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"Metrics of Environmental Sustainability, Social Equity and Economic Efficiency"

by

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Abstract

Institutional drivers of the Australian Capital Territory' s Government responses to climate change in Canberra's urban area (*Weathering the Change*), and the role of different actors and institutions are described, especially the Sustainable Communities Program, initiated in September, 2008. A critical objective of this 3-year program is cooperation and collaboration between actors to effectively establish better measures, solutions, and responses to climate change. Quantitative measures are needed and new indicators are introduced, especially in the area of the built form, transport and greenhouse gas emissions, that respond to community concerns. A holistic assessment framework is presented for urban development and transport with innovative triple bottom line sustainability metrics that include greenhouse gas emissions from transport construction and operation, and residents' accessibility to employment and employers access to labour markets. This is combined with risk assessment. Planning for sustainability in cities is discussed in the context of land use and transport in a climate change affected world. Agency level impacts of climate change in relation to rail systems are discussed. These take into account the business risk to the agency due to such factors as infrastructure failure risk, revenue risk, political risks, maintainability risks, life cycle costs, insurance risk for assets damage and secondary damage to other assets.

INTRODUCTION

In Australia, the amount of greenhouse gases pumped out by energy generation and transport fell in New South Wales last year, bucking the national trend, but emissions in Queensland and Victoria, the two other states that make up the east coast electricity grid, still rose. In 2008, the east coast released 19 per cent more carbon dioxide than in 2000. Compared with 1990, the year usually used to calculate emissions under the Kyoto Protocol, emissions from NSW have risen 30 per cent, Queensland up by 116 per cent and Victoria up by 32 per cent (http://www.smh.com.au/news/environment/nsw-bucks-national-trend-for-gas-emissions/2009/01/11/1231608523379.html, accessed 10 January, 2009). The figures mean Australian society has a huge challenge ahead just to stabilize greenhouse gas emissions over the next few years, before meeting even the modest 5 per cent cuts now proposed by the national government for 2020.

Nevertheless, in a communiqué issued on 3 July, 2008, the Council of Australian Governments (COAG) noted the significant progress being made on the climate change agenda, including on developing the National Renewable Energy Target Scheme, options for feed-in tariffs and measures to accelerate energy-efficiency enhancements. In addition, state and territory governments were also pursuing integrated policies for urban areas aimed at mitigation and adaptation to climate change, especially reducing green-house gas emissions. One such example briefly described is the Australian Capital Territory (ACT) Government's responses to climate change in Canberra's urban area (*Weathering the Change*), and the role of different actors and institutions, especially the Sustainable Communities Program, initiated in September, 2008.

One of the needs identified at stakeholder workshops is for a holistic approach to greenhouse gas reduction in cities. Research that demonstrates the various trade-offs that have to be made by policy makers and businesses when dealing with complex issues such as climate change is reported in this paper. The first two sections of the paper deal specifically with the ACT Government's response to climate change, and the risks facing developers and transport service providers, respectively. The substantive contribution made in this paper is the presentation of the visual metrics within a holistic urban sustainability framework and the visual presentation of the sustainability metrics.

GOVERNMENT RESPONSE TO CLIMATE CHANGE - ACT

The ACT Government has made a commitment to sustainability to ensure that future generations have a quality of life that equals or surpasses the current generation. Meeting the climate change challenge is part of that commitment. The ACT Climate Change Strategy provides an overview of climate change science, the predicted impacts on the ACT, and the Government's vision and direction for responding to climate change. It has evolved from a discussion paper released in March 2006, to which many submissions from the public, business and community groups were received.

The aim of the Government's sustainable communities program is "*to put into effect a planning policy framework for more sustainable living that draws on the inherent qualities of Canberra and builds a greater sense of place, spirituality and responsibility*". A series of objectives are derived from five major drivers of change, as shown in Figure 1. Under each of the drivers of change are a set of objectives grouped under Built Form, Urban Ecology and Community (reproduced in Appendix A with some editing from the original). Figure 1 identifies these interrelationships between the various elements of Canberra's form and urban systems. Those elements of particular relevance to transport movement and access were addressed by Black (2008) at the first of a series of stakeholder workshops.

