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Urban Density and Ecological Footprints

An Analysis of Canadian Households

Lyle A. Walker and William E. Rees

Achieving sustainability will require difficult choices about both public expenditures and personal consumption patterns. This chapter examines the ecological implications of a consumption choice that all households face, that of dwelling type, recognizing that private decisions about housing also affect public investment. We use a new tool, "ecological footprint analysis," to translate the total ecological impact associated with different housing types into the area of productive land required to support associated resource consumption.[1]

Thinking Ecological Footprints

Urbanization and technology have increasingly alienated people both spatially and psychologically from their biological roots. How many city-dwellers have ever paused to wonder just how much of the Earth's surface is dedicated to supporting just themselves? Not very many! The fact remains, however, that humans everywhere are still dependent for their survival on numerous biophysical "goods and services" provided by terrestrial and aquatic ecosystems. High income urban societies in particular require a constant flow of material and energy from nature not only to feed themselves, but also to build and operate their factories and other capital goods, their

consumer products, the service infrastructure — indeed, all the accoutrements of modern life. The waste burden has, of course, increased proportionately. In fact, since the beginning of the industrial revolution, our so-called "industrial metabolism" has grown greatly to exceed our biological demands on the ecosphere.

In recognition of the role of nature in maintaining the human economy, ecological economists have begun to recognize that ecosystems and biophysical resources can be treated as forms of "natural capital" (Costanza and Daly 1992). In economics, capital is the means of generating wealth. It is the means of production, our way of generating money income. Thus, like other forms of capital, well-managed natural capital is capable of producing a stream of income indefinitely into the future. Indeed, all the goods and services flowing from nature can therefore be thought of as "natural income." Fish stocks and forests are forms of natural capital, and sustainable annual harvests represent natural income. The ecological dimension of sustainability requires that we live within nature's means, on the income generated by natural capital. By contrast, much of our money income at present is derived less from sustainable flows than from the liquidation of Earth's once bounteous natural wealth.

In this light, a fundamental question for sustainability is whether remaining natural capital stocks are even theoretically adequate to support the growing human population with its rising material standards through the next century (Rees 1996). William Rees and his students at the University of British Columbia have developed ecological footprint analysis as one approach to addressing this question (Rees and Wackernagel 1994, Wackernagel and Rees 1995, Rees 1996). Ecological footprinting provides an area-based estimate of the natural capital requirements of any defined human population, from an individual to an entire city or country. It starts from the premise that energy and material production and waste assimilation by nature require the services of a measurable area of land and water ecosystems. Thus, we define the ecological footprint of a given population as the total area of productive land and water required on a continuous basis to produce all the resources consumed, and to assimilate all the wastes produced, by that population, *wherever on Earth that land is located.*

Let us consider a typical household to illustrate the concept. When we build a home, we obviously physically occupy a certain amount of land. But housing consumes a lot more land than the foundation area. Besides the building site, there is the household's share of all the streets in the city and intercity highways. The forest products consumed in constructing and maintaining the house — framing timbers, wooden floors, building paper, etc. — can be translated into an equivalent area of productive forest land. We can also convert the carbon dioxide generated by the household for space heating into a land area equivalent. This would be the area of "carbon sink" forest needed to prevent these emissions from accumulating in the atmosphere and adding to the greenhouse effect. These items contribute to just the "housing" component of the household's ecological footprint. If we sum the land area equivalents of the household's entire average annual shopping basket of consumption

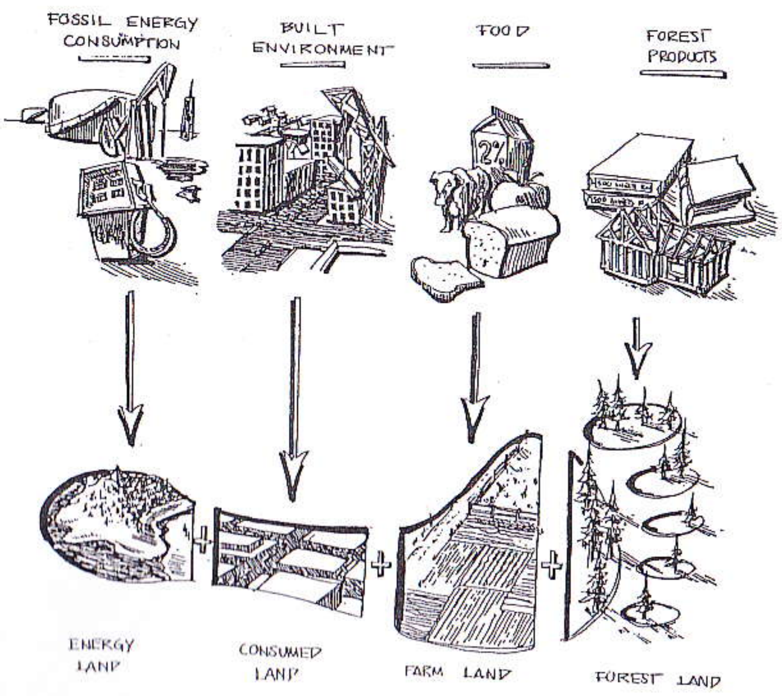

Figure 1: Converting Consumption Into Land Area.
The production and use of any good or service depends on various types of ecological productivity, which can be converted into a land-area equivalent. Summing the land requirements for all significant categories of consumption and waste yields the total ecological footprint for that population. Illustration by Phil Testemale. Source: Wackernagel and Rees 1995: 67.

items, we obtain an estimate of the household's total ecological footprint (Figure 1).

We use a simple two-dimensional matrix relating consumption with land productivity to organize our ecological footprint estimates. The rows of the matrix represent five main consumption categories: 1) food, 2) housing, 3) transportation, 4) consumer goods, and 5) services. The columns of the matrix represent specific land use categories: a) fossil energy land, b) consumed land, c) food land, and d) forest land. Fossil energy land is land used to sequester carbon dioxide emissions. Consumed land includes degraded land that humans have rendered biologically unproductive, such as building sites and road surfaces. Food and forest land are cultivated or modified landscapes whose annual production of biomass (natural income) is appropriated by people. Each cell in the matrix represents the land area required to satisfy the *per capita* demand for the corresponding consumption item on a sustainable basis.

Wackernagel and Rees (1995) estimate that the ecological footprint of an average Canadian is about 4.3 hectares. Comparing this calculation with the actual *per capita* productive land available on the planet produces a startling result. If everyone on the planet consumed like an average Canadian, we would need approximately two additional Earths to support the consumption demands of the world population! These findings indicate that it is not biophysically possible using prevailing technologies to bring the world's population up to North American material standards on a sustainable basis.

Some Pros and Cons of Footprint Analysis

The major strength of ecological footprint analysis is its conceptual simplicity. This method provides an intuitive and visually graphic tool for communicating one of the most important dimensions of the sustainability dilemma. It aggregates the ecological flows associated with consumption and translates these into appropriated land area, a familiar indicator that anyone can understand. The ecological footprint of any defined population and level of technology can then be compared with the available supply of productive land. The conclusion is unambiguous for the conditions specified because land is assuredly finite and represents an inelastic limit on material growth. In short, ecological footprinting succeeds as a communication tool because it conveys a profound message that can readily be communicated to the general public.

While acknowledging its power to communicate a fundamental message, some commentators have suggested that the footprint concept is too simplistic. It is true, of course, that footprint analysis is static, rather than dynamic, modeling and that it has no predictive capability. However, prediction was never our intent. Ecological footprinting acts as an ecological camera — each analysis provides a snapshot of our current demands on nature, a portrait of how things stand *right now* under prevailing technology and social values. We show that humanity has already exceeded carrying capacity and that some people contribute significantly more to this ecological "overshoot" than do others. Once such basic conclusions are accepted, the analysis begs such policy-relevant questions as just how large is our ecological deficit and what must be done to reduce it?[2] We believe that this in itself is an important contribution.

It is also true that eco-footprinting ignores many other factors at the heart of sustainability.[3] Of at least equal relevance are considerations of political and economic power, the responsiveness of the political process to the ecological imperative, and chronic distributional inequity which actually seems to be worsening (both within rich countries and between North and South) as the market economy becomes an increasingly global affair. In fact, our current approach does not even account for the myriad indirect effects of production/consumption such as the disruption of traditional livelihoods and the damage to public health that results from expanding economic activity. Obviously such limitations call for additional research on the issues raised, but none detracts from the fundamental message of ecological footprint analysis — that whatever the distribution of power or wealth, society will ultimately have to deal with the growing global ecological debt. (For an expanded discussion of the strengths and weaknesses of eco-footprint analysis, see Rees and Wackernagel 1996.)

Resource Consumption Related to Dwelling Type and Density

As noted, dwelling type and density affect sustainability through differences in the consumption of energy, materials, and land for housing, transportation, and urban infrastructure. Nationwide, this represents a significant portion of total resource consumption. In 1989, housing and transportation accounted for 21 per cent and 28 per cent respectively of final energy use in Canada (Environment Canada 1991: 12-11). Housing and transportation also consume

significant quantities of land. Residential land and roads, including parking lots, typically consume approximately 51 per cent and 19 per cent of land use respectively in large urban areas (Hodge 1991: 148).

Housing and transportation are also the two largest expenditure items in most households in Canada, representing about 25 per cent and 17 per cent respectively of the average household's after-tax expenditures (Statistics Canada 1993b: 35). Given the resource and financial significance of housing and transportation, these sectors represent great potential scope for reducing consumption.

The Influence of Dwelling Type and Density on Consumption Patterns

Dwelling Type and Resource Consumption for Housing Lot size determines the amount of land directly occupied by a household. We consider land lying underneath the dwelling and any impervious surfaces, such as driveways, to be permanently degraded. The remainder of the lot is in the "garden" land category.

Different dwelling types have differing energy requirements for space heating and cooling which account for 64 per cent of energy consumption in B.C. homes (B.C. Energy Council 1994: 98). Dwelling type determines the proportion of walls and floors that are shared with other dwellings which affect the amount of exposed surface area for heat transfer. In addition, floor space generally decreases as density increases. Thus, as density increases, the *per capita* requirements for space conditioning in buildings decreases (Lang 1985: 18). Detached houses consume the most operating and embodied energy per unit of floor space when other factors are held constant (Burby et al. 1982).

Higher densities also facilitate the use of more efficient energy technologies, such as district energy systems which are used extensively in Scandinavia and northern Europe. Such systems pump hot water, steam, or chilled water generated at locations along the system to buildings on the network to satisfy their space heating, domestic water, or industrial process needs (MacRae 1992). In Britain, a threshold of 44 units per hectare was considered to be the minimum density required to introduce district energy systems (Owens 1986). Efficient design and building codes can further reduce energy needs. An R2000 house may use half the energy of standard detached houses, while an energy efficient Advanced House may save an additional 50 per cent.

Dwelling type, floor space, construction materials, and building height all influence gross material consumption. For example, an average Canadian home requires approximately 24 cubic metres of wood for its frame and floors (Environment Canada 1991: 10-11), significantly more than that required for a wood-frame apartment. Above four storeys, building frame materials are generally steel or reinforced concrete which have higher embodied energy contents than wood.

Density and Energy Consumption for Transportation The number and length of trips, the split among transportation modes, trip speed, and vehicle occupancy rates all affect total transportation energy consumption (Handy 1992: 2). The most important factor relating urban form and transport energy consumption is the separation of activities which is itself a function of density and land use mix (Owens 1986: 32). Density and distance between destinations affect the availability and feasibility of alternative transportation modes. For example, densities of 15 and 30 units per gross residential hectare have been suggested as the thresholds for cost-effective bus and rapid transit service respectively (Snohomish County Transportation Authority 1994: 21). Walking and cycling are feasible options only for short trips. Not surprisingly, automobile ownership is highest among single-family households at 94 per cent compared to 56 per cent for apartment-dwelling households (Statistics Canada 1992b). Similarly, about 77 per cent of fully-detached households have at least one auto commuter compared to only 57 per cent of apartment-dwelling families (Statistics Canada 1993a: 55).

How people travel affects energy consumption. Walking and cycling require only caloric intake from food. Transit is more energy efficient per passenger-kilometre than are automobiles at typical occupancy rates. However, there is potential for a ten-fold increase in vehicle energy efficiency by shifting to ultralight hybrid cars (Lovins and Lovins 1995).

In a study of 32 international cities, Newman and Kenworthy (1989) found an exponential decrease in *per capita* gasoline consumption with increasing density (Figure 2). Reduced auto dependency occurs above a density of 30-40 persons per urban hectare. High density European and modern Asian cities consume the least gasoline consumption while low density U.S. and Australian cities have the highest consumption. Toronto and five other Canadian cities fell within this range (Newman, Kenworthy, and Lyons 1990). It should be noted that many studies have been unable to isolate the effect of density on consumption from that of other factors, such as the socio-economic characteristics of households.

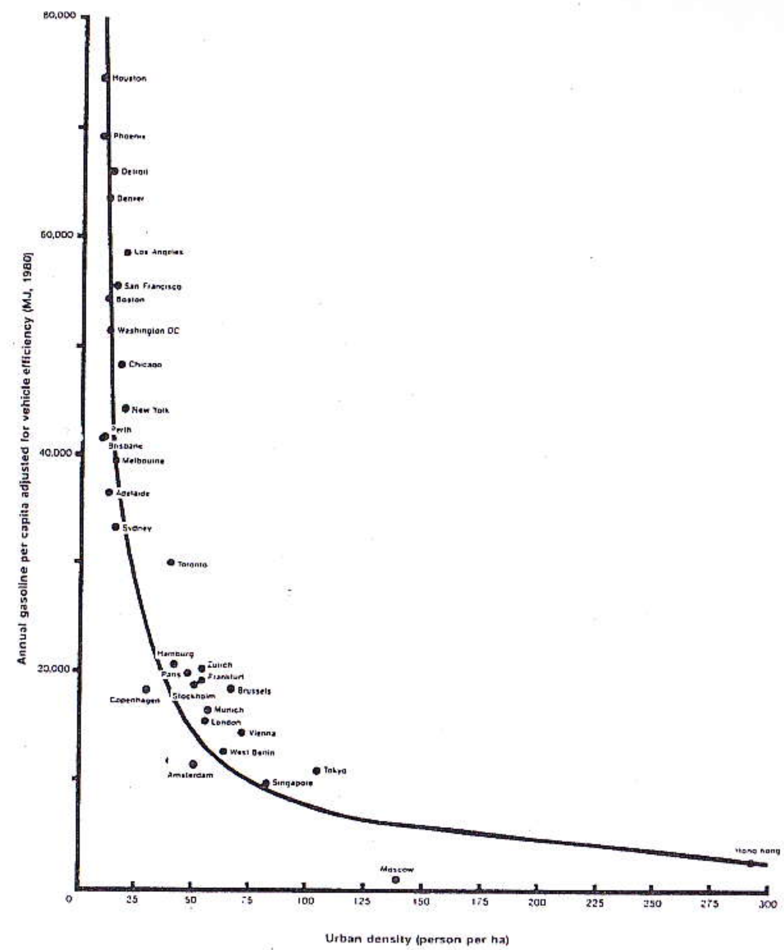

Figure 2: Urban Density Versus Gasoline Use Per Capita Adjusted for Vehicle Efficiency, Newman and Kenworthy 1989: 49. Reprinted with permission from P. Newman and J. Kenworthy, *Cities and Automobile Dependency: An International Sourcebook* (Gower Publishing Ltd., 1989), p.49.

Density and Resource Consumption for Infrastructure Buildings require infrastructure such as roads, sidewalks, street lights, and water and sanitary sewers, all of which consume land, energy, and materials. Density, lot size, municipal standards, characteristics of occupancy, contiguity of development, distance to central facilities, and settlement size are the main variables affecting infrastructure costs and presumably resource consumption (Frank 1989). Gagnon (cited in D'Amour 1993) estimates that street length per dwelling unit falls from 17.5 metres for single-family bungalows to one metre for eight-storey apartments. Nevertheless, the energy savings from infrastructure at high densities are believed to be less than those associated with corresponding shifts in building type and transportation mode (Lang 1985: 31).

Applying the Ecological Footprint Concept to Household Comparisons

To assess the housing-related ecological impacts of different housing options, we performed an ecological footprint analysis at the household level and made comparisons on a per occupant basis. Each housing type has characteristics — e.g., floor space, lot size, and number of occupants — that measurably affect consumption related to house construction and operation, and transportation.[4] Similarly there is a link between lot size and the energy, material, and land required for infrastructure. Lot size determines the frontage which in turn dictates the amount of linear infrastructure, such as residential streets, electricity, and communications cables, water and sewage lines, etc., required to service the lot. As noted, we convert fossil energy consumption into the area of carbon-sink forest required to absorb carbon dioxide emissions, taking into account electricity derived from fossil fuels.

Mirrored Density: Reflections of a Household's Housing Choice

We used "mirrored density" as the basis for comparison among housing types. Mirrored density is the overall density that would result if all households were similarly housed. In other words, consumption estimates for each household type are based on the assumption that everyone lives in the same type of house and that the resultant density is uniform across the city. Mirrored density is preferred to actual density because we were not interested in specific sites but rather with the general implications of dwelling type. In mixed residential areas, those households living on smaller lots effectively subsidize transportation services for households living on larger lots (i.e., higher densities make public transit more feasible). Thus data on particular housing types from real-world mixed neighborhoods would be augmented or diluted by spill-over effects from other housing types. Mirrored density avoids this problem.

Mirrored density provides a way to link dwelling type and lot size with transportation energy consumption. To make this link, we used Newman and Kenworthy's (1989: 49) graph of urban density and gasoline consumption data. We matched our mirrored densities to their gross urban density scale and took the corresponding gasoline consumption from the graph.

Description of Housing Types

We made ecological footprint calculations for four dwelling types: single-family detached, townhouse, walk-up, and high-rise apartment. We examined detached houses on both 8,400 square foot lots and 6,000 square foot lots. For each dwelling type, the physical characteristics of the existing Canadian housing stock were assumed (Table 1). Note that occupancy decreases from about three in detached houses to 1.8 in apartments. Average floor space decreases from about 1,700 square feet in detached houses to 800 square feet in apartments.

Comparison of Ecological Footprints

We compared the ecological footprints of the dwellings by consumption category (Figure 3). The per occupant housing-related ecological footprint of a standard detached house is about one and a half hectares. Approximately 53 per cent of the footprint is for housing, 44 per cent for transportation, and three per cent for infrastructure. The ecological footprint of the small-lot house is 92 per cent of the standard house value, mostly due to reduced energy consumption for transportation. The per occupant ecological footprint of a typical townhouse was estimated to be 78 per cent of that for a standard detached house. The smallest eco-footprints are for residents of high-rise and walk-up apartments at 60 per cent to 64 per cent respectively of the value obtained for occupants of standard detached houses. For reasons noted above (see Note 3), the ecological footprint calculations are probably underestimates. However, more refined calculations would not much affect the relative differences between dwelling types.

Table 1: Profile of Household and Dwelling Characteristics by Housing Type					
	Standard lot Detached House	Small lot Detached House	Townhouse	Walk-up Apartment	High rise Apartment
Household characteristics					
- number of occupants	3.0	3.0	2.3	1.8	1.8
Dwelling characteristics					
- net floor space (m^2)	159.8	159.8	120.8	74.3	74.3
Building characteristics					
- framing material	wood	wood	wood	wood	reinforced concrete
Lot characteristics					
- net dwelling unit density (units/ha.)	12.8	17.3	36.0	72.0	188.7
- lot size/dwelling unit (m^2/unit)	780.4	557.4	277.7	138.9	53.2
- lot width/dwelling unit (m/unit)	18.3	15.0	9.0	7.9	3.0
Transportation characteristics					
- number of vehicles owned	2.04	2.04	1.46	0.94	0.94

Figure 4 plots housing-related ecological footprints versus dwelling unit density. The ecological footprint per occupant falls steeply between low-density detached houses and medium-density townhouses and walk-up apartments. It declines more slowly between medium and high density high-rise apartments.

Operating energy for housing and transportation account for over 60 per cent of the housing-related ecological footprint regardless of housing type. When embodied energy use is added, this rises to 82-90 per cent. Wood and fibre consumption is the next most important component for all dwelling types except high-rise apartments. Forest land occupies five to 15 per cent of the housing-related footprint depending on dwelling type.

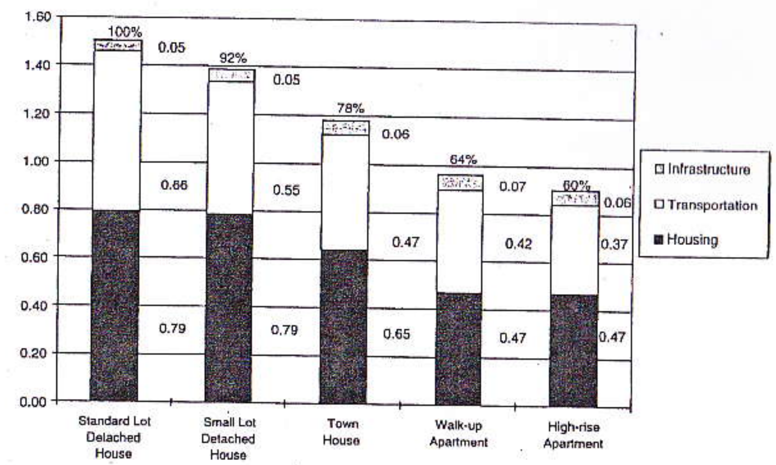

Figure 3: Comparison of Ecological Footprints per Occupant by Dwelling Type (ha/capita)

Interestingly, the smallest bit of the housing eco-footprint (four to five per cent) is the building lot and land required for infrastructure. For a household in a detached house, its housing-related ecological footprint is over 50 times its lot size. The ratio is even higher for townhouses and apartments since lot size per unit decreases faster than the ecological footprint. Here the total land appropriated for housing and related transportation needs is at least one to two orders of magnitude larger than the per occupant lot size (this increases to two to three orders of magnitude if all consumption categories [including food, clothing, etc.] are considered). It seems that the most tangible portion of a household's ecological footprint is the least significant.

Strength of this Approach

This study illustrates an integrated approach to the analysis of the ecological demands of different housing types. In addition to housing *per se*, it also includes resource consumption associated with housing-related transportation and infrastructure requirements. For example, consider the case of single-detached houses on different lot sizes: if only the housing portion of the ecological footprint were considered, there would be a reduction of less than 0.01 hectare per

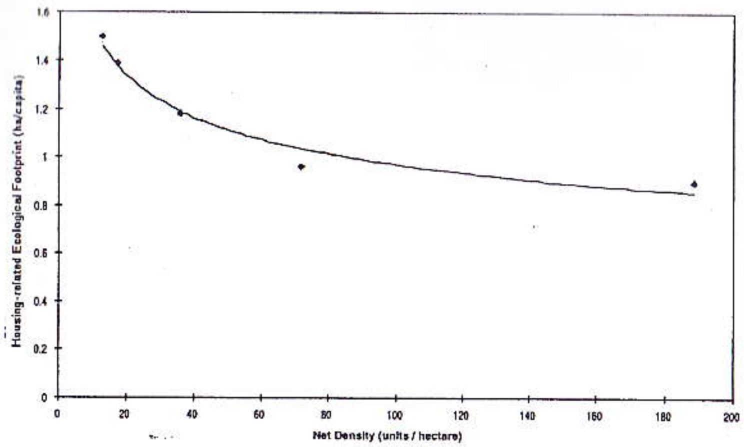

Figure 4: Urban Density versus Ecological Footprint per Occupant and Trend Line

occupant for the household on the small lot due to smaller lot size. However, when we include the relationship between density and travel requirements, the ecological footprint shrinks much further from the decline in transportation energy consumption. Another strength of the method is its ability to integrate the consumption of different resources. Consider the fact that buried infrastructure, such as sewers, does not directly occupy land. However, infrastructure requires embodied energy for its manufacture and installation. By converting the fossil energy used into carbon sink land, it becomes apparent that buried infrastructure does in fact "consume" land.

Conclusions: Policy Implications for Planning

Society continues to debate the goods and bads of higher urban densities. At higher densities, the needs of a changing demographic structure and the trend towards smaller households are better met, housing is more affordable, infrastructure costs are reduced, public transit becomes feasible, the city may be more accessible and even healthier, and farmland and environmental assets can better be preserved (Rees and Wackernagel 1996, Mitlin and Satterthwaite 1994). Countering this, the market continues to demand low density housing, there is a perception that low densities provide a higher

quality of life, and some analysts argue that the environmental benefits of higher density are exaggerated (Isin and Tomalty 1993).

Our finding that occupants of detached houses have the largest housing-related ecological footprints is an additional argument for higher density living in a world approaching global carrying capacity. Single-family detached houses have the largest eco-footprint and, in general, as density increases, the footprint per occupant decreases. Significantly, however, single-family detached houses comprise 57 per cent of the current housing stock in Canada and detached houses are preferred by a majority of Canadians. If we wish to reduce the ecological footprint of housing, then taxation, zoning, and related policies should provide incentives to promote higher density living. To be truly effective, a policy of increasing densities should be integrated with policies respecting land use, transportation, and urban form.

Operating energy for housing and transportation comprise over 60 per cent of a household's housing-related ecological footprint. These two areas should therefore be targeted as high leverage areas for eco-footprint reduction. This accords with Marshall Macklin Monaghan (1982: 5-2) who conclude that "transportation and space heating have been identified as the two aspects of new development which offer the greatest potential for energy conservation and are capable of being directly influenced by municipal planners. They are typically the two largest users of energy in urban areas." One reason for this is that under-pricing generally leads to the over-consumption of resources and discourages the development of alternative technologies. Accordingly, the artificially low prices for fossil fuels will be among the first to be adjusted upward by accelerating depletion taxes should governments introduce ecological fiscal reform as a conservation and sustainability measure (Rees 1995).

Strong measures to deal with the ecological crisis will remain politically unacceptable without public education to increase awareness about sustainability. Today's urban residents are generally alienated from the natural environment. They do not appreciate the volume of resources they use and wastes they generate to satisfy their consumption patterns. This research shows that, contrary to popular perceptions, the land used for residential lots and roads — most of the modern city's built-up area — comprises only a small part of the actual total land appropriation by high-income cities.

Thus, ecological footprinting can be a powerful heuristic tool in communicating the *de facto* impact of our consumer lifestyles and the potential gains from adopting alternative consumption patterns. The data also show that shifting to high density multi-family from low-density single family housing can carve as much as 40 per cent from the housing-related component of our personal ecological footprints. The implications of this measure for long-term sustainability are much easier to grasp than the corresponding value of dollars saved or calories unspent.

Rethinking the Characteristics of Sustainable Communities Thinking from an ecological footprint perspective suggests that sustainable communities would meet the following two criteria (among others):

1) Preserves on-site natural capital, particularly highly productive ecosystems;

2) Minimizes the ecological footprint of the development and its occupants, which largely manifests itself off-site.

Some so-called "environmentally friendly" developments may only reflect the first criterion. However, as this study shows, preserving stream corridors, wetlands, and natural areas in a low density, automobile-dependent subdivision, is a far from complete model of sustainability. Conversely, development may have a small ecological footprint while doing little to preserve on-site natural capital. Indeed, one can readily imagine a sterile, compact, medium to high density city with efficient housing, excellent public transit, and a smaller ecological footprint than the comparable North American city today. However, the livability of such a community would be greatly compromised in the absence of the amenities associated with vibrant local natural capital stocks.

Reducing Our Housing-Related Ecological Footprints The steep slope of the ecological footprint curve at the low density end (Figure 4) indicates that even small increases in density can greatly reduce a household's ecological footprint. To achieve these higher densities, it will be necessary to make the associated lifestyle desirable, especially for those households that have choice over dwelling type and location.[5] In this light, it is important to distinguish perceived densities from actual densities. Good design, public open space, and creative landscaping can reduce perceived density.

In general, the traditional homogeneous single-family subdivision

should be discouraged. We can begin the transition by mixing medium density dwelling types with detached houses and by allowing secondary suites or 'granny flats' in single-family residential neighborhoods. Higher densities in existing urban areas without intruding on neighborhoods can be achieved by building three or four storey apartments along commercial streets, with retail on the first floor and residential suites above. As such medium density buildings are less intrusive than high-rise structures, some communities may choose to make them a mainstay of densification policy.

Extra care needs to be exercised when planning for high-rise apartments. High-rise apartments should be carefully located on desirable sites. Sites with high amenity value, particularly access to open space or waterfront areas, public facilities, shopping and restaurants, enhances the attractiveness and value of the apartment units. One of the most successful and highest-density residential areas in North America is Vancouver's West End. This area is bounded by waterfront on two sides, and by Stanley Park and downtown Vancouver on the other sides. It has very low vacancy rates and a vibrant commercial area. Most significantly, 40 per cent of households do not own automobiles.

In developing densification strategies, we need to search for synergies where multiple objectives can be achieved by a policy. As noted, a policy to harden the urban fringe preserves farmland, enhances food security, reduces the costs of infrastructure, and improves the efficiency of public transit. Similarly, housing coops, public housing, and other forms of affordable housing can be integrated with energy and water conservation policies to further enhance both affordability and sustainability. Building to at least an R2000 standard would in itself greatly reduce the ecological footprint of housing. Expanding our focus to affordable living, we would also consider transportation, the second or third largest expenditure for most households. Locating efficient medium-density housing near transit corridors and shopping would reduce the amount of travel, number of cars owned, and associated transportation costs.

There is clearly no shortage of strategies to increase densities and otherwise reduce our urban ecological footprints. However, sustainability requires more than technical means and political good intentions. Taking sustainability seriously forces a re-examination of deep social values, popular beliefs, and personal behaviors. Thus, if ordinary citizens are to "buy in" to sustainability, they must be convinced that they have more to gain than to lose by doing so. Success will undoubtedly require strong leadership and integrated strategies and plans for future development. Most important, however, will be an informed public supportive of strong policies for change, many of which seem to fly in the face of popular perceptions today.

9

Ecology and Community Design

Lessons from Northern European Ecological Communities

Todd Saunders

In many ways, ecology and community design are in contradiction. Most designs for development inevitably require the destruction of natural ecologies. Consequently, designers often face the paradox that sometimes the most ecologically desirable decision is not to build at all (Kareoja 1993). There are solutions to this paradox. Designers can create communities that have less impact on the natural environment and are practical alternatives to conventional community design.

Unfortunately, in North America, architectural and planning theorists, not practitioners, develop most ecology and community design concepts. While these works confirm the need for an alternative approach to design, the solutions put forward often are highly theoretical, and do not address practical concerns. Although many architects and planners profess an interest in both ecology and community design, there are virtually no contemporary built examples of "ecological communities" in North America.[1]

Northern Europe, in contrast, supports a long tradition and ever-expanding practice of ecological community design, with a large palette of academic and practical research to draw upon. In 1994, I spent four months visiting 15 ecological communities in northern Europe. I examined five in detail — Ecolonia, in Alphen aan der Rijn, The Netherlands; Lebensgarten, near Steyerberg, ıeeds and way

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Part Four

Eco-city Housing and Community Development

We turn our attention next to eco-city housing and community development. ***Lyle Walker****, a recent graduate of the School of Community and Regional Planning at the University of British Columbia, and* ***William Rees****, professor and Director of the School, examine the ecological implications of a consumption choice that all households face, that of dwelling type. They use a new tool which Rees originated, "ecological footprint analysis," to translate the total ecological impact associated with different housing types into the area of productive land required to support associated resource consumption. Walker and Rees find that occupants of detached houses have the largest housing-related ecological footprints, an additional argument for higher density living in a world approaching global carrying capacity. Sustainable communities should strive to preserve on-site natural capital, particularly highly productive ecosystems, and to minimize the ecological footprint of each development and its occupants, which largely manifests itself off-site.*

Todd Saunders*, who helps design ecological communities in Bergen, Norway, explores the idea of resident participation in relation to ecological community design. Ecological communities are designed to imitate the efficiency in nature, where there is a balance of inputs and outputs of energies, products, and waste. Saunders offers ten recommendations for community designers and others wishing to translate ecological community theory into practice. He draws lessons for us from the experience of northern European communities, which demonstrate that well-rounded ecological communities are not only desirable, but also clearly possible.*

ECO-CITY DIMENSIONS

Healthy Communities
Healthy Planet

Edited by

Mark Roseland

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