprint) and g is the number of household groups. For this study an average household was established for each of the 1346 Statistical Local Areas (SLA) defined by the Australian Bureau of Statistics (ABS). This procedure is discussed further below.

$\mathbf{Q}^{hh}$ Matrix of *household factor multipliers*. Its elements $\{Q^{hh}_{ij}\}_{i=1,\dots,f;\,j=1,\dots,s}$ describe the usage by private households of factor i per A$ value of final consumption of commodities from industry j. $\mathbf{Q}^{hh}$ has dimensions $f\times s$, where s is the number of classified industries. The Centre for Integrated Sustainability Analysis at the University of Sydney (ISA) has expanded the more aggregated Australian *input–output tables* compiled by the ABS to distinguish s = 344 industry sectors. These range from primary industries such as agriculture and mining, via secondary industries such as manufacturing and electricity, gas and water utilities, to tertiary industries such as commercial services, health, education, defence and government administration. This expanded input–output framework applies to the year 1998–99.

$\mathbf{Q}^{emb}$ Matrix of *embodied factor multipliers*. Its elements $\{Q^{emb}_{ij}\}_{i=1,\dots,f;\,j=1,\dots,s}$ describe the usage of factor i per A$ value of final consumption of commodity j, (1) by the industry sectors producing commodity j, (2) by all upstream industry sectors supplying industry

sectors producing commodity j, (3) by all upstream industry sectors supplying industry sectors that supply industry sectors producing commodity j, and (4) so on, infinitely. $\mathbf{Q}^{emb}$ thus captures the *total factor requirements* of industries in the entire economy that are needed to produce commodities consumed by households. $\mathbf{Q}^{emb}$ has dimensions $f\times s$.

Y Matrix of *household expenditure*. Its elements $\{Y_{ij}\}_{i=1,\dots,s;\,j=1,\dots,h}$ describe the amount of A$ spent on commodity i by household group j during the reference year. **Y** has dimensions $s\times h$.
$\mathbf{Q}^{emb}$ can be calculated according to the *basic input–output relationship*

$$\mathbf{Q}^{emb} = \mathbf{Q}^{ind}\left(\mathbf{I}-\mathbf{A}\right)^{-1}. \quad (2)$$

The variables in Equation 2 are:

$\mathbf{Q}^{ind}$ Matrix of *industrial factor multipliers*. Its elements $\{Q^{ind}_{ij}\}_{i=1,\dots,f;\,j=1,\dots,s}$ describe the usage of factor i by industry sector j per A$ value of total output by industry sector j. In contrast to $\mathbf{Q}^{emb}$, $\mathbf{Q}^{ind}$ represents only factors used directly in each industry, but not in upstream supplying industries. $\mathbf{Q}^{ind}$ has dimensions $f\times s$.

I The *unity matrix*. Its elements $\{I_{ij}\}_{i=1,\dots,s;\,j=1,\dots,s}$ are I_{ij}=1 if i=j, and I_{ij}=0 if $i\neq j$. **I** has dimensions $s\times s$.

A Matrix of *direct requirements*. Its elements $\{A_{ij}\}_{i=1,\dots,s;\,j=1,\dots,s}$ describe the amount of input in Australian Dollars (A$) of industry sector i into industry sector j, per A$ value of total output of industry sector j. **A** has dimensions $s\times s$. It comprises imports from foreign industries and transactions for capital replacement and growth. **A** captures the interdependence of industries in the Australian economy and their dependence on foreign industries, and – assuming that imports are produced using Australian technology – thus enables the translation of industrial factor multipliers $\mathbf{Q}^{ind}$ into embodied factor multipliers $\mathbf{Q}^{emb}$.

Furthermore, factor requirements for Australian industries producing exports are removed from $\mathbf{Q}^{ind}$, since responsibility for these impacts are borne by the purchasers of the exported commodities (see Gallego & Lenzen 2005; Lenzen et al 2007)). In Australia there is a strong trade surplus of environmental impacts, associated mainly with impacts relating to the export of primary commodities. For a comprehensive description of the Australian input–output framework, see papers by Lenzen (Lenzen 2001b; 2001a; Lenzen & Foran 2001).

Data sources, regression and results breakdowns

A traditional problem in undertaking generalised input–output analysis is the alignment of different data sources which may vary in industry sector classification and reference year. Approaches to these problems are described elsewhere (e.g. Gallego & Lenzen 2006; Lenzen, Gallego & Wood 2007). The Household Expenditure Survey (Australian Bureau of Statistics 2000) commodity classification and the Input–output Tables (Australian Bureau of Statistics 2004a, 2004b) refer to the year 1998–99 but Australian population census data from 2001 were used. The industrial energy and greenhouse multipliers were obtained by consulting a range of sources such as fuel statistics (Australian Bureau of Agricultural and Resource Economics 1999, 2001), the Australian National Greenhouse Gas Inventory (National Greenhouse Gas Inventory Committee 1998) and motor vehicle and transport surveys (Australian Bureau of Statistics 1996, 1997). These industry multipliers are used to calculate energy embodied in consumer items. Producers making up the supply chains of these establishments are likely to be distributed across the whole of Australia, so that we apply state adjusted energy multipliers for the first and second layer of suppliers, and national averages further upstream. Household energy multipliers $\mathbf{Q}^{hh}_{energy}$ are generally specific to a state, and were therefore sourced separately. Examples of regionally adjusted figures are those for electricity (NSW Department of Energy and Utilities 2000), petrol (Australian Automobile Association 2000) and local transport data (Lenzen 1999). Other sources include data for water (Lenzen & Foran 2001; Vardon et al 2007) and land use, weighted by degree of disturbance (Barson, Randall & Bordas 2000; Graetz, Wilson & Campbell 1995; Lenzen & Murray 2001). In order to match the

Household Expenditure Survey data, all factor multipliers were extrapolated to 1998–99 values, considering trends in industrial factor use, changes in product taxation, and developments in the Consumer Price Index (CPI) to account for inflation (Bureau of Labor Statistics 2002). While this procedure introduces additional uncertainty into the estimates of factor requirements, this uncertainty is well below the variability of these requirements across different household groups in a typical sample.