Against this background, the first stakeholder workshop in Canberra addressed transport and mobility. Among other recommendations, Black (2008, p.14) suggested that:

> "Transport proposals for private transport solutions are evaluated with a full understanding of their direct social, environmental, and health costs and other externalities to the transport sector."

In the context of Canberra, the ACT State of the Environment Report 2007 - 2008 provided the following facts. Compared with other Australians traveling to and from work, Canberrans used their cars more (81%), cycled a little more (2.5%) and walked some more (4.9%), but used public transport less. Currently, Canberra only achieves a 7.9% public transport patronage on the city's bus system. Given Canberra's design, comparatively small population and low density, commuting offers the greatest opportunity for achieving significant

improvements in this sustainable travel ratio. The greatest opportunity for significant change is in travel to and from work as it involves large numbers of people traveling at the same time. The ACT Government's commitment to sustainability demonstrates how community and governments alike know the need for sustainability in our cities. Whilst community and government have been able to develop a shared vision for the character of the ACT into the future, community participation beyond visioning and goals setting is presently limited. When it comes to the question of which scenario should be selected, there is little scope for government and community to interactively shape the choice. Without quantifiable assessment methods, the connection between scenarios and sustainability outcomes are extremely subjective to the point where little benefit may come from public discussion. Improving the visibility of these connections for community and decision makers alike will increase the opportunity for better choices.

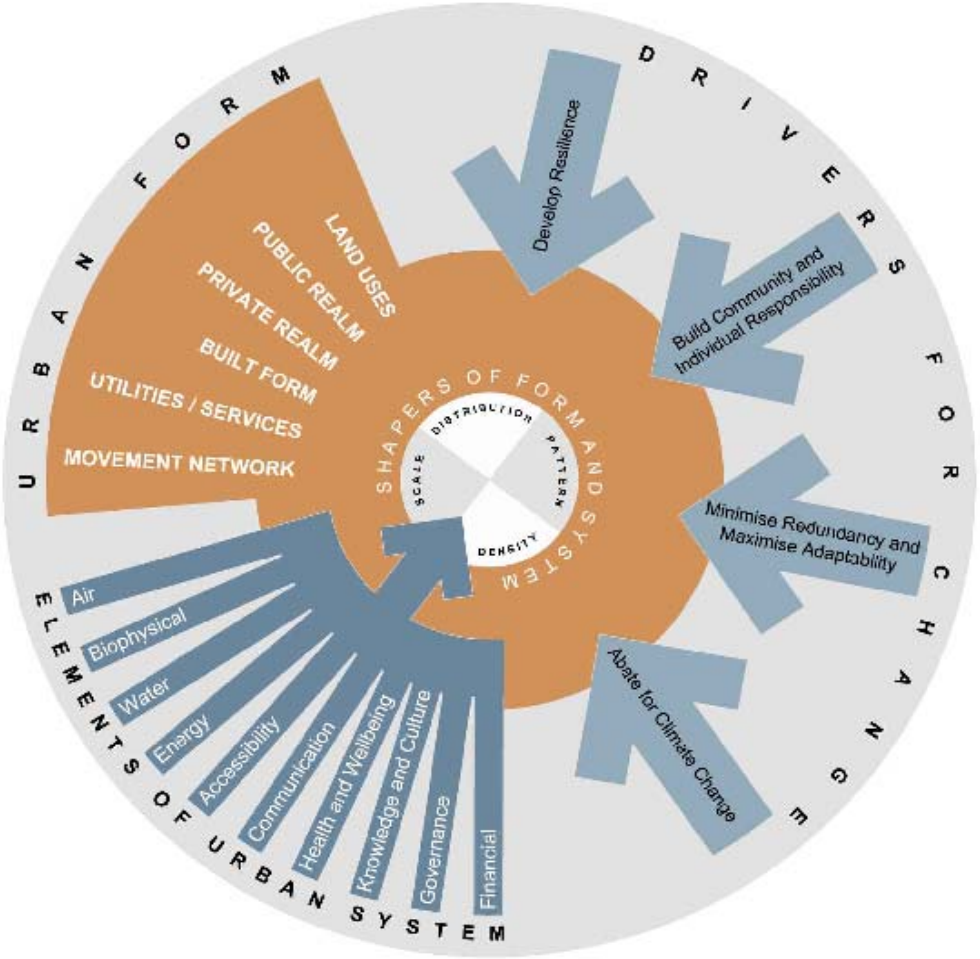


Figure 1: Elements of Canberra's form and urban systems (source: ACT Government)

