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Paper title: **Towards an energy ‘accessibility based’ rating scheme for development assessment planners**

Author(s) name(s): Andrew Allan

Organisation(s): Transport Systems Centre, University of South Australia

Contact details:

Postal address: GPO Box 2471 Adelaide SA 5001

Telephone: +61 8 8302 1476

Facsimile: +61 8 8302 2252

email: andrew.allan@unisa.edu.au

Abstract (200 words):

In 2003, the SA government made it a requirement for all new residential related development applications to comply with a minimum standard to energy efficiency. This type of initiative has been mirrored by most state governments around Australia and to some extent prompted by issues raised through the 1997 Kyoto Accord. However, important as it is to require less energy consumption in new domestic residential development, the travel demand associated with new urban development is at least as significant a component of the total level of energy consumed by new development, particularly in areas that are largely car dependent. In a city such as Adelaide with around 1.1 million people in a sprawling urban area stretching approximately 70km north to south, overall residential densities are still too low to allow all of Adelaide’s residents to walk or cycle or even use public transport to access local facilities. New development, particularly in outlying urban fringe areas, has occurred that is not optimally located with regard to accessibility issues. This paper argues the need for an accessibility energy rating development assessment planning tool and examines some of the accessibility issues that need to be taken into account when establishing such a tool.

Introduction

Conventional development assessment techniques focus on the aesthetics, compliance with building codes and the environmental impacts of development. In 2003, most Australian state planning authorities have required local government planning authorities to address the issue of environmental sustainability, particularly with regard to household energy consumption and lately, at least in the South Australian context, planning legislation is about to be introduced which makes it mandatory for minimum water conservation measures (eg the use of rainwater tanks) to be included in new housing. What has not been addressed in planning regulation to date, however, is the issue of how location impacts on transport related energy consumption for particular developments. Various transport planning techniques are currently available that provide qualitative (Bradshaw, Chris, 1998) (Eliot, Allen, 2004) and quantitative (Litman, 2004) (Allan, 2001) means of describing the degree and quality of accessibility in urban development, but to date, nothing has been done which actually applies these techniques in the planning decision making process regarding whether certain types of development should be allowed to proceed. This paper suggests some considerations for the eventual creation of a development assessment tool that could be applied by urban planners in assessing the accessibility merits of a proposed development. The use of such a development assessment tool could help to encourage more transit oriented development, inhibit development with primarily car dependent access from occurring or it could be used to optimize new development proposals towards more environmentally sustainable transport modes, such as walking and cycling.

The need for an accessibility or accessibility energy rating schema

Australia has a major problem with the amount of greenhouse gas emissions (which is for burnt fossil fuels is roughly proportionate to the amount of energy consumed), largely because of its heavy reliance on fossil fuels for almost all of its domestic, commercial, industrial and transport energy requirements. Although in 2000, the transport sector was only responsible for about 14% of total greenhouse gas emissions, 85% of this came from the road sector and 57% from cars (i.e. 6.8% of the Australian total) (BTRE, 2002). Improvements in automotive technology over the period 1991-2000 resulted in a 5% improvement in automotive fuel efficiency (BTRE, 2002) and while there is the potential for petrol-electric hybrid vehicles such as the Toyota Prius to realize further gains as large as 50% over similarly sized equivalent petrol powered cars (Toyota, 2004), the high cost of hybrids and inertia from motoring consumers and most mass market motor manufacturers such as General Motors, Ford, Nissan and Mitsubishi, makes it unlikely that gains of more than 10% will be realized over the next 10 years. As far as the planning profession is concerned, it would be unlikely that urban planners would have any direct effect on transport technology initiatives, however, introducing planning measures that legally require certain accessibility performance standards has the potential to not only effect dramatic travel behavioural changes in the community, but also create urban environments that allow environmentally sustainable options such as walking, cycling and public transit to become the preferred means of accessing urban locations. Given that 79% of weekday person trips in metropolitan Adelaide in 2001 were made by car, there is enormous potential to switch car travelers to these more environmentally sustainable modes (South Australia, April 2003). If this figure was reduced to 50% through encouraging modal switches to public transit, taxis, cycling and walking, and these changes were mirrored Australia wide, national greenhouse gas emissions could drop by 2-3%.

Defining accessibility

Urban planners often make a distinction between ‘movement’ and ‘accessibility’. The transport infrastructure of a city may facilitate a high rate of movement for vehicles in terms of speed and traffic volume but at the micro level, it may have poor levels of accessibility to the places that people want to go. For example, freeways have limited access points, and while they may facilitate high rates of vehicle movement, they can be poor in providing access at the local neighbourhood level if it is not immediately adjacent to a freeway junction. Cities with car oriented transport infrastructure (i.e. road based hierarchical road networks) may not offer easy access to facilities at the local level for pedestrians and cyclists. Westerman et. al. (1989), developed a categorization system of roads that recognized that all roads provide some level of accessibility in the urban environment, but that it can be seen to be in the form of a continuum ranging from the freeway at one end which provides almost 100% movement but little accessibility down to the local access street or residential cul-de-sac which provides almost 100% accessibility but very little movement capacity.

From a planning perspective, accessibility is made up of several elements: the ease of getting to a facility via the local transport network from where one is (the trip generation point) to where one wants to go (the trip attraction point) which will be determined by the transport network design characteristics and the transport technology (if applicable); the nature of the facility; the attractiveness of a facility; the centrality of the facility; and the availability of facilities. Development assessment in Australia is normally only concerned with micro accessibility issues associated with a development proposal (i.e. immediate egress and ingress to the development) and not necessarily be concerned with the impact on the wider environs at the suburban or metropolitan level. For larger developments, such as a regional shopping centre, the potential impacts on the wider transport network would be investigated. However, as development assessment techniques currently stand in Australia, none per se, quantitatively evaluate accessibility from the perspective of energy consumed or whether a location is optimal for the community that may make use of the completed development project.

Techniques for evaluating accessibility

Rating schemes for evaluating energy efficiency inevitably involve a range of quantitative measures that are then converted into discrete or categorical variables that are essentially qualitative in nature. For example, the degree of permeability of a street network could be expressed as the average size of a block that would then be rated using a Likert scale from bad to good according to the subjective, but hopefully informed viewpoint of the researcher/s. This subjectivity can be problematic in that everyone potentially has a unique perspective of the value of a particular environment according to their accumulated set of experiences, their age, physical capabilities, skills, health, perception of social conventions, psychology, personal value systems, attitudes and predilections. Figures 1 and 2 illustrate examples of such rating systems.

While statistics can be used to achieve ‘normalised’ or representative values, nevertheless, many models, such as Bradshaw’s Walkability Index (Bradshaw, 1998) (see figure 1) and Allen’s Index Pedestrian Indicators (Allen, 2004) appear to be framed around a particular ‘expert/s’ set of values, rather than with generalized values that are derived from surveys of community opinions. Permeability walking indices based on travel time or distance through a

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local street network can show how direct a particular route is by comparing the Euclidian distance between two points in a network with the most practicable route available through the network between those two points (Allan, 2001). This quantitative approach can then be refined to be more representative through the use of surveys that determine pedestrian walking performance characteristics of the local population in the area being studied.

In some cases, allowing experts to arbitrate what is and is not accessible is understandable, given that some measures are technically derived or of too much of an esoteric nature to be easily comprehended by the lay person.

However, whilst the parameters of what constitutes accessibility can be determined by purely physical (eg sidewalk pedestrian capacity) and human physiological indicators (eg how far a person of average health and physical capability can walk), ultimately, for each trip that is generated, a set of sometimes purely subjective decisions is what ultimately motivates trip behaviour. Selecting indicators that are able to satisfactorily determine what motivates a person to take a trip (and the manner in which they take the trip), can be very difficult to accurately predict, even when people are asked beforehand what their travel behaviour intentions are likely to be.

To some extent, this problem can be overcome through the use of stated preference surveys of persons likely to be making the trips with regard to their likely travel intentions. With stated preference surveys, as an example, respondents can be provided with a range of travel choices that are determined by particular variables such as cost, comfort, convenience, safety, location, travel modes etc. which can then be compared with the respondent's actual travel behaviour for the journey to work. A Logit Model can then be used to see how respondents might respond to new travel situations when presented with different scenarios.

A form of multivariate regression analysis has also been used to see how variables such as housing location and income using data from travel survey responses in the 1999 Adelaide Household Travel Survey influence accessibility for households (Primerano and Taylor, 2003).

Other research (Soltani and Allan, 2004) aims to determine whether there is a connection between good urban design in a number of Adelaide suburban case studies and the propensity to use environmentally sustainable modes of transport. This research is currently developing a database of urban design and demographic characteristics for various road networks for approximately 50 Australian Bureau of Statistics Census Collector Districts case study areas, which are to be tested for correlations with the level of travel activity by environmentally sustainable transport modes such as walking and cycling. When completed, this research may indicate whether urban design initiatives can help increase walking and cycling and furthermore, which could lead to the creation of a model that allows the impact of urban design initiatives on transport activity to be estimated.

Bradshaw's Walkability Index				
Criteria	1 pt.	2 pts.	3 pts.	4 pts.
1. Density (persons per acre, up to centre-line of neighborhood borders, e.g., roadway, river, park)	over 15	10-15	5-10	<5
2. Parking places off-street per household	less than 1	1-2	2-3	more than 3
3. # sitting spots (public & private) on benches per household (incl. seating in front porches & yards)	more than .75	0.5 to 0.75	0.25 to 0.5	0.25 or fewer
4. Chances of meeting someone you know while walking*	10 or more per mile	3-10 per mile	fewer than 3 per mi	"Are you kidding?!"
5. Age when child allowed to walk alone *	Age 6 or younger	Ages 7-9	Ages 10-12	Age 13 or older
6. Women's rating of neighbourhood safety*	I'll walk alone anywhere anytime	I'll walk alone, but am careful of routes†	I'll must walk with someone at night‡	I'll never walk, except to car visible from entrance"
7. Responsiveness of transit service: amt. of time walking & waiting.	10 minutes or less	10-20 minutes	more than 20 minutes	no service
8. # neighbourhood places of significance named by avg. respondent*	10 or more	5-10	3-5	fewer than 3
9. Parkland (amount & proximity)	>50 ac./sq. mile & avg. residence <1,500-ft. walk	>50 ac./sq. mile & avg. residence >1,500-ft. walk	<50 ac./sq. mile & avg. residence <1,500-ft. walk	<50 ac./sq. mile & avg. residence >1,500-ft. walk
10. Sidewalks (1 point each):	<input type="checkbox"/> Not on both sides of 90% of streets <input type="checkbox"/> Width discontinuity (1 ft. or more) per block <input type="checkbox"/> Widths <5 feet on residential streets; 8 feet on shopping streets <input type="checkbox"/> Dips at each driveway			

Figure 1: Bradshaw's walkability index (source: Bradshaw, (1998))

The more sophisticated models that attempt to predict and describe the travel behaviour of people tend to be all inclusive of a wide range of factors. This leads to a tension between reductionist approaches with simple to apply methodologies that aim to distil the key elements related to travel behaviour and all encompassing approaches which have greatly increased complexity, but which are difficult to apply in practice because of enormous data needs. In working towards a system that could relate development location to accessibility for the purposes of considering the merits of development projects, in the absence of quality travel survey data such as that available from the 1999 Adelaide Household Travel Survey, reliance may have to be placed on developing a system that can employ physical measures that are easily quantified from already available maps of the physical features in the local environment.

Development assessment and accessibility

Urban planning is constantly challenged by the space-time conundrum in which it is impossible to achieve equal levels of accessibility for all of the residents in an urban area. Even in the densest urban areas on the planet, planners have to grapple with balancing the tradeoff between spatial proximity and time that they must inevitably impose on a city's residents for the facilities that they want to access. Whilst planners are not particularly concerned with the laws of physics, planners are inevitable bound by the physical law that no

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two objects can occupy the same place and time in the universe. There are three basic urban planning elements that affect the degree of centralization provided: urban densities; transport technology; and the centrality of facilities.

Index Pedestrian Indicators		Illustrative Scores	
Indicator	Definition	favorable	unfavorable
Block size	Acreage	1	8
Block face	Avg. side length in feet	200	600
Sidewalk coverage	% of street frontage with sidewalks	100	25
Sidewalk connectivity	% of sidewalk segments connected with other sidewalks	90	50
Sidewalk capacity	Avg. width in feet	6	3
Sidewalk condition	% of sidewalk centerline distance in satisfactory condition	90	50
Crossing distance	Avg. curb-to-curb street width in feet	26	40
Crossing spacing	Avg. distance between crossings in feet	200	400
Crossing safety	% of crossings controlled/calmed	75	25
Sidewalk/ traffic conflicts	Avg. distance between commercial driveways in feet	150	50
Route directness	Ratio of shortest walking distance from outlying nodes to central node vs. straight line distance b/w same points	1.3	2.0
Effective walking area	Ratio of land area reachable within 1/4 mile walk from central node vs. total land area of 1/4 mile theoretical walkshed	0.9	0.5
Pedestrian orientation of commercial buildings	Avg. building setback from streets in feet	10	100
Building(storefront) texture	Avg. distance between pedestrian entrances into businesses in feet.	30	200
Proximity to recreation facility	Avg. walking distance from dwellings to closest park, school, or community center in feet.	1000	6000
Proximity to shopping	Avg. walking distance from dwellings to closest grocery/pharmacy in feet.	800	5000
Proximity to transit	Avg. distance from dwellings to closest transit stop in feet.	600	3000
Transit service density	Miles of transit routes multiplied by number of transit vehicles traveling those routes each day, divided by total acres.	0.8	0.3
Topography	% of sidewalk centerline distance exceeding 10% slope.	5	20

Figure 2: Criterion Planners' index system for pedestrian indicators (source: Allen (2004))

For the past two decades in Australia, the planning profession has been challenging this spatial-time conundrum through policies such as urban consolidation and transit oriented centres that aim to minimize trip distances between urban locations initially for reasons of urban economics during the 1980s, and latterly in the 1990s for reasons of encouraging more urbane environments and minimizing the contribution of cities to the greenhouse effect through the transport activities that they generate.

In the Australian context, increased urban densities in residential areas are being achieved through a reduction in residential allotments from 600-700m² down to 200-300m² and encouraging multi-storey flats in more central locations or around transport interchange hubs. There is a limit to increasing suburban densities through mandating smaller and smaller allotments because each resident is entitled to a minimum amount of living space around them, which may be at least 25m².

Inevitably, planners are forced to consider multi-level solutions, but even these can be problematical. As buildings increase in height, if cars remain the dominant transport mode in an urban environment, traffic congestion increases to a level that negates the advantages of spatial proximity that the increased urban densities might have originally conferred. There are also limits to a city expanding in the vertical dimension. Buildings over 300m in height (about 75 storeys), become more dysfunctional in proportion to increasing height as lift cores and service conduits swallow up commercial floorspace on lower floors. Just as unconnected residential cul-de-sacs at ground level stretch out travel time, ultra tall skyscrapers, which are akin to cul-de-sacs in the sky, ultimately negate the benefits of very high urban densities. In a three dimensional city, the ultimate urban density would reach a practical limit of about 0.33 m²/person, based on each person having at least 25 m² of living space and a development height of 75 storeys. Although mass transit works better and more efficiently with higher densities, if the ground level transport interface remains at street or sub-street level, accessibility will be poor for people on the upper levels of buildings. The technology to build 200 storey skyscrapers does exist, but it is these practical accessibility complications that have prevented visions such as Frank Loyd Wright's 1956 proposal for the mile high 528 storey Illinois Tower in Chicago from being realized (Pfeiffer, 2000).

Apart from the physical complications of compressing urban space in three dimensions to solve the urban-space conundrum, an additional complication is that every person will have different requirements about what they have to access in the urban environment, when and how quickly they have to access it by and the transport mode that they need to access it by.

This leads to the next consideration in dealing with the space-time conundrum, which is transport technology. Transport has the ability to negate the effects of both space and time. Transport technology, in the form of public mass transit systems or freeways, have been used to overcome the tyranny of urban sprawl. Extending back to the 1960s, great urban planning thinkers such as Lewis Mumford (1961) and Jane Jacobs (1961) have decried the anti-urbanism that seems to have gone hand in hand with increased car dependency, when freeway dominated urban sprawl began to define the character of many North American cities. Sudjic (1993) coined the expression the '100 mile city' to describe sprawling megapolises such as New York, London, Los Angeles and Tokyo which are possible only because of modern transport technology in the form of the freeway or public mass transit systems. Contemporary urban planners across the developed world (and most famously lamented by West Australians Newman and Kenworthy, 1989) seem to accept it as an inalienable truth that allowing increased car densities in urban areas can only result in poorer levels of accessibility.

This may be true if automobile based road systems remained at street level, but if the famous Swiss-French architect Le Corbusier's vision of the city of the future had been fully realized, road systems in three dimensions would have significantly increased capacity by minimizing intersection conflict points and maintaining high vehicle speeds. Whether such an urban environment with multi-level traffic environments would be an urbane environment to live in, is of course open to debate, even if cars could be made to be virtually non-polluting and

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whisper quiet. Le Corbusier's urban vision was an interesting one because it combined both high density and elevated car-based freeways, suggesting that these urban innovations could create much more efficient cities, making cities echo the machine age that was the early 20th century. In popular cinematic culture, visions of the city portrayed in Fritz Lang's 1927 film 'Metropolis' and the 1982 film 'Blade Runner' have included transport infrastructure becoming multi-level or three dimensional, with people moving around the city on multi-level roads and in personal flying machines. The 2002 film 'Minority Report' set in Washington D.C. in 2054 introduced a two seater vehicle (badged as a 'Lexus') which zipped around using a visually breathtaking Maglev system able to operate in both the horizontal and vertical planes.

High speed mass transit systems such as Shanghai's new German designed Maglev train which opened in 2003 with operational speeds of 430km/h on the relatively short run between Shanghai's city centre and airport (less than 30km), demonstrate that transport technology can at least theoretically and albeit for enormous cost, overcome the tyranny of distance (Gluckman, 2003). This new technology theoretically allows cities to spread several hundred kilometres and yet still allow urban commuting travel times of 30 minutes or less. The drawback with such technology is that allowing for acceptable rates of acceleration (1.0m/s^2) and de-acceleration (0.5m/s^2), stations would need to be at least 7.5km apart which would reduce average service speeds to around 150-190km/h although peak speeds of 400km/h would be attained. Clearly high speed rail systems would only be practical for the longer trans-metropolitan or intercity trips.

Urban geography and planning has long held up the importance of the centrality of facilities in terms of ensuring that they provide the maximum utility to the areas that they serve. The American, Clarence Perry in 1910 identified centrality as a critical element in neighbourhood planning for the 'neighbourhood unit' or precinct. Christaller's Central Place Theory which was developed in the 1930s from empirically based research of rural settlement patterns in southern Germany, essentially suggested that populations will establish facilities in the most centralized location of their region and that the goods and services that are offered will be based on their catchments (usually retail in nature) of the various facilities located in such centres. Christaller also claimed that in a uniform landscape, a hierarchy of settlement patterns could be discerned with lower order centres nested inside the catchments of higher order centres, and so on.

Urban planners have drawn on such theories in shaping the centres policies, most clearly evident in the post-World War II British New Towns, in Australia, Elizabeth, Canberra and the still-born scheme for the proposed New Town of Monarto were dominated by a hierarchy of centres, each serving catchments that in theory reflected Christaller's work. The underlying rationale for this focus on centrality in urban planning has been to maximum accessibility and travel efficiency for a community's residents. Even when planners accepted the car as the dominant urban transport choice in the community during the 1950s, 1960s and 1970s, (which implied an intrinsic acceptance of greater dispersal of development), metropolitan planning schemes still advocated centralization of important community functions such as schools, hospitals and shopping. However, with increased importance now being given to making cities more environmentally sustainable, public transit solutions and modes with negligible environmental impacts such as walking and cycling, centralized facilities are of paramount importance. For mass public transit to work efficiently, the fact that it cannot be taken to everyone's front door means that it has to be restricted to a few centralized locations in order to provide the maximum benefit to the community. It is somewhat of a paradox that high

capacity mass public transit can be relatively inaccessible, that is unless urban densities are sufficient to minimize this effect.

Hence, the three basic elements that help to frame space-time conundrum in planning urban accessibility are the density of development, transport technology and centrality of facilities. A Development Assessment system that attempts to assess whether a development should be allowed to occur on the basis of the acceptability of accessibility provided to the community needs to consider these key variables in developing the necessary yardsticks.

Elements required in an accessibility model

A possible exemplar of an accessibility energy rating model in terms of functionality and the style of output is the new energy rating system for housing energy efficiency now being applied across Australia, which uses proprietary software (Firstrate or NatHers) that converts a number of quantitative measures to provide an energy rating for development that ranges from one star (bad) up to five stars (excellent). In the case of South Australia, Development Applications for new residential development require an accredited Energy Assessor to enter a number of variables for the particular development concerned into an approved energy rating model (such as type of ceiling insulation, north facing glass area, etc), which can then estimate the energy rating based on the amount of energy required to keep the building at a particular temperature given the thermal characteristics of the building shell. The power of this planning tool is that it can then be used to refine the design of the building to achieve the maximum possible energy rating. Alternatively, if the building cannot be made to comply, it may prevent planning approval for an inefficient building being given. The successful implementation of the energy rating scheme has shown that rating tools can be applied in development assessment. The key lesson from this experience, does suggest that there is scope for examining the feasibility of introducing such a rating system for rating the energy implications associated with accessibility variables for new development. Producing an energy star rating or likely energy consumption measure for accessibility to common journey destination points would be the ultimate output of such a model. However, in order to develop a rating schema, elements have to be identified that would make up this model.

Many of the elements that would constitute a rating schema are interdependent. The following list of points is simply intended to show the range of elements that ideally would have to be taken into account in formulating such a schema. Some of the elements that could be incorporated into an accessibility model are detailed as follows.

1. A categorization of the travel needs for persons associated with the proposed development

This would involve identifying the travel behaviour characteristics of people for each type of development. Each type of development would have different type of travel needs. These could eventually be standardized, once the necessary research has been completed. To achieve simplicity, a reductionist approach would be required to the extent that only the dominant types of trips need be identified. For example, with primary schools, the bulk of the population using such a facility will be school students aged 5-13 years old. School staff (e.g. teachers and school administrators) would be the other significant cohort. For each of these population cohorts, the main types of trips would be identified and are likely to constitute

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school-home and home-school trips. Likely travel mode preferences for particular cohorts would also be taken into account.

2. The 'population' of the proposed development

By knowing the demographic profile of the people populating a development and their likely travel behaviours (ie travel modes, trip route choices, trip timings and trip destinations).

3. The type of transport infrastructure network that the proposed development would be accessible by

Virtually all development would be accessible by the road system that would be relevant for transport modes such as cars, taxis, bus transit, road freight haulage, cycling and walking. However, consideration would also need to be given to public mass transit such as light rail, heavy rail, monorail and ferries.

4. Whether there is a public transit interchange facility close to the proposed development.

A proposed development in close proximity to a transport interchange may result in reduced transport energy demands than one that is exclusively reliant on cars for its transport requirements.

5. Whether there is a public transit stop near to the proposed development

A development close to a public transit stop, would be more likely to result in people using public transit, which may result in reduced energy demands.

6. The commercial freight transport activities associated with the proposed development

Some developments are industrial or commercial in nature. Developments that are proposed in locations likely to result in excessive freight haulage kilometres would lead to increased transport energy requirements.

7. The trip attraction and generation characteristics of the proposed development

Different categories of development will have different trip attraction and generation characteristics. The likely contribution of a proposed development to trips on a city's transport networks would need to be estimated in order to determine its transport energy impact.

8. The amount of car parking provided by the proposed development on site

On-site parking can be one of the most significant determinants for the amount of car usage for a new development. This measure would need to be linked to the travel behaviour patterns for the people likely to be using the proposed development to yield an estimate of the transport energy impact.

9. The amount of on-street and off-street car parking available off site, within 400m of the site of the proposed development.

This measure would need to be linked to the travel behaviour patterns of people using the proposed development. An abundance of off-site parking would be likely to result in increased car usage for the proposed development which would contribute significantly to its likely transport energy impact.

10. The quality of the pedestrian network in the vicinity of the proposed development

The major concerns for pedestrians using a dedicated pedestrian network would be that it is reasonably direct to where they need to go, it is safe, comfortable, aesthetically pleasing and functional. Determining to what extent people using the proposed development will use a local pedestrian network will largely be determined by whether their trip requirements are local or not and their travel behaviour characteristics. Because people do not consume fossil fuels and their contribution to greenhouse gases is negligible, people opting to walk would have no net contribution to the transport energy impact.

11. The development density of the proposed development

A development project may need sufficient critical mass before density can be considered to have a reduction on its transport energy impact. Large, high density projects in areas that are already central, may allow an upgrading of public transit which would in turn allow less reliance on cars by the people using the proposed development and this could help to reduce the proposed development's transport energy impact.

12. The contribution of the development proposal to centrality in the locality

Developments located in central locations will have better accessibility characteristics more conducive to walking, cycling and public transit which will contribute to a reduction in the expected level of transport energy usage.

The listed elements suggest enormous complexity, but as the energy rating schema for housing demonstrates, computer software can easily overcome this complexity, although it may require specialists to understand what data the model needs for a particular development application and how to enter it correctly. The most significant technical impediments to the development of such a model are the data needs, since much of it cannot be derived from the current information that is included in Development Applications submitted for development consent across Australia today, with the exception of very large projects that have obvious

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impacts on local transport infrastructure. There are also other intangibles, such as in determining the aggregate transport energy required for a building's users to access a particular development, which could vary considerably especially if private motorized transport is used. An example of this intangibility arises in determining whether the user of a building opts to use a Lambretti motor scooter or to arrive in a monstrous 4 wheel drive such as a Hummer. Furthermore, if a building's users do choose to arrive by personal motorized transport, the transport energy consumed may vary by time of day according to the extent of traffic congestion encountered in accessing the building. Notwithstanding this, modelling could overcome these complications through the use of average standardized values (much as planners adopt a 'standard' car size in determining the design parameters of parking lots) and by obtaining data on traffic behaviour using the local road network likely to serve the proposed development.

Towards an accessibility rating system in development assessment

An accessibility rating system for Development Assessment would require four areas to be addressed. They are: the technical aspects which would culminate in a software package with the capacity to rate any development for accessibility and an indicative estimate of transport energy consumption; the involvement of stakeholders in the planning profession and development industry to see how such a system can best be implemented; the Institutional arrangements for safeguarding standards in the application of the model; and the legislative arrangements to compel compliance for new development, manage enforcement and provide avenues of legal appeal.

The technical aspects may require specialized data sets to be established which are able to link demographic data derived from the Australian Bureau of Statistics Population and Housing surveys and the 1999 Adelaide Household Travel Survey to a GIS map data set with information about transport networks, public transit services, freight routes, property cadastre, development types and densities. Further specialized surveys may be needed in order to determine the travel behaviour patterns of people accessing certain land uses. Standardised values may need to be developed to simplify the application of the model to specific development proposals. The first step would be to develop a pilot model for the purposes of proving that the concept is technically feasible and practical. It would also be useful in highlighting resource and data needs to make the rating system operational in day to day development assessment work.

Consultation with stakeholders, primarily the planning profession but also including local government, state government, the Local Government Association, the Urban Development Institute of Australia and the development industry (eg the Property Council of Australia), would be required before such a system can be implemented. Stakeholders would be introduced once a pilot model was developed which demonstrates the feasibility of the concept.

For a system such as this to become part of the development assessment process, it would need to have strong institutional arrangements to support it. The energy rating system for housing used state government planning authorities to introduce the system, while local government planners provide the legal checks and balances to ensure that developers comply with the legislation. The same approach could be adopted for an accessibility energy rating system without too much difficulty. In South Australia at least, Planning SA, the state

government planning authority, is custodian for many of the GIS data sets for the state, so it would be sensible for the state government to be responsible for the maintenance of resources and data sets needed to keep the system operational and contemporary. The state government would also be responsible for determining what would constitute minimum standards of accessibility performance for all transport modes.

Finally, the legislative arrangements would be to introduce legislation that mandates that submission of development application for development assessment by a local council or state government would also require completion of an accessibility rating report using the specialized software and a certified auditor accredited by the state planning authority. A possible difficulty in this regard is that whilst the energy rating scheme for new housing piggy backs off the Building Code of Australia, an accessibility/transport energy rating scheme does not have any legislation to become incorporated into, except possibly the local plan (or Development Plan in South Australia). Local government planning departments would be given the legal authority to accept or reject a development application if it was deemed to not comply with minimum standards of accessibility or they could impose the necessary conditions on development consent. Local government planning departments would be responsible for enforcement, but penalties for non-compliance with the accessibility rating scheme would be determined by the environment court of state government. The state environment court would also be responsible for hearing appeals for aggrieved parties which could be rejected development applicants, local councils seeking enforcement or affected third parties.

Conclusion

Global climate warming due to increased greenhouse gas emissions will be one of the most pressing policy issues governments will have to grapple with over the coming years. The high reliance of Australian cities on fossil fuel powered cars to meet their mobility and accessibility needs in the urban environment is a major contributor to transport derived greenhouse gas emissions. However, our current planning system does not force developers, planners or the community to make informed development decisions about development from an accessibility/transport energy consumption perspective. The crisis that we face with the environment suggests in fact that we need to have minimum development performance standards to minimize the transport energy impact of new development. This paper has suggested that just as we have an energy rating system to evaluate the energy consumption performance of new buildings with regard to heating and cooling, a similar system is needed to rate the transport energy implications of new buildings. Developing the conceptual framework for such a rating scheme may be a relatively straightforward technical undertaking, however, the real challenge will be the data resource needs to allow such a system to function on a day to day basis for planners involved in development assessment. The institutional and legal infrastructure necessary to support a rating scheme has already been shown to be workable with the energy rating scheme for new housing, and whilst there are difficulties in determining the appropriate legal mechanism to facilitate an accessibility/transport energy rating scheme for new development, they are not insurmountable problems, particularly if the political will exists to seriously address the transport related causes of greenhouse gas emissions.

References

Allan, A (2001), *Walking as a local transport modal choice in Adelaide* pp35-46 of *Road & Transport Research, March 2001, Volume 10, Number 1*, Published by ARRB Transport Research Limited, Vermont South Victoria, Australia, ISSN 1037-5783

Allen, Eliot (2004) *Index Planning Support Software*, accessed online June 2004, <http://www.crit.com/index/index.html>

Areal A (2004) *Fritz Lang's Metropolis* accessed online June 2004 at <http://www.persocom.com.br/brasil/metropo.htm>

Bradshaw, Chris (1998) *Bradshaw's Walkability Index*, Website: <http://www.ncf.ca/freeport/community.associations/ottawalk/menu>

Bureau Transport Research Economics (BTRE) (2002) *Greenhouse Policy Options for Transport, Report 105*, Commonwealth of Australia, Canberra, Australia

Christaller, W (translated by C.W. Baskin) (1966) *Central Places in Southern Germany*, Prentice Hall Inc., Englewood Cliffs, New Jersey, USA

Gluckman, Ron, (2003) *Is it a Bird, Is it a Plane?* Accessed online June 2004, <http://www.gluckman.com/Maglev.html>

Hayashi, Alden (1999) *The Sky's the Limit; Superskyscrapers stretch toward new heights. How high can they go?* pp66-72 of *Scientific American, Volume 10, No.4, Winter 1999*.

Hutchings A and Bunker R (1986) *With Conscious Purpose: A History of Town Planning in South Australia*, Wakefield Press/RAPI

Ingels, N (2004) *Los Angeles 2019*, accessed online June 2004 at <http://www.tyrell-corporation.pp.se/pictures.shtml>

Jacobs, Jane (1961) *'The Death and Life of Great American Cities'*, Random House, New York

Le Corbusier, (1931) (1986 reprint) *'Towards A New Architecture'*, Dover Publications Inc., New York, United States of America

Litman, Todd (2004) *Economic Value of Walkability* pp5-14 of online journal, *World Transport Policy & Practice*, Volume 10, Number 1, 2004

McMillan J D P, Abraham, J E, Hunt, J D, (1997) *Collecting Commuter Attitude Data Using Computer Assisted Stated Preference Surveys*, in *Compendium of Papers for the 1997 Joint Conference of the Canadian Institute of Transportation Engineers and the Western Canada Traffic Association*, Paper 2B-3, University of Calgary, Department of Civil Engineering, 2500 University Dr. NW., Calgary, AB, T2N 1N4, Canada

Mumford, Lewis (1961) *The City in History*, Penguin Books

Newman P and Kenworthy J (1989) *Cities and Automobile Dependence*, Gower Technical, Aldershot, England

Pfeiffer, Bruce, (Editors Gossel, Peter and Leuthauser, Gabriele) (2000) *Frank Lloyd Wright*, Benedikt Taschen, Koln, Germany

Primerano, F and Taylor, M A P (2003). Towards a policy-sensitive accessibility measure *Papers of the 26th Australasian Transport Research Forum*, October 2003, Wellington. CD-ROM, Paper no 35. (Transit New Zealand: Wellington).

Ratcliffe J (1981) *An Introduction to Town and Country Planning*, Hutchinson, London

Soltani, A., Allan, A., (2004 (pending)) The Effectiveness of Transit-Oriented Development in addressing the Problems Associated with Car Dependency: A Study of Four Residential Suburbs in Metropolitan Adelaide, Australia, paper submitted to the 27th *Australasian Transport Research Forum*, Adelaide, 29 September-1 October, 2004, Adelaide, Australia.

South Australia (Government of) (1999) *Adelaide Household Travel Survey* Transport SA, Adelaide, Australia

South Australia, (Government of) (April 2003) *South Australia's Draft Transport Plan*, Adelaide, South Australia

South Australia (Government of), (2004) *Energy SA Website* accessed June 2004 at <http://www.sustainable.energy.sa.gov.au/home/home.htm>

Sudjic, Deyan (1993) Chapter 13: The Freeway versus the Metro, pp269-285 of *The 100 Mile City*, Flamingo Press, London

Toyota (Car company), (2004), '*Toyota Prius*', Website: <http://www.toyota.com/prius/> accessed June 2004

Westerman H L, Black J A, Lukovich T & Allan A S (June 1989) Environmental Adaptation of Sub-Arterial Shopping Strings: Towards Preliminary Guidelines, *The Environmental Planning & Management Series, School of Town Planning Publication, Volume 89/2*, University of New South Wales

Westoff, Geoffrey (2002) *Minority Report Film Review* accessed on August 28, 2004 at http://www.rottentomatoes.com/m/minority_report/