The average household expenditure matrix (**Y**) by SLA was derived from the 1998–99 Household Expenditure Survey (HES) aggregated to statistical sub division (SSD) level and then regressed against the census data. The range of the explanatory variables used in this derivation was as follows: weekly per capita income, average number of persons in the household, average age from HES structure, educational qualification, population density (km^{-2}), and household type (renting, purchasing, owners, average number of employed persons in household, car ownership, state, and dwelling type). The multivariate regression technique used is similar to that employed for the ISA study on Sydney households (Lenzen, Dey & Foran 2004).

Previously employed techniques known as production layer decomposition, sectoral breakdowns, and structural path analysis may be used to provide breakdowns of aggregated results (Lenzen & Treloar 2003; Treloar 1997).

Results and discussion

This section presents a selection of the results of the analysis, including a sample of the typical Consumption Atlas maps. Key findings and responses to them in terms of environmental policy and action are also discussed. Average Australian, and by state, greenhouse gas emissions, water use and ecological footprint results are given in Table 9.1. These are calculated from the SLA data, weighted by population. To support the average Australian lifestyle, 18.9 t CO_2-e (tonnes of carbon dioxide equivalent) of greenhouse gases are emitted, 720 000 litres of water are used, and an ecological footprint of 6.45 ha is required.

The principle reason for differences between states is different levels of affluence, as indicated by the annual per capita income figures. One exception to this is due to the predominant electricity generation infrastructure in each state. Tasmania, being largely powered by hydroelectricity, is lower than average, whereas Victoria, largely powered by brown coal generated electricity, is higher. Note that despite Tasmania's own electricity being mostly low-emission hydropower, the average Tasmanian still has significant emissions because their consumption draws on power consumed by industries in the higher emitting mainland states. The other major instance for state differences not following per capita income is in the ecological footprint and is due to different stocking rates for grazing, particularly for Western Australia.

The high water use and greenhouse emissions in the ACT are predominantly an affluence effect, as indicated by the ACT's high average per capita income. Differences in household water use reflect these income differences, but also variations in climate. Where water is relatively plentiful, as in Tasmania and parts of the Northern Territory and Queensland, less water extraction is required for gardening and other uses.

Table 9.1 Average per capita national results, and for each state, for the indicators greenhouse gas emissions, water use and ecological footprint.

	Annual income	**Greenhouse gas emissions**	**Water use**	**Ecological footprint**
	$ / capita	t CO_2-e / capita	ML / capita	ha / capita
ACT	25,016	22.5	0.86	6.96
NSW	20,092	19.3	0.74	6.33
NT	19,274	19.0	0.65	6.73
QLD	18,201	18.4	0.68	6.51
SA	18,166	17.2	0.68	6.67
TAS	16,529	14.3	0.65	5.50
VIC	19,504	19.7	0.75	6.18
WA	18,949	18.0	0.72	7.32
Australia	19,309	18.9	0.72	6.45

Breakdown of average Australian household impact

Profiles of the environmental impacts of consumption for the three cross-cutting indicators (greenhouse gas emissions, water use, and ecological footprint) are given in Figures 9.1–9.3. For each indicator a breakdown of the direct and indirect contributions to these environmental impacts for the average Australian household is given. A key overall finding, and that which is consistent with earlier work, is that indirect impacts of consumption outweigh direct household use of energy, water and land. That is, the major environmental impacts occurring in the production and distribution of goods and services that households consume far outweigh the direct household impacts.

Certainly, the direct use of petrol, electricity and water might be the most visible and most discussed areas of personal impact on the environment, and these typically are some of the largest single components of household impacts. However while many Australians are increasingly aware of the need to conserve water and reduce energy use, information about the hidden environmental costs of many products and services is much harder to acquire. Direct household and personal activities account on average for only 30 per cent of a household's total greenhouse gas emissions, 23 per cent of total water use, and just 10 per cent of the total ecological footprint.

The profiles in Figures 9.1–9.3 are challenging, for individuals as well as governments and organisations seeking environmental change. They suggest that even drastic measures to reduce direct personal water and energy use may not have the desired effects, unless they are complemented by strong action to reduce the environmental impacts associated with such activities as food and clothing provision, and goods and services purchased in general.

Burning fossil fuels for the provision of energy, mostly electricity, accounts for approximately 70 per cent of total greenhouse gas emissions in Australia (Australian Greenhouse Office 2007). This energy is used mainly in the production and distribution of goods, with household electricity and personal transport being important secondary components. The direct use of energy and the indirect use of energy embodied in goods and services consumed by an average Australian in one year result in the generation of about 19 t CO_2-e greenhouse gas emissions. Agriculture, largely emissions from livestock, is a significant source of non-energy emissions embodied in household consumption. Areas where a household has relatively direct control – such as their own electricity, natural gas, and transport use – on average account for less than a third of total emissions (Figure 9.1). In fact, if every Australian household switched to renewable energy and stopped driving their cars tomorrow, total household emissions would decline by only about 18%. The emissions generated from producing the food we eat and the goods we purchase are together more than four times the emissions from our own personal use of electricity. This suggests that for households to make a serious reduction in greenhouse gas emissions, they must go well beyond merely reducing household energy and petrol use.

Figure 9.1 Breakdown of the total greenhouse gas emissions for the average Australian (18.9 t CO_2-e)