Business Response to Climate Change – Urban Development and Transport
The Climate Change Dimension

Similarly, a quantifiable assessment methodology is required for the urban development industry and for transport service operators in all Australian cities. Under a long-term future

driven by climate change urban space may have new constraints imposed, especially where areas are in low-lying areas or are close to shore lines (Australian settlement patterns are dominated by coastal communities). There is increased threat from storm intensity, which can lead to greater flash flooding risk in low lying areas, and to storm surges into shore line areas as a result of offshore storm events. Although buildings are typically designed to be in place for 50 years, it is not uncommon for them to be in place for 100 years, or even longer. Even where the structure has reached its useable life communities have a sense of place and heritage that leads to refurbishment of the building.

A slower but just as significant effect of climate change is sea level rise. Current forecasts due to thermal expansion of the seas may well be significantly worsened as the melt down of land locked ice sheets in Greenland and Antarctica becomes clearer. The important point is that these predictions are within the time frame of urban space choices society makes in the next 10 years: these decisions will govern land use form over the next 50 to 100 years. Future scenarios for new land use areas will need to be constrained by limitations imposed by more flood prone areas and this might include the need to relocate existing land use activities accordingly.

Climate change effects also include changes to transport system performance. Increases in temperature extremes and storm events can alter the operating characteristics of transport systems. High temperatures can restrict operating speeds on railway services during these events, as was the case in Melbourne, Victoria, in February, 2009, when temperatures were in the 40C for several days. Storm events reduce the reliability of both rail and road-based services (Planning Research Centre, 2006). Corridors exposed to low-lying areas and storm surge effects may require the transport network itself to be relocated - depending on the frequency of events. The time scale for putting major transport system changes into effect can be 10 to 15 years from the master planning stage to commissioning and operations. The expected life expectancy is at least in the order of 100 years. As transport infrastructure is difficult to change it is important to carefully choose the appropriate transport system at inception and to add as much flexibility to adapt to potential changes as can be managed.

A most significant effect also likely, is a change in urban dynamics. For example, how the community responds to changes in climate may see relocation of residents to cooler coastal parts of in cities. At the same time, communities within storm surge areas, may retreat away from the coast. Community aspirations for climate change mitigation may see a shift in demand towards smaller carbon footprints in their journeys taken. This is likely to cause a consequential shift in demand for minimising trip lengths, more carbon efficient vehicles, and public transport – these demands have a feedback effect to further shape the type of urban form and transport system.

Other effects external to the city systems, such as changes in rural productivity and demand for minerals commodities, such as coal, are likely to have flow-on effects that affect the city. A redistribution of where commodities are sourced, and a change in the types of commodities in demand, could change the capacity required of regional transport corridors. Redistribution could also change the location of jobs and journey to work patterns within a city. Unless these effects of climate change on the urban system, and the associated urban dynamics are taken into account in the sustainability performance assessment, the choice of scenarios to progress, and the policies needed to implement them, are likely to fall short of community expectations.

Businesses and agencies with the role of managing and operating transport services and infrastructure are themselves at risk. In the case of a rail agency, economic aspects must take into account the business risk to the agency. It is common for modern passenger rail businesses to operate under a business model where their services are considered as products. Customers are both the passengers carried and the government which often

provides funding as a commercial agreement for a level of service; they are the sources of revenue and financial viability of the business.

Changes in passenger demand (whether a change in the distribution of passengers in the system, an overall decrease or an overall increase), has a real impact on the rail business bottom line. With change in demand comes the question of pricing. Should areas affected more than others be expected to pay a bigger price to cover the costs of aligning the business to the change in demand? This raises questions of social equity. The effects of climate change on operating characteristics of the rail system can also put at risk the satisfactory performance of the services offered, reducing revenue and adding operating cost. Rail systems are complex, with rolling stock and infrastructure needing to be managed together to give good service. Higher costs for maintenance to restore services – for example, under more adverse storm events - insurance, and other remedial costs, such as secondary damage to adjacent infrastructure, add to the life cycle cost of the system. These factors place pressure on the business financial performance.

Where a rail business incorporates climate change effects in its advance business planning, a better managed cost of change and opportunity to adjust to demand changes would be expected to lower the risks significantly. With large, long-term investments in the transport system, failure to align the effects of climate change places the revenue streams for these businesses at risk. The community confidence in the rail business is also at risk when demand exceeds capacity or service quality falls below customer expectations. This can lead to wider effects for community, with increased congestion and social exclusion. When community concerns are significant enough governments themselves, as the over arching responsible party, are also at political risk at the next election cycle.

For transport businesses that offer a lower carbon footprint than others, the opportunity may well provide a stronger market position than higher carbon footprint businesses. The cost of carbon being added to the business financial ledger gives advantage to the low carbon transport business. At the same time, demand for these services is likely to increase as community and government alike favour the transport systems that these businesses provide. With increasing demand and responsive forward planning, the cost and revenue streams should be more advantageous than higher carbon businesses. Adding to this is the supply of investment funding. The 2008 world financial crisis has highlighted the risk exposure of investment funds through high risk lending practices. This has shifted thinking in investment agencies to a more cautious approach to investments compared with previous decades. Already, there has been a marked shift in investors looking for the long-run, lower risk, opportunities. Transport systems that meet sustainability criteria are being considered more favourably for investments due to their greater certainty and therefore prospects of stability (Rubinstein, 2008).

Thus, for those discerning transport system businesses with lower carbon footprints, climate change is an imperative with risks that they share with their competitors, but with opportunity to be in a competitive advantage over higher carbon businesses. The opportunity to plan and enable more sustainable transport systems carries with it the prospect of lower relative cost and greater revenue than the higher carbon transport businesses and more available investment funding. In the planning of such transport systems a full understanding of urban dynamics is required – especially in Australia which is a highly urbanized country – and metrics are needed of economic, social and environmental sustainability to test out the implications of different, long-term scenarios.

VISUAL METRICS IN A SUSTAINABILITY FRAMEWORK

The sustainability framework that we now describe is appropriate to apply in the specific ACT policy environment, in the more general urban policy arena and in the private sector analysis of risks associated with development and transport. It is useful to recap on what sustainability is – especially our interpretation of sustainability. The principal meaning of sustainability was identified in the three pillars of sustainable development in ground breaking work by the United Nations in the last decades of the 20th century. The pillars of environmental sustainability (or stewardship), social equity and economic efficiency are identified as embracing all aspects of sustainability (World Commission, 1987).

Sustainability in cities has been identified (United Nations, 2002) as all three pillars of environmental sustainability (stewardship), social equity and economic efficiency working together. Therefore, an effective sustainability performance requires all three pillars to achieve complementary outcomes rather than simply individual outcomes. A most significant influencer of sustainability is the urban form, the transport characteristics and the interactions between these and the communities they support. Outcomes of these urban dynamics shape the sustainability performance of a city, which in turn can feedback to reshape the urban dynamics. Furthermore, the outcomes of these urban dynamics can feedback to affect the characteristics of the urban form and transport elements themselves.

Consistent with the need for a holistic approach to greenhouse gas reduction, as identified in the Sustainable Communities Program for Canberra, for example, is the need for a holistic assessment framework. Methodologies to better understand urban dynamics, the drivers that produce sustainability performance and to objectively measure the performance of all three pillars of sustainability are keys to this understanding. A particular challenge is to not only fill the sustainability assessment methodology gap, but to provide metrics that are able to be simply and meaningfully understood.

In a new approach to sustainability analysis (Doust, 2008), a sustainability framework is formulated to bring not only the three pillars of sustainability together, but also a holistic consideration of the urban system, the urban dynamics and the resulting sustainability performance. Figure 2 summarises this framework, showing the interconnection between the urban system elements, the urban dynamics and identifying the three pillars of sustainability. This framework lays out the frame points for ensuring that the systems elements and interactions that drive the sustainability performance of the city are visible and measured.

The “Urban System” is the physical aspect of the framework, consisting of the “Urban Form” and “Transport” elements which define the structural configuration of the city. Interaction between these two elements shows their interdependencies. “Urban Form” is characterised by density and spatial distribution of land-use. “Transport” on the other hand is characterised by the transport network spatial layout and the specific mode characteristics. The system function is to provide for the needs of the community (including industry). Response by the community to the “Urban System” produces interactions – the selection of location of residence and workplace, industry and travel patterns, and so on. These interactions are collectively known as “Urban Dynamics”. It is an iterative process as indicated by the circular arrow having feedback effect between each element.

The resulting “Urban Dynamics” outcomes generate the sustainability performance in terms of the three pillars included as elements in Figure 2. Each pillar has a feedback to the “Urban Dynamics” and consequently the “Urban System”. This is indicated by the double headed arrows in the figure. Existing visualisation methods using GIS and graphical displays illustrate the value of visual metrics in communicating urban dynamic outcomes and sustainability performance to policy makers and the wider community.

Visualisation using GIS techniques is proving to be effective in displaying complex information in a simple but meaningful way.

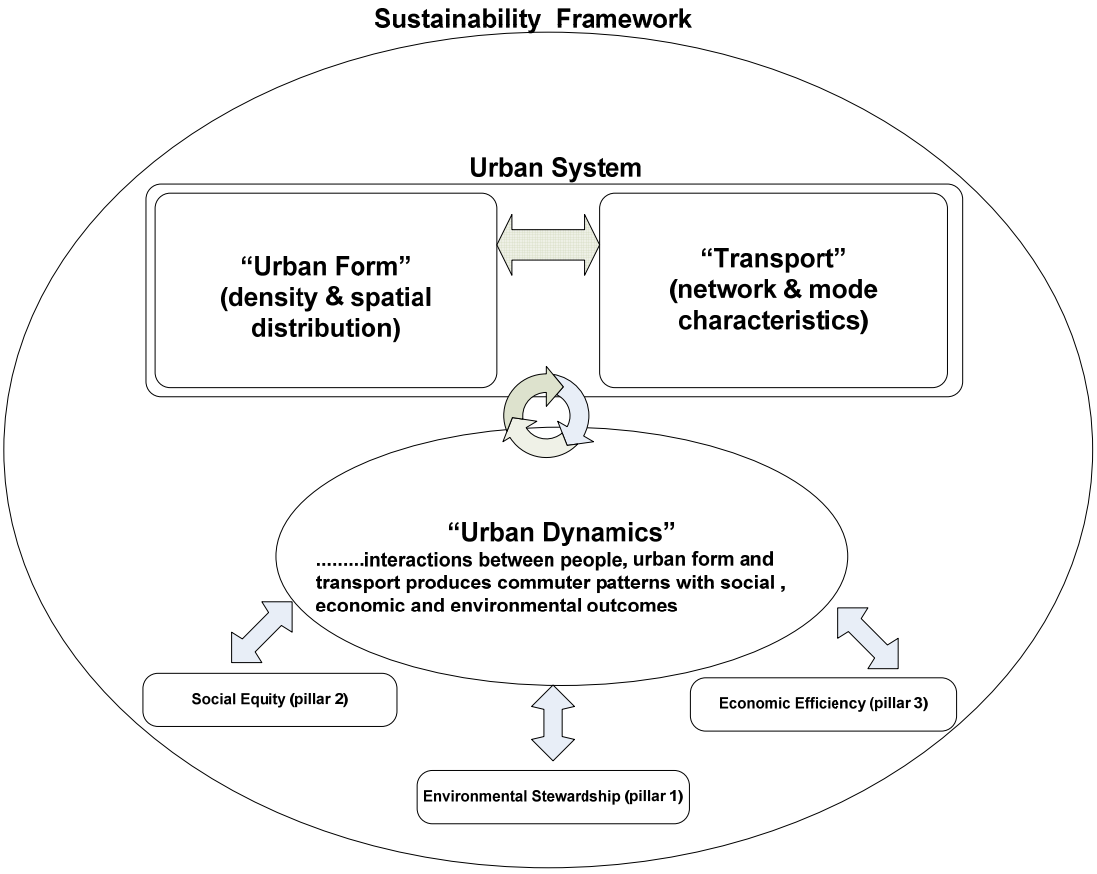


Figure 2 The urban "sustainability framework"

VISUAL METRICS OF SUSTAINABILITY PERFORMANCE

Sydney, a global city with a history of planning policies since 1948 and a long running series of journey to work data sets was selected to case study test the feasibility of the urban sustainability framework in Figure 2. Like Canberra, trips to and from work by road account for a significant proportion of the transport pressures on sustainability in Sydney and as such form a good subject for illustrating techniques in sustainability assessment.
Visualisations display a social spatial equity form of accessibility in a metric indicating the accessibility to jobs for workers from their place of residence. Visualisations for measures of environmental sustainability and economic efficiency focused accessibility (the first and third pillars of sustainability) were also produced.

The metrics have been developed based on the concept of a sustainability goal in "environmental sustainability – accessibility space". Figure 3 illustrates this spatial concept and the idealised performance goal. A city's transport related sustainability performance can be quantified and visualised in a detailed but simple manner by collectively plotting in this space the points for different locations in the city. Each of these points represents the environmental sustainability and accessibility performance for a specific origin and destination location pairing. For a city divided into travel zones, each origin and destination zone pair has an environmental sustainability characteristic and an accessibility characteristic.

The sustainability performance is thus able to be related individually for each pairing and collectively for the whole city, to the idealised performance goal, by the visualisation in environmental sustainability – accessibility space.

The environmental sustainability measure (Pillar1) can be formulated from many different parameters (e.g. traffic noise generated, ecological stress, particulate emissions, resource usage). For illustrative purposes a measure based on known fuel consumption of vehicles (see Cosgrove, 2003, p342) with speed was used to calculate CO_2-e footprints for motor vehicles for the Sydney case study.

Detailed operational methods were developed (Doust, 2008, Chap 4) and applied to generate a quantifiable measure. Accessibility has been identified as a useful measure in social and economic aspects of sustainability (see Expert Group on the Urban Environment, 1996; Warren Centre for Advanced Engineering, 2003; Kachi, *et al.*, 2005; Kachi, *et al.,* 2007). Accessibility measures were derived (Doust, 2008, Chap 4) for each travel zone pair. Separate operational methods were developed to generate worker and employer focussed accessibility measures. These are measures that are relatable to social equity (Pillar 2) and economic efficiency (Pillar 3) respectively.

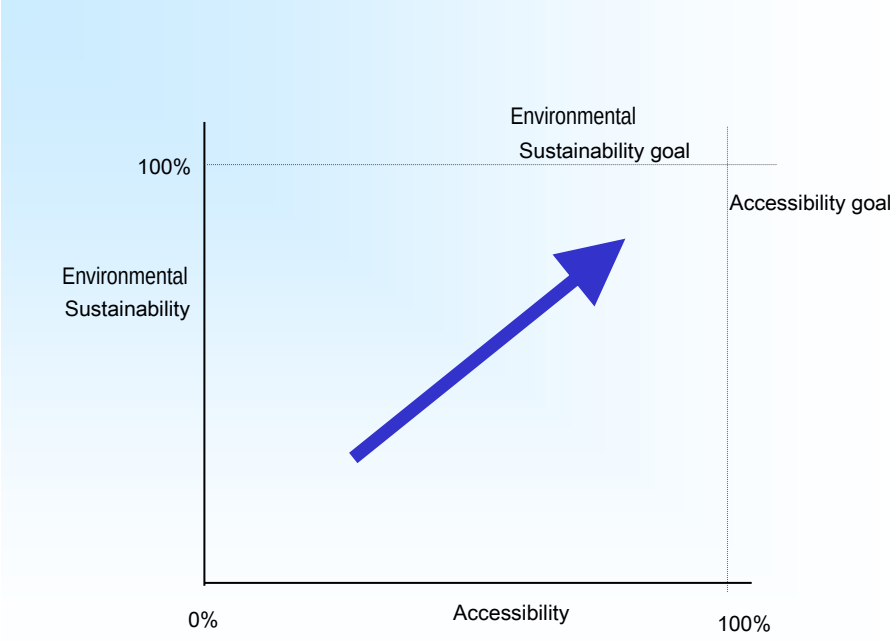
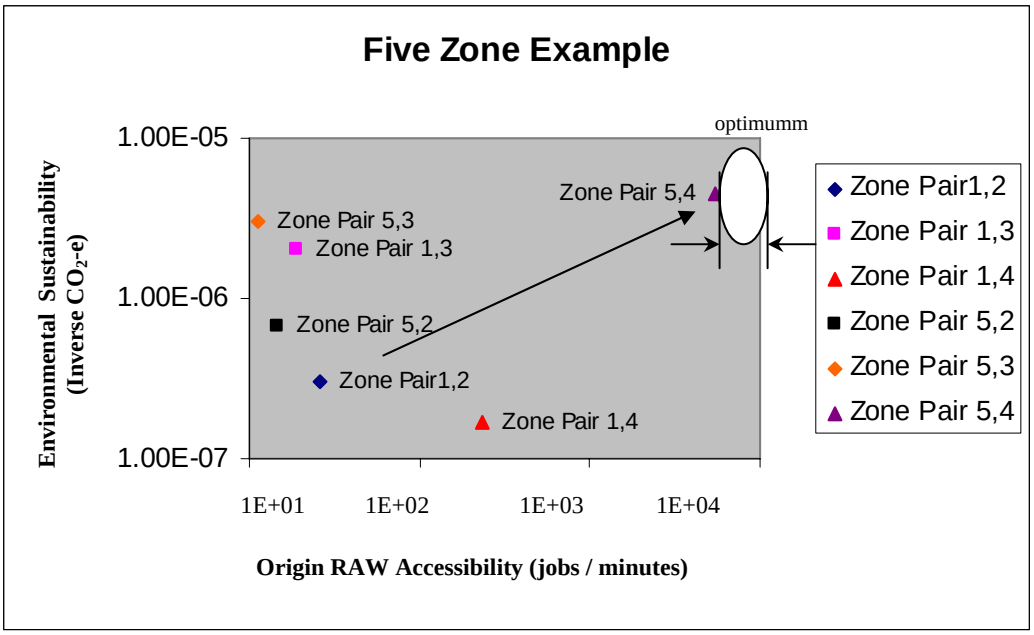


Figure 3 Environmental sustainability - accessibility space

The following simple five zone example provides the fundamentals of the concept. The scatter plot shown in Figure 4 shows the sustainability performance against the desirable trend in sustainability. A shift to the top right hand corner and a limited spread in accessibility is identified as the theorised optimum.

The same metrics were determined for large data sets for the Sydney case study (792 travel zones) by systematic analytical techniques using trip tables, network skims and car

emission rates as inputs. These techniques have given the metrics a clear objective basis traceable to the source data. The visualizations, although built from many thousands of pieces of data, provide a simple representation giving a holistic view of the sustainability characteristics and trends. Figures 5 & 6 illustrate the scatter plot form of the visualisation for social and economic efficiency aspects of sustainability respectively. Figure 5 uses accessibility to work for residents as a measure of the spatial equity component of social equity. Figure 7 uses accessibility from the perspective of the industry. More specifically, access to workforce (spatial labour markets) as a measure of economic efficiency for firms located at centres such as North Sydney.



Notes:

1. Origin RAW Accessibility is defined as the accessibility to jobs at a destination zone (TZj) from an origin zone (TZi) calculated by dividing the total attractions from all origin zones to TZj by the transport impedance from TZi to TZj. Units are workers/ minutes, where workers are a proxy for jobs.
2. Environmental sustainability measure is defined as the inverse of CO2 emissions from the total JTW trips between zone pairs, including an allocation of emissions from manufacture of vehicle and road infrastructure. This is calculated as a sum of the carbon dioxide equivