

EXAMINING MATERIAL FLOWS IN FRESHFORD, CO. KILKENNY: AN ANALYSIS OF HOUSEHOLD TRANSPORT CONSUMPTION

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ABSTRACT

This research proposes to advance the pursuit of sustainable development in small Irish settlements by means of exploring the link between materials consumption and sustainability in a small settlement setting. This initiative will facilitate a pattern of development and resource use promoting positive effects on our current supply of natural capital. Natural capital, defined as stocks of natural assets, facilitates our materials consumption, and a criterion for sustainability is now deemed to be non-declining natural capital, thus enabling material flows to be maintained indefinitely (Hinterberger *et al.* 1997, p2; Bartelmus 1999, p159). The consumption component of personal transport has been accounted for in Freshford, Co. Kilkenny. Ecological footprint (EF) analysis was applied as a tool to indicate the sustainability of current transport patterns within the settlement. The results have indicated that reliance on the private car to facilitate the majority of journeys is the primary contributing factor to unsustainable transport patterns in the settlement.

INTRODUCTION

One of the chief obstacles to sustainable development has been the increasing materials (goods and services) consumption particularly in developed countries (Mega 2000, p228). Sustaining consumption through natural resource extraction and manipulation has resulted in environmental depletion and degradation (Barrera-Roldan & Saldivar-Valdes 2002, p251). Moreover, continuing in this manner is not sustainable as “the limits of nature” are at risk of being exceeded (Spangenberg *et al.* 2002b, p430). Environmental depletion is not only an issue for industry and enterprise, the unsustainable utilisation of materials by households warrants evaluation in order to produce an estimate of the depletion cost relative to household management (Bartelmus 1999, p164). The environmental impacts of household consumption have grown over the last three decades and it is anticipated that they will intensify over the next twenty years (OECD 2002, p12). Promoting sustainable consumption, defined as “the use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste pollutants over the life cycle, so as not to jeopardise the needs of future generations”, can assist households in reducing their environmental impact (OECD 2002, p15-16).

Sustainable development investigation in Ireland has focused predominantly on large- to medium-sized settlements, specifically through the assignation and development of Gateways and Hubs. The large conurbations of Cork, Limerick, Galway and Waterford (see Fig. 1) have become Gateway cities under the auspices of the 2002 *National Spatial Strategy*. This document sets out the government objective of developing in a sustainable and balanced manner, outlining how Ireland can be spatially structured and developed over the next twenty years in a way that is internationally competitive, socially cohesive and environmentally sustainable (NSS 2002, p10-15). Gateway cities are expected to become engines of national and regional growth. Hubs, strong county towns and large towns located close to Gateways, will support this regional growth and in theory be responsible for disseminating

balanced and sustainable growth to smaller settlements and rural Ireland (NSS 2002, pp39 & 50).

Small settlements with populations under 1,500 have not been adequately represented in national sustainable development research to date. More than 550 such settlements exist in Ireland, representing almost 10% of the total population (CSO 2003). The research described here presents empirical findings of the hitherto unexamined materials consumption of small settlement households. Specifically, it provides an account of the current baseline of personal transport metabolism in a small settlement conducted from a bottom-up perspective.

Policies devised to counteract the growing trend of unsustainable materials consumption must be informed by greater understanding of the impact of consumption on ecological services. Ecological footprinting (EF) can be used as a tool to fulfil this requirement. It has the capacity to clarify and make explicit the link between human consumption and nature's ability to sustain humankind demand. The applicability of EF in this research was driven by a number of different functions that EF has to offer in the realm of sustainability research. The focus of community individuals in this research demanded the use of a tool with the ability to simplify and communicate the primary materials consumption data. It was desirable that such a tool would aid in making explicit and communicating to stakeholders the ecological impacts of their current lifestyles. In addition, EF was used in this research to conduct a sustainability assessment of current consumption patterns.

The settlement selected was Freshford Co. Kilkenny (see Figure 1), with a population of 756 in 2002 (CSO 2003). In 2001, the Freshford 2020 Committee was formed and published a *Draft Proposal for a Development Plan in Freshford* in January of that year. In this document it was recognised that Freshford, like other villages and small towns in Ireland, will be facing “dilemmas of growth, pollution and energy sourcing in the next few years” and the committee wished to “offer Freshford a safe, healthy and sustainable future” (Freshford District 2020 2001, p4). An awareness of sustainable development among the settlement residents combined with an appropriate data gathering

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Fig. 1 – Map of Ireland displaying location of Freshford and major Irish settlements.

technique resulted in a high level of participation in the study by community members.

METHODOLOGY

This section provides an overview of the methods used to:

- select the materials of relevance for examination in the settlement;
 - facilitate the data collection in the settlement;
 - conduct the sustainability assessment of the materials consumption;
- and it outlines the data categories of personal transport that were gathered from the settlement respondents.

MATERIALS SELECTION

Prior to delivering a materials consumption and metabolism overview of the settlement, particular emphasis was placed on selection of the relevant components of consumption. There is a vast array of materials consumed in any given settlement, but evaluating all these flows was

Table 1 – Household consumption classes (Adapted from Spangenberg & Lorek 2002, p134).

No.	Class
1	Clothing: textiles for human use
2	Education: kindergartens, schools, universities
3	Food: food production, cooking
4	Health care: hospitals, rehabilitation
5	Housing: construction, heating
6	Hygiene: washing, disinfecting
7	Laundry: cleaning of textiles
8	Recreation: leisure activities without the transport involved
9	Social life: police, military and other public services
10	Transport: commercial transport, commuting and leisure related mobility

outside the scope of this research. In determining the consumables to be selected for investigation in this settlement, the findings of Spangenberg & Lorek (2002) (*Environmentally sustainable household consumption: from aggregate environmental pressures to priority fields of action*) were considered. Household consumption may be disaggregated into 10 distinct consumption classes comprising more than 95% of household related natural resource consumption (see Table 1). Classes considered significant when determining priority fields of action for households, as consumers, must satisfy two criteria (Spangenberg & Lorek 2002, p134):

- Be environmentally relevant (those clusters activating the most resource flows throughout the product life-cycle);
- The consumers must exert significant influence on the extent of consumption.

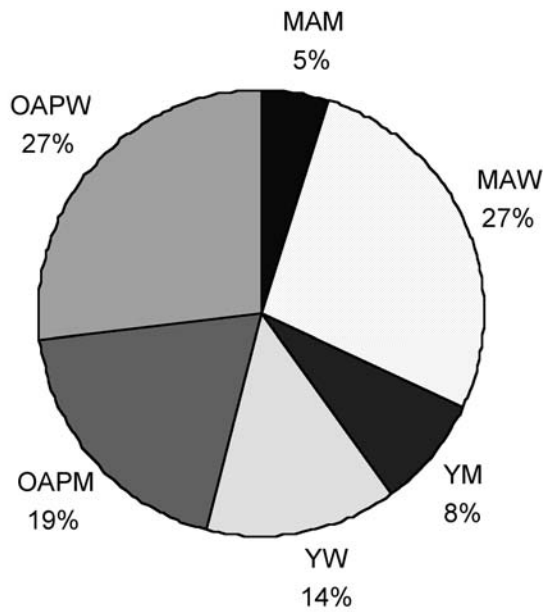
Health care, education and social life are chiefly components of state consumption providing services, which are directly or indirectly consumed by households (Spangenberg & Lorek 2002, p135). Households exert limited influence on the frequency and intensity of use they make of these services (*ibid*). For example, a minimum consumption of education is legally required in most countries. In addition, householders have little choice regarding the production of these services. The resource intensity of providing these services is influenced by a series of administrative decisions by public or in some cases private institutions, and not household decisions (*ibid*). These sectors are beyond the reach of consumer influence and as such were regarded as being outside the scope of this study of consumption accounting.

Householder decisions wield substantial influence regarding their respective consumption of each of the seven remaining classes (Spangenberg & Lorek 2002, p135). After due assessment of their causal responsibility towards environmental depletion and degradation, significant variations between the classes emerged. The total resource requirement of three classes, namely housing, food and transport accounted for approximately 70% of material extraction and energy consumption and more than 90% of land use (*ibid*). Elements of these classes and associated material flows were selected for analysis in this research. However, the findings presented in this paper are limited to exploration of small settlement personal transport consumption.

SURVEYING

The boundary for the study site encircled the village at each of the speed limit signs on all roads entering the village. There are 258 occupied households located within this village boundary. As data on the relevant materials consumption of these households were not entirely available from government, council or other sources, data were sought directly from the settlement residents by means of surveying. The surveying was conducted on a face-to-face basis. This method can expect to realise a 70–80% response rate (McNeill 1990, p40). A 62% response rate was achieved in Freshford, representing 161 households and a population of 488 (Freshford_161).

Ensuring accurate answers and avoiding guesswork from the respondent required setting the question in an easily measurable context for the householder. For example, in the waste component the question posed directed the respondent to consider wheelie bin capacity. They were not expected to give an estimate of annual tonnage of waste produced. The questions were kept closed where possible, as restricting the number of open questions in the survey avoided the possibility of “over-probing” or influencing responses during the interview and ensured honest and accurate responses (McNeill 1990, p26). At each interview the head(s) of household was requested to complete the survey in an effort to ensure greater precision in the



Legend

W = Woman; M = Man
 YW/YM: Young (aged 20–39)
 MAW/MAM: Middle-aged (aged 40–59)
 OAPW/OAPM: Old-aged Pensioner (aged 60 and upwards)

Fig. 2 – Survey respondents classified by age and gender.

answers. No time constraints were placed on the duration of the interview and in most incidences the time required exceeded 30 minutes. Although the survey was designed to require 15 minutes for completion, securing participation of the householder entailed spending time explaining the aims and objectives of the study and addressing any concerns the householder may have had about the survey. Fig. 2 displays the respondents categorised by age and gender. Females comprised 68% of the total respondents while the greatest number of male respondents was located in the 60+ years category.

ECOLOGICAL FOOTPRINTING

Component ecological footprinting, applied in this research, adopts a bottom-up approach to the calculations of the area required to support human consumption (Ryan 2004, p224). Instead of considering the effects of the consumption of raw materials, this approach considers the demand arising from a region’s transport, water, energy, etc, requirements (Barrett & Scott 2001, p16; Ryan 2004, p224). It is an additive approach that sums the ecological footprint of all relevant components of a population’s resource consumption and waste production (Wackernagel *et al.* 2004, p5-6). Two distinct steps are required to facilitate component-based footprinting (*ibid*):

- Resource accounting: identify all the goods and service and amounts thereof that a population consumes;
- Life Cycle Analysis (LCA) data are used to track the resource requirements of each consumable good or service, from raw material extraction to waste disposal.

Equation 1 describes the calculation used to determine a region’s footprint using the component approach (adapted from Barrett *et al.* 2004, pp2-13):

$$EF_r = \sum_{i=1}^n (D + N) \tag{1}$$

where: EF = total ecological footprint of a region, r
 D = direct land use,

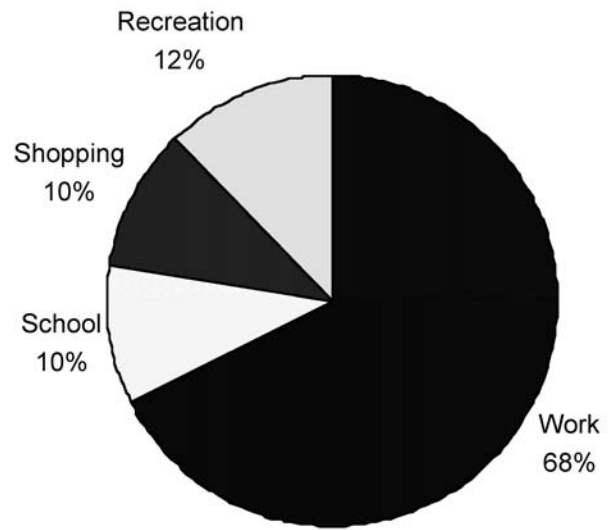


Fig. 3 – Distribution of passenger kilometres.

N = additional land requirement (notional energy land),
 I = represents the number of component parts to the footprint.

The component method of ecological footprinting was selected as the calculation method most suited to this research. The reasons for this are twofold. Firstly, the bottom-up nature of data gathering in this research was logically suited to the bottom-up calculation methodology of component footprinting. Secondly, this method is of use in gaining insight into the ecological requirements of activities. With the overriding objective of this research being one of exploring means to advance sustainability in a small settlement, highlighting the community activities prohibiting this progression was paramount. The component calculation methodologies applied in this research have been largely based on work carried out at the Stockholm Environmental Institute–York (SEI-Y) located at the University of York, UK. This research group have applied EF at a number of levels ranging from national level, *An Ecological Footprint of the UK: Providing a Tool to Measure the Sustainability of Local Authorities*, regional level, *A Material Flow Analysis and Ecological Footprint of York* and the *Ecological Footprint of Inverness*, and at the local level, *Sustainability Rating for Homes – The Ecological Footprint Component*.

PERSONAL TRANSPORT

The personal transport footprint investigated the impact of travel by community residents using various modes of transport. Walking and cycling were not included in this analysis as they have a negligible footprint (Barrett *et al.* 2002, p50). In calculating the EF of passenger transport a number of factors required consideration. These included:

- Fuel consumption;
- Energy requirements of manufacturing and maintenance of the vehicle;
- Land area occupied by transport infrastructure;
- Distance travelled;
- Occupancy rate.

The EF of a single passenger kilometre was calculated for each mode and then multiplied by the total number of passenger kilometres per mode to determine an EF value for personal transport by the settlement respondents. This total can be further disaggregated to establish the EF of travel to services such as a) work, b) shopping, c) education and d) recreation.

Table 2 – Total Passenger km by mode.

	Annual Passenger (km)	By Car	By Bus	By Taxi	Car Share
Home to Work	2,150,150	2,150,150	0	0	0
Home to School	314,986	32,595	282,392	0	0
Home to Shops	331,313	283,307	32,094	0	15,912
Home to Recreation	389,197	346,265	0	41,340	1,591
Total	3,185,646	2,812,316	314,486	41,340	17,503

RESULTS

PERSONAL TRANSPORT

The passenger kilometres (passkms) for 2004 for Freshford_161 residents amounted to 3,185,646 passkms (see Table 2). Travel from home to work contributed 68% of these kilometres (see Fig. 3). Travel to school, shopping and recreation represented an almost equivalent proportion of the remaining passenger kilometres.

Private vehicles and buses were primarily used to provide transport to work, shopping, school and recreational facilities. Other modes of transport include travel by taxi and receiving a lift. It was assumed that the occupancy rate of these latter modes was at least two persons and this assumption was included in the relevant footprint calculations.

ECOLOGICAL FOOTPRINTING

The sum of the personal transport subcomponents represents the overall footprint of personal transport by Freshford_161 residents (see Table 3). Of the total footprint, 137 gha/per capita, the travel to work subcomponent contributed significantly to this total, responsible for a per capita footprint of approximately 103 gha (see Table 3). Contributing factors to this footprint are most likely a) the volume of kilometres related to travel to work, 68% of the total kilometres travelled, b) significant reliance on use of the private car (Table 2 indicates that no other mode of transport is used to provide transport to work), c) low occupancy rates on work journeys, confirmed with field observation, and d) travel to work frequency is greater than that of other travel habits, such as shopping and recreation, etc.

The positive impact of travelling by bus was highlighted in this study of travel habits, particularly in the case of travel to educational services. From Table 2 one can see that total passenger kilometres for each are similar: 314,986 passkms for school and 331,313 passkms for shopping. However, their respective travel by modes contrasted significantly: 283,307 passkms travelled using private vehicles for shopping as opposed to 32,595 passkms travelled using private vehicles for journeys to educational facilities. The remaining passkms for school journeys were travelled using school buses; these buses operate with a

Table 3 – Overall personal transport footprint results.

Sub-Component	Total Footprint (gha)	Per Capita Footprint (gha)
Travel to Work	50,122	102.7
Travel to Education	1,625	3.3
Travel to Shopping	6,291	12.9
Travel to Recreation	8,655	17.7
Total	66,693	136.6

high occupancy rate that resulted in the lowest calculated per capita footprint of 3.3 gha (see Table 3).

DISCUSSION

Sustainability assessment using EF analysis is enabled by the comparison of supply versus demand (the footprint). EF applied to the results of the passkms transport accounting for the settlement comprised the demand share of the comparison, a total per capita demand of 136.6 gha. Supply, or to apply the technical term, biocapacity, currently stands at a global average of 1.8 gha per capita (Loh & Wackernagel 2004, p34). This value corresponds to the equitable amount of renewable natural capital available to the world population in order to facilitate consumption (*ibid*). In cases where demand exceeds supply, remembering that demand is driven by consumption, demand levels can be classified as being unsustainable and contributing to the liquidation of natural capital, thereby hindering its ability to provide satisfactory levels of material flows indefinitely. The footprint of Freshford residents' travel habits as calculated by this study can be classified as being unsustainable and in need of alteration to be steered on a sustainable pathway.

Small settlements offer unique challenges in terms of facilitating the necessary alterations to existing travel habits. The foundation from which to develop sustainable transport strategies is frequently non-existent in these settlements. For example, Freshford is poorly serviced by public transport. A bus leaves the village square just twice daily for Kilkenny city, and other nearby settlements are not serviced. Observations of the bus occupancy rate during surveying periods revealed passenger numbers of less than 10 persons on all occasions. Lack of choice in departure times may be a contributing factor in the poor uptake of public transport in the settlement. Conversely, low passenger numbers, such as those observed, most likely do not encourage transport companies to offer extensions to their services. As a result there appears to be a significant reliance on the use of the private car to facilitate journeys to employment, recreational and shopping services. Combined with an observed occupancy rate of just 1.18 (for travel to work) the large footprint can be classified as being a reflection of unsustainable transport methods.

In addition to transport by bus, other more sustainable methods include walking and cycling. However, it is logical to assume that to increase uptake of these transport modes services such as employment, shopping, recreation and education would have to be located in or very close to Freshford. Survey results indicated that only 19% of workers find employment in Freshford, 45% travel to Kilkenny with the remaining 36% travelling to other locations. The population of Freshford has undergone a 19.6% increase in the period from 1996 to 2002, from 632 to 756 (CSO 2003, p27). The current level of services in Freshford appears to be incapable of wholly supporting the increasing population. The infrastructure in the village has not

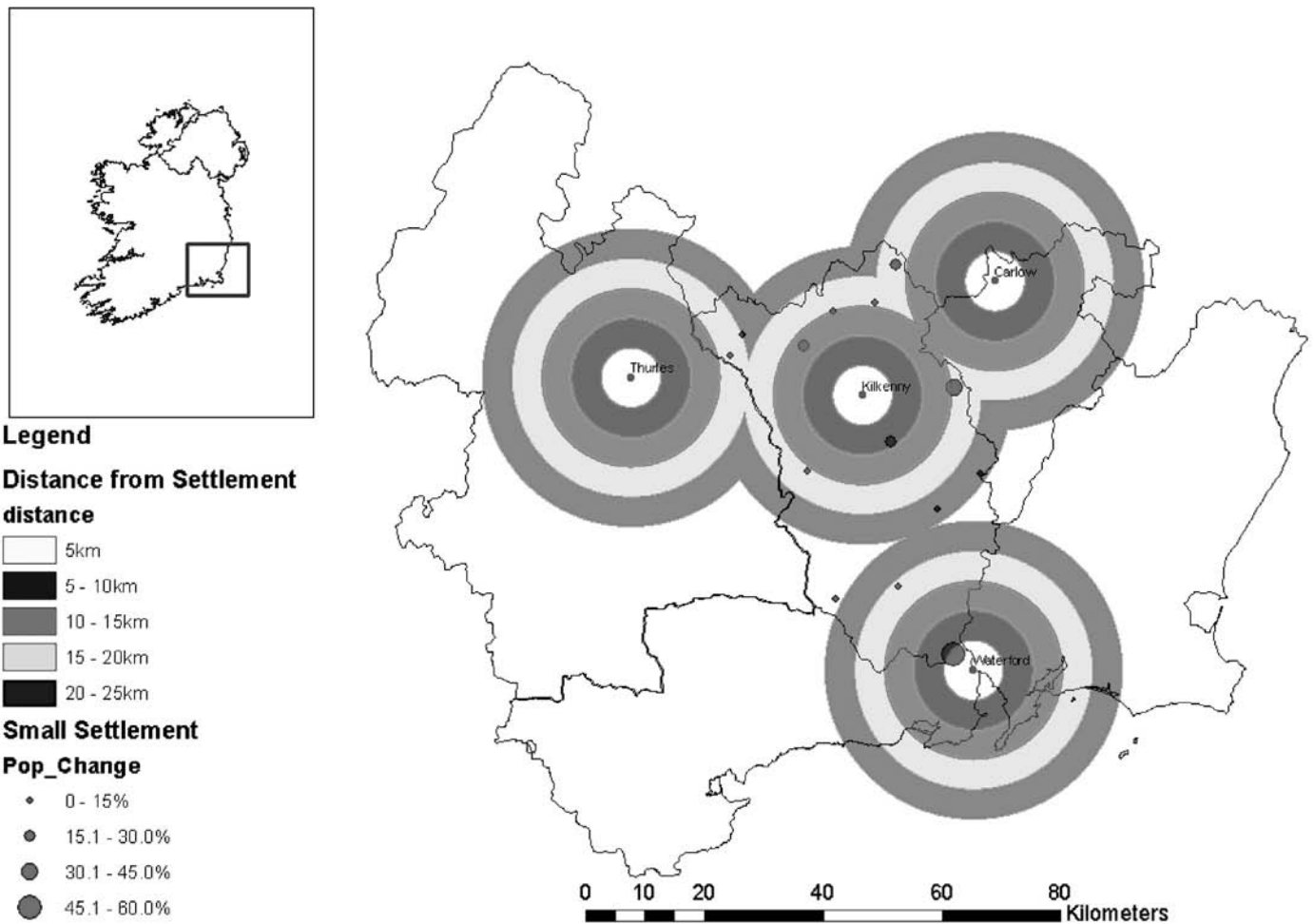


Fig. 4 – Population change of small settlements in relation to proximity to large settlements.

developed in tandem with the population. People are forced, and in some cases perhaps choose, to leave the settlement to avail of educational, shopping, recreational and employment services. While not every service can be catered for within the settlement, such as secondary schooling or a cinema for recreation, emphasis should be placed on existing services and locals encouraged to use these. For example, grocery shops in the settlement may find it difficult to compete with larger supermarkets so instead perhaps their focus should be in offering alternatives, such as organic local products. The high proportion of residents leaving the village on a daily basis is believed to have contributed to an “empty nest syndrome” according to Linda Tallis, Administrator, Freshford 2020 Development Group (27/04/05). Its proximity to Kilkenny makes it an attractive location to live in with the result that a large number of people are commuting to Kilkenny for work, leaving the village in the morning and not returning until evening or night time and as such are not contributing to the vitality of the village on a day to day basis. It is likely that Freshford is not alone in experiencing this phenomenon and this suggests that several small settlements throughout Ireland may have similarly large personal transport footprints. Fig. 4 represents the positive population changes of small settlements within Co. Kilkenny from 1996 to 2002. It is evident that settlements located within a 15km radius of larger settlements experienced the most significant population changes, most notably Slieverue, located 5km from Waterford, which experienced a population increase of 55%. Research such as this reveals the

environmental cost of current lifestyles and exposes areas where change is necessary to bring about a reduction in environmental impact. In the national drive towards sustainable development, the personal transport of small settlements is undoubtedly a blackspot. Further research in this area will examine the potential pathways open to small settlements in reversing the unsustainable trend in personal transport.

CONCLUSIONS

The current trends of personal transport in the small settlement of Freshford indicate unsustainable patterns of resource use are facilitating the residents’ requirements. Contributing factors include the location of services such as employment, shopping and recreational services and the transport modes with which these services are accessed. The implications of these findings, especially if mirrored in other small settlements nationwide, represent a challenge for policymakers to combat the unsustainable patterns of personal transport emerging from small settlements like Freshford.

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