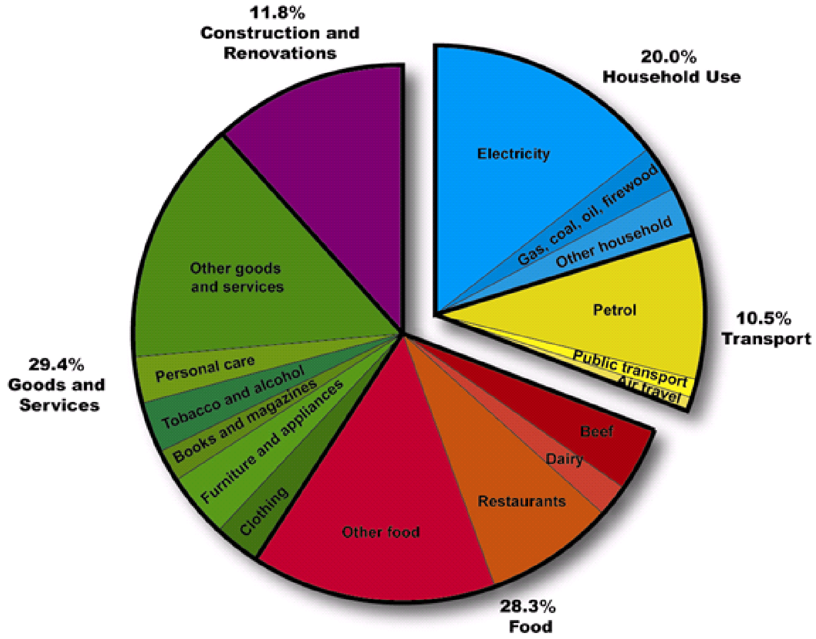
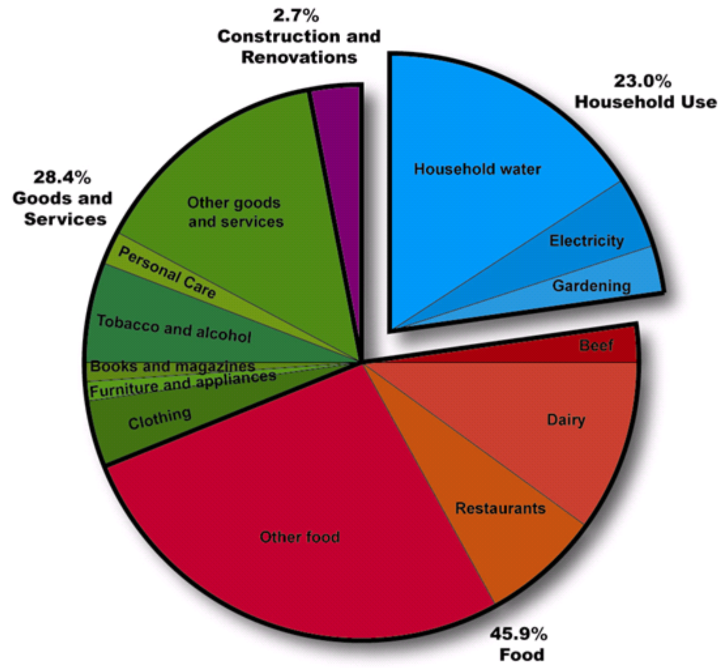


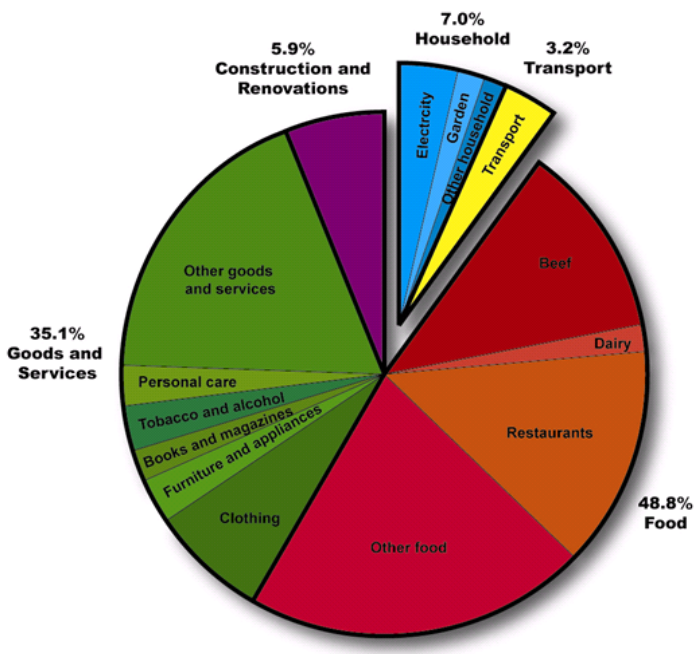
Figure 9.2 Breakdown of the total water use for the average Australian (720 kL)



The total water use by the average Australian amounts to 720 kL (kilo litres) per person, per year, including water embodied in all food, goods and services (Figure 9.2). This amount of water is comparable to the volume of an Olympic-sized swimming pool. Direct water use in the household only accounts for just over 16 per cent of total water use. The water used to produce all goods and services consumed is more than six times greater than direct household water use. Production of dairy and beef products is particularly water-intensive; the dairy sector alone accounts for one out of every ten litres of total household water use. Traditional electricity generation, which uses water for cooling, is a large user of water, amounting to nearly 4 per cent of the total water used by households.

The ecological footprint is a measure of the total amount of land required to supply all the resources a person's lifestyle demands. This includes land disturbance related to agriculture and other activities, as well as a component to account for greenhouse gas emissions. At an average of 6.45 ha (hectares) per person, Australians have one of the highest ecological footprints in the world (World Wide Fund for Nature 2006).

Figure9. 3 Breakdown of the ecological footprint for the average Australian (6.45 ha)



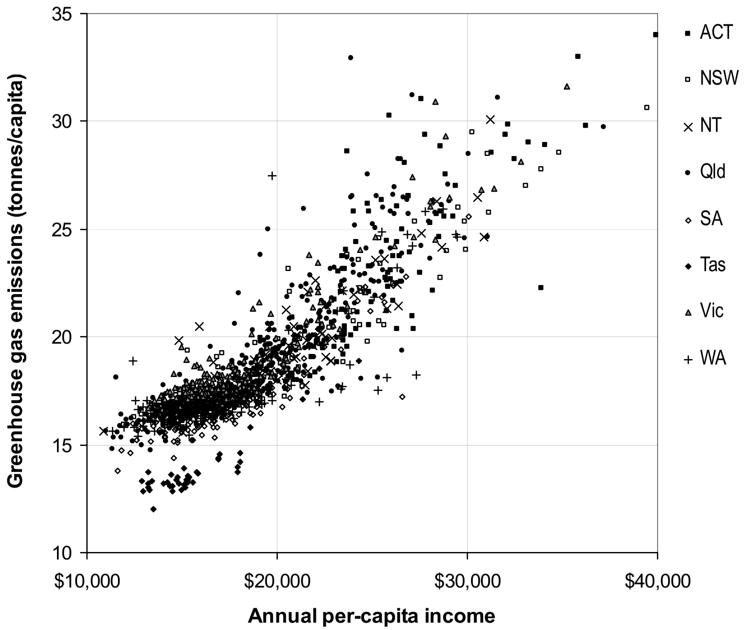
As Figure 9.3 shows, nearly half of the average person's ecological footprint is attributable to the land disturbed by food production. Cattle grazing in particular requires vast amounts of land in Australia. However, stocking rates and land use characteristics in the Australian rangelands are quite different from more intensively stocked and developed grazing land in other countries, closer to being in a natural state. Nevertheless, because direct household and transport contributions to land disturbance are relatively small, the most practical way for individual households to reduce their impact in terms of land disturbance is to alter their patterns of consumption of food, clothing, and other goods heavily reliant on agriculture.

General trends in total impacts from consumption

The per capita average greenhouse emissions for all SLAs are plotted against average per capita income in Figure 9.4. Despite the scatter of many different SLAs, there is a clear trend towards increasing emissions for higher incomes, as observed many times previously (e.g. Munksgaard, Pedersen & Wier 2000). Groups of symbols reflecting the state SLAs can be observed, with the Tasmanian SLAs particularly noticeable toward the bottom of Figure 9.4, due to their own electricity being mainly hydropower, as mentioned above. The shape of the curve shows no evidence for decreasing emissions for higher incomes, as would be expected if a Kuznets relationship did hold. The significant scatter of the data is indicative of the vastly differing lifestyles of Australian households, where it is quite feasible for emissions to range over a factor of two for the same per capita income. This is not surprising perhaps, since consumer preferences and activities vary enormously. Note that a central assumption of the methodology used here is that impacts are linearly related to expenditure. In reality, higher quality goods (and services) and therefore generally higher priced, will have higher impacts, but not necessarily as high as their premium price suggests. However, in the absence of extremely detailed goods and services information, both in terms of what households buy and the profiles of different quality goods in the economy, the linearity assumption is reasonable, since it is unlikely that all consumption of a household is of above-average goods and services, meaning overall uncertainties are acceptable (Lenzen 2001a). Expenditure is in general a better proxy for environmental impact, but the income data by SLA is more reliable here and for the purposes of showing important relationships, income is shown in Figures 9.4–9.6.

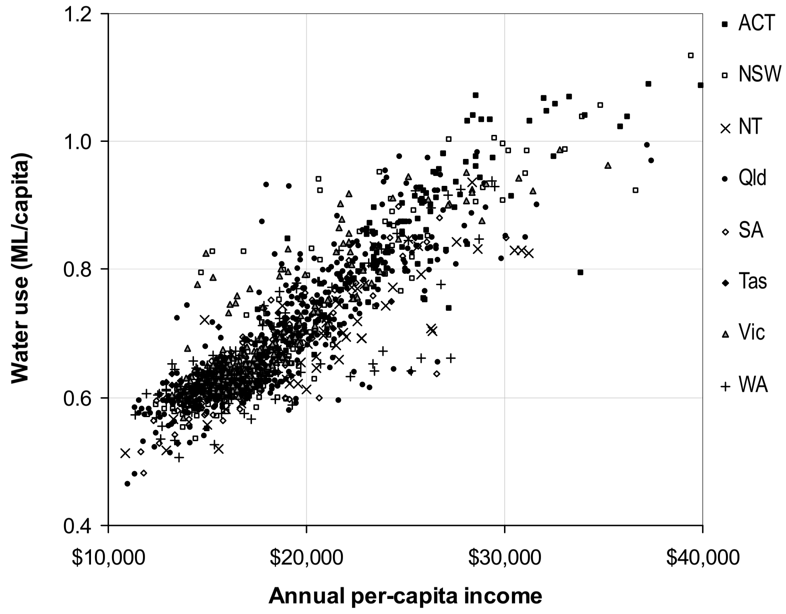
Closer examination of the HES shows that, while high income households spend more on high–cost, low–impact activities such as entertainment and other services, they also spend more on electricity and most other categories of goods. Furthermore, some activities with high greenhouse impacts, such as air travel and construction and renovation, tend to be concentrated in high income groups.

Figure 9.4 Greenhouse gas emissions (t CO_2-e) for each SLA as a function of annual per capita income, with states indicated



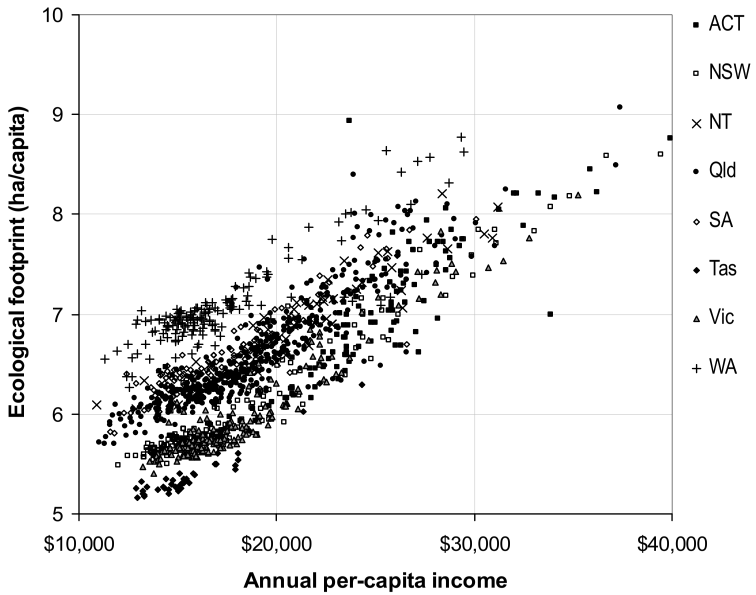
In contrast to the greenhouse gas relationship shown in Figure 9.4, there is less of an income dependence of water use and ecological footprint, as shown in Figures 9.5 and 9.6 respectively. This is readily explained since the production of food tends to be water- and land-intensive, and above a certain level of affluence average expenditure on food starts to plateau.

Figure 9.5 Total water use for each SLA as a function of annual per capita income, with states indicated



From the results shown in Figures 9.4–9.6 it can be concluded that increased wealth is leading to higher expenditure, or higher consumption of goods, services and fuels, and ultimately higher environmental impacts. It is often assumed that affluent societies and individuals will have the means to be environmentally responsible and to be able to afford to purchase better technologies with lower impacts. In theory, increased wealth could enable individuals to purchase higher quality, more environmentally sound products, and consume greater levels of services. To the extent that well-off people also have high levels of education, one might expect an increased awareness of the environment and capacity to seek out a sustainable lifestyle. However, far from enabling a sustainable lifestyle, increases in wealth appear to go hand-in-hand with greater environmental pressures. Aside from the sheer increase in expenditure, it may be that well-off individuals are 'time poor' and thus more likely to take consumption short-cuts rather than pursuing sustainable lifestyle options. For instance, households with higher incomes tend to waste more food than those on lower incomes (Hamilton, Denniss & Baker 2005).

Figure 9.6 Ecological footprint for each SLA as a function of annual per capita income, with states indicated

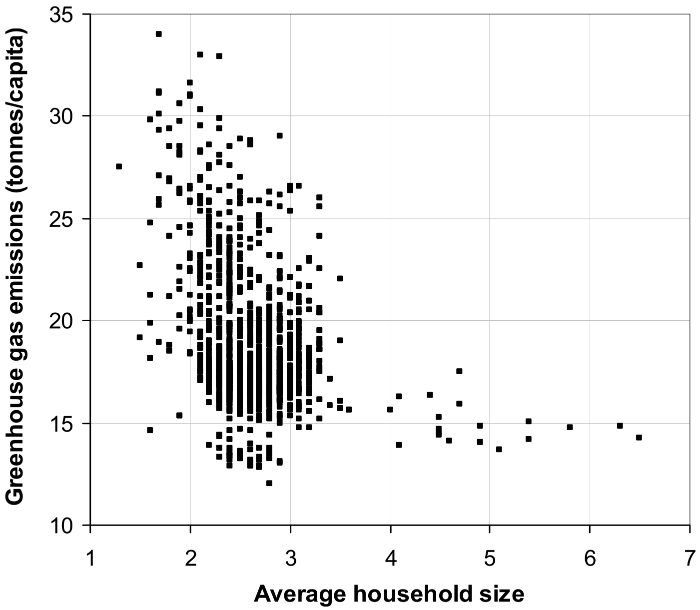


Wealth does not have to have an environmental penalty: the impact depends more importantly on how wealth is used. It is not how much is earned, but how it is spent, and on what, that determines the environmental impact. In Australia, and indeed in many other developed countries, wealth could be utilised in a more environmentally sound way. More of our individual and national wealth could be used to enable us to lead fulfilling, sustainable lives rather than just consuming more, and to invest in environmental protection and a more sustainable economy.

Environmental impact vis-à-vis household size is another interesting relationship that arises from this study, shown in Figure 9.7 for greenhouse gas emissions. The general trend towards decreasing per-capita impact as more resources are shared in larger households is clear and has been well-observed before (Lenzen 1998; Lenzen, Dey & Foran 2004). On average, single-person and small households have greater environmental impacts than larger households. As Figure 9.7 shows, areas with higher than average household size tend to have markedly lower levels of greenhouse gas emissions per capita. However there is large scatter in emissions for different households of the same (smaller) size, primarily reflecting the income effect. Large households are relatively rare in Australia, and this is reflected in the small number of large households in the HES sample. The comparatively small scatter in the results for large households probably reflects the fact that, by necessity, large households are much more similar to each other in profile (age, education, house type, etc) than are smaller households, which are more diverse.

There are several plausible explanations for this correlation. In larger households, people tend to share common living areas, which will lower the per-person heating and electricity bills. In addition, larger households can share items such as furniture and appliances, whereas a person living alone generally owns a full suite of such items. It is also reasonable to think that larger households are more likely to cook together, resulting in more efficient purchasing patterns and lower levels of food waste. In short, communal living is, in many respects, more efficient than single-person living or small households. In Australia, though, the general trend for household size is moving in the other direction: numbers of people per household are decreasing, and at the same time, the physical size of the average house is increasing in terms of floor area and number of bedrooms (Australian Bureau of Statistics 2007).

Figure 9.7 Dependence of greenhouse gas emissions on household size for all SLAs



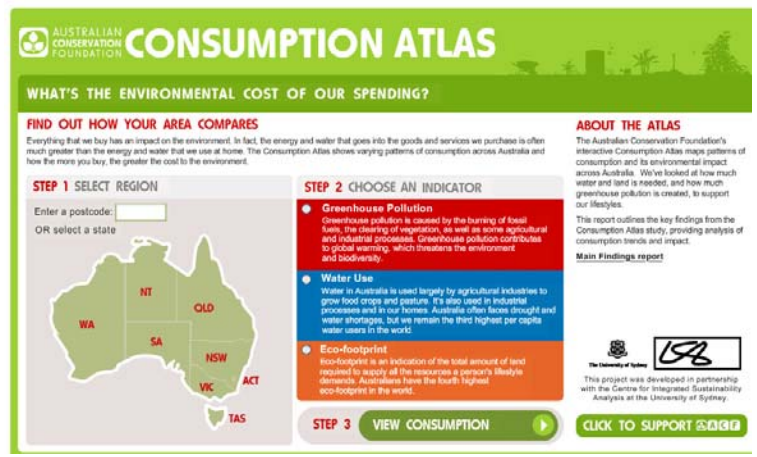
The Consumption Atlas – regional differences in environmental impacts

The detailed statistical local area data presented above may be plotted on maps using the Consumption Atlas to show patterns of consumption and environmental impact across Australia.[4] The Atlas directly illustrates

[4] The Consumption Atlas is accessible at: www.acfonline.org.au/consumptionatlas (Fig. 9.8)

how much water and land is needed, and how much greenhouse pollution is created, to support the average household consumption in each SLA in Australia. Designed and hosted by the Australian Conservation Foundation (ACF) as an interactive web-page, the Atlas is publicly accessible and supported by considerable explanations and educational material. The Atlas is a central part of environmental campaigning by the ACF, in particular their 'Green Home' initiative which is aimed at engaging Australian households through seminars, incentives and comprehensive online materials to reduce their environmental impacts. SLAs can be browsed by individual states, capital cities, and some high population areas to show environmental impact in terms of the three indicators. Impacts by SLA are shown in a colour-scale which is the same for all of Australia, allowing consistent comparisons to be made. Users can also enter postcodes and the site returns the most appropriate SLA. In the following, several examples are presented to demonstrate the Atlas.

Figure 9.8 Main page of the Consumption Atlas website



The first example is the greenhouse emissions by Queensland SLAs, showing the whole state (Fig. 9.9), zoomed to the populous south east areas (Fig. 9.10), and then zoomed into the capital of Brisbane (Fig. 9.11). Per capita emissions over the Queensland SLAs vary from 15-17 t CO_2-e in the poorer rural areas, to around an average of 20-22 t CO_2-e in metropolitan areas, to 28-32 t CO_2-e in the most affluent inner Brisbane SLAs.

Figure 9.9 Greenhouse gas emissions map for Queensland

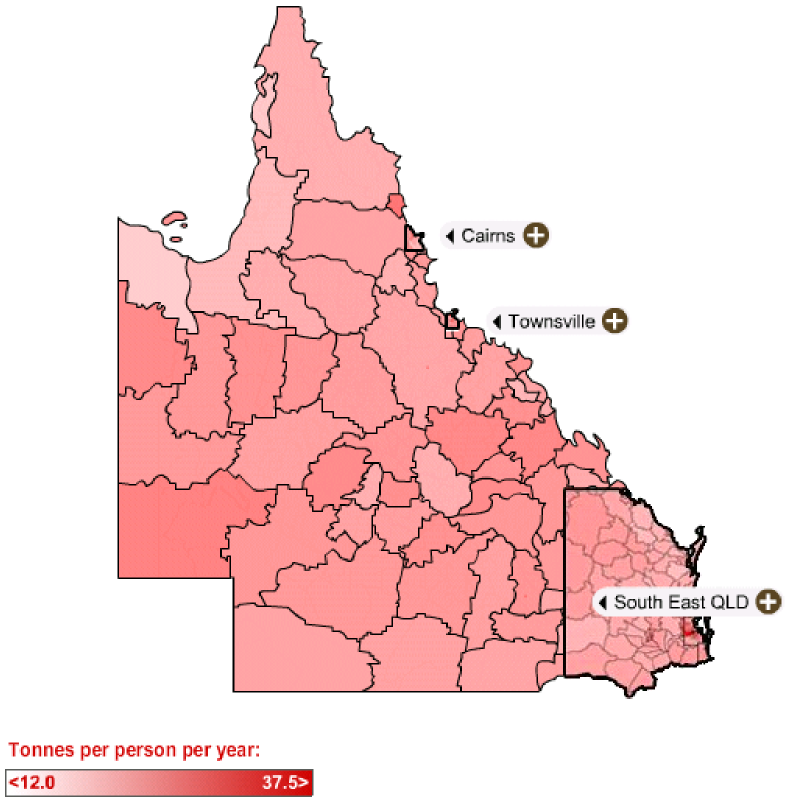


Figure 9.10 Greenhouse gas emissions map for South East Queensland

The dark areas near Brisbane indicate where the majority of the high emissions SLAs are located.

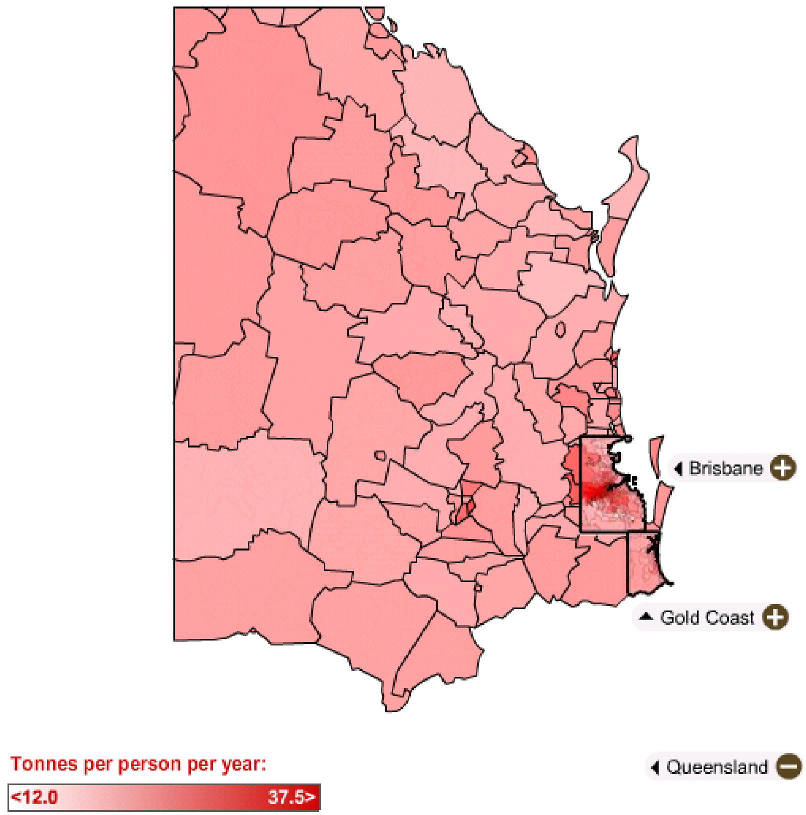
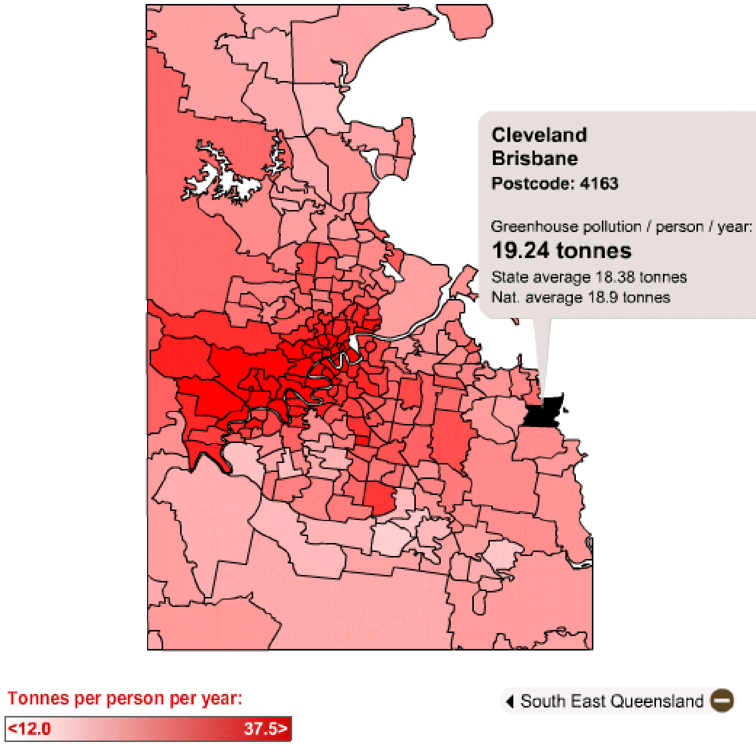


Figure 9.11 Greenhouse gas emissions map for Brisbane

The dark areas around the centre of Brisbane represent the more affluent SLAs with corresponding high per capita emissions. A pop-up window reveals the actual results for a sample SLA and shows the postcode.

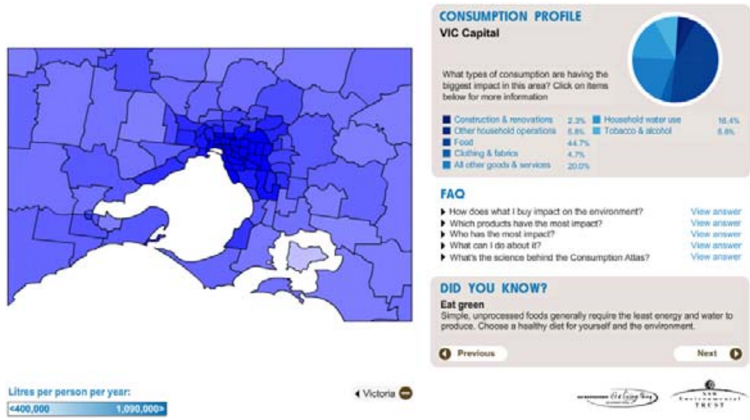


A water example is shown in Figure 9.12 for Melbourne, again clearly showing that the affluent inner–city suburbs have considerably higher water 'footprints' than the rest of Victoria. The area on the right shows a typical consumption breakdown and some further information. Those households with the highest water use (up to nearly one

million litres per capita) are indicated on the map by the darkest shade (blue in the original Atlas). These households appear predominantly in central Melbourne and throughout the wealthy coastal suburbs bordering Port Philip Bay. The highest water use occurs in Prahran South Bank and Docklands. On average, Melbourne's water use is about 5 per cent higher than the state average and 9 per cent higher than the national average.

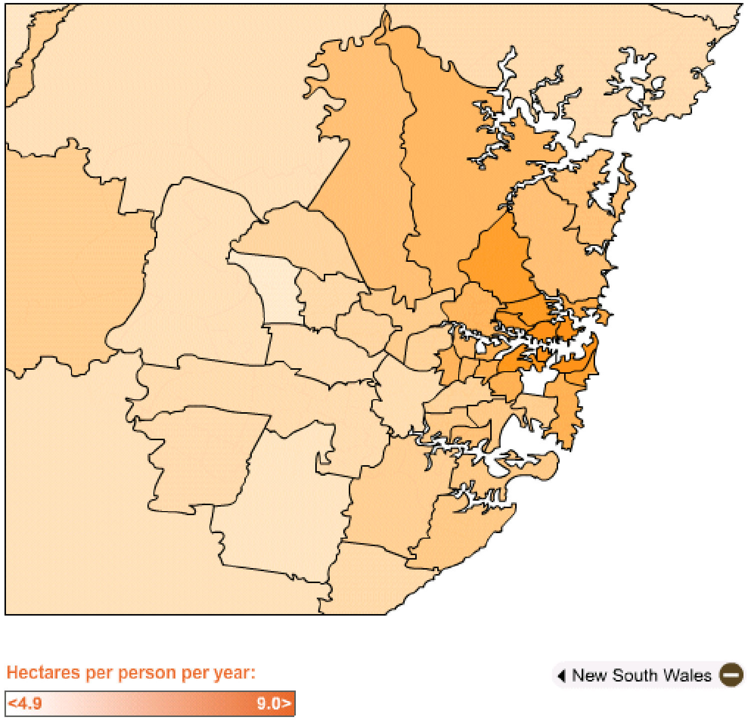
Figure 9.12 Water use map for Melbourne

The highest SLAs have water uses of up to 950,000 litres per capita.



The third example of the Consumption Atlas is for the ecological footprint indicator for Sydney SLAs (Figure 9.13). As with the other capitals, the highest footprints (up 8.2 ha per capita) are in the most affluent suburbs located around Sydney Harbour.

Figure 9.13 Ecological footprint map for Sydney



Discussion of results in environmental policy and action terms

Four main points can be made about the Atlas results. Firstly, any benefits from urbanisation, such as higher population densities in the inner cities leading to increased use of public transport, are completely over–ridden by the negative impacts of the additional consumption of the (affluent) inner-city areas. In each state and territory, the centre of the capital city is the area with the highest environmental impacts,

followed by the inner suburban areas. Rural and regional areas tend to have noticeably lower levels of impact. Affluence is the dominant effect, even though urban living patterns offer many opportunities for efficiency and reduced environmental impacts, compared to more dispersed populations.

The second point is that there is 'under' consumption in some remote areas, indicative of significant social and economic disadvantage. These low levels of consumption in remote areas may be offset to some degree by non-monetary or traditional economic activities, which are not reflected in the results. Nevertheless, the results are also consistent with a range of studies finding conditions of severe hardship in many remote communities.

The third point is that 'smarter consumption' is a valid response to reduce the environmental impact of consumption. Household environmental initiatives such as reduced waste, and lower water and energy consumption, though important, may offer much smaller environmental improvements than those achievable through smarter consumption. In terms of personal action for smarter consumption, households have many options such as: reducing their expenditure on non-essential goods; engaging in activities and choosing to consume services rather than goods; sharing goods amongst friends, neighbours and family; choosing goods which are recycled, recyclable, of high quality and high efficiency; and finally, reducing waste, particularly food waste. Smarter consumption is not necessarily incompatible with a vibrant and growing economy, but it does represent a substantial shift away from the current high consumption economies which are the norm in most developed countries.

The final point is that there is a role for governments to educate and encourage populations to consume sensibly. Viable initiatives include: education on sustainable consumption (the importance of the indirect components of the environmental impacts of households); regulation on improved product labelling; higher performance standards for equipment; and investments in infrastructure which will improve the choices available to households.

Public and media response

The Consumption Atlas was launched in July 2007 by the Australian Conservation Foundation (ACF), with state-specific media releases made possible by the detailed national data broken down by SLA. The Atlas received very strong media attention throughout Australia, with significant articles continuing to appear in major newspapers for two months after the launch. It appears that, through this coverage, the Consumption Atlas has contributed constructively to generating a national dialogue on the impacts of household consumption on sustainability in Australia. It is rare in Australia that an interactive environmental website and associated messages be so widely viewed. A summary of the main media exposures include:

- six segments on televised news and current affairs programs, reaching an estimated 2 million viewers
- strong national and state newspaper coverage, encompassing at least 25 articles mentioning the Atlas. Of particular note were a front-page story in the *Sydney Morning Herald*, a front-page story and a strong associated editorial in the *Canberra Times*, detailed pieces in the Melbourne *Herald-Sun* on two Sundays, and good coverage in the Adelaide *Advertiser* over two weekdays
- very substantial interest over several weeks by radio, including at least 47 segments covering all capital cities and numerous regional areas
- significant coverage in about 20 local newspapers across Australia, relating the information about the relevant suburbs to local readerships
- a growing list of links and articles on the internet, with mentions on prominent websites and blogs such as the *New Scientist* environment blog, *Choice* news online, *domain.com.au*, *treehugger.com*, and others.

The ability to compare the environmental performance of individual suburbs was unquestionably the major attraction for much of the mainstream media coverage. It seems that, without this geographic specificity, there would not have been any local media interest, and state and national coverage would have been much less prominent. Having

attracted the attention of the media in this way afforded an opportunity to discuss messages around the environmental impacts of consumption that are otherwise difficult to raise in the mainstream media. The media responded strongly to the 'league-table' nature of the website and detailed breakdown of SLAs. The affluent suburbs are a popular target for journalists and the general public alike.

There were also challenges in dealing with the differences between the consumption issues and the traditional environmental messages around waste reduction, efficiency, and direct household action. The main top-line message for mainstream media articles tended to be "New study finds rich are the biggest polluters", whereas more empowering and sophisticated messages around the opportunities for reductions in consumer environmental impact, and the differences between different expenditure patterns, tended to appear later in the articles or, in some cases, not at all. The ACF worked hard on media strategies to ensure that the media did not stray from reasonable interpretation and that they communicated good action messages.

The duration of media interest in the story is noteworthy. Major media pieces occurred well after the launch and initial media flurry, such as a front-page story in Sydney that appeared six weeks after the launch. An explanation for this extraordinary interest is a combination of the novelty and depth of the data and analysis itself, but also the differentiated messages for each state and individual localities. In other words, the fact that a Victorian Sunday paper did a major story did not preclude a major story some weeks later by a rival Sydney paper, because the Sydney story was different enough from the Melbourne story in its particulars.

The geographical specificity of the Atlas has made it an ideal tool to supplement other community outreach strategies the ACF is pursuing as well. For instance, in GreenHome workshops, rather than simply presenting national aggregate statistics on per capita emissions, average results for the specific area in which the workshop is being held can be shown, and consumption patterns in that area discussed. This makes the message much more 'real' for audiences, and thus more effective at driving behavioural changes.

There were, however, some misconceptions and lost messages in some of the media activity that warrants discussion. Several letters to the editor in the days following major stories about the Consumption Atlas challenged the results and argued that inner city suburbs had lower impacts, meaning direct-only impacts. This response demonstrates that, despite the clear media messages, and in fact the good representations of most of the articles, the public can still choose to rely on their traditional thinking and understanding. It is clear from some of the reactions that the results were an affront to members of the public who consider themselves good environmental citizens. Furthermore, this highlights that some people have difficulty with the concept of the performance of the average person in SLA.

Even some environmentally-aware commentators missed the premise of the study and the meaning of the results. In a newspaper story, which was printed more than two months after the launch, a local environmental commentator responded to the result of above average local greenhouse gas emissions by describing direct-only effects contributing to emissions, such as air conditioning use and lack of renewable energy sources. Similarly, an Australian academic prominent in the field of sustainability challenged the findings using direct-only arguments when questioned by a journalist. Despite the main point of the actual stories, and the basis of the Consumption Atlas, even environmental experts had difficulty recognising the fundamental message here. Whilst some of these reactions may be due to their being unfamiliar with the Consumption Atlas, or because they were asked leading questions, it appears that the issue of indirect aspects of consumption is not universally recognised.

Public attitudes to and understanding of environmental issues have been surveyed in NSW every three years since 1994 (*Who cares about the environment?*). A general result from the most recent survey (2006) is that there is a growing awareness of the complexities and linkages between environmental issues, and more generally about the concept of sustainability (Department of Environment and Conservation NSW 2007). However, none of the survey questions were aimed at examining attitudes and understanding of environmental effects of the general

purchase of goods and services by households. For example, reductions in energy, water and plastic bag consumption were consistent activities in the responses, but these responses (and indeed their questions) were almost universally about direct effects, not about wider impacts from general consumption of households. In fact the only mention of consumption concerns the category of responses called 'green purchasing' where 're-using things' is noted as a response. Water consumption is particularly closely linked to direct household behaviour, although an increasing number of people recognise that the majority of water use in NSW is for agriculture. This commentary is not a criticism of the *Who cares…?* survey, which is a very valuable gauge of public knowledge and action on the environment over the last 13 years. Rather, the lack of attention in the survey to the wider impacts of consumption (e.g. the water and greenhouse footprints of consumers) is indicative of the lack of awareness of these issues even among environmental professionals.

Conclusion

This chapter described the rationale, methodology, results, interactive website, and the public response to a detailed set of environmental performance data for Australian households. The data fundamentally includes upstream or indirect contributions to environmental pressures from households and is therefore substantially different from most environmental education material. The website and results in general provided a wider scope for environmental action and campaigning. An extensive but carefully managed outreach program by the Australian Conservation Foundation achieved substantial public and media interest, covering a relatively new area of environmental message.

The success of the project can be attributed to the 'personalisation' of environmental performance that the good spatial breakdown afforded: despite the use of average figures, the public still considered themselves to have a personal connection with the results. The results of the project are a significant benchmark of national environmental performance by households for three important indicators. Web-based delivery and good media and communications have enabled very successful outreach of research to be achieved. This represents a good partnership between researchers and committed media and education specialists.

Although difficult to assess, some of the success of the project may be attributable to the current high public environmental awareness in Australia, due to a combination of the protracted drought, recent major natural disasters and their links, even without good evidence, to climate change. Relatively recently there has been acceptance in the mainstream that climate change is a significant issue. All these factors are likely to have had an important bearing on the media and public's receptivity to the Consumption Atlas.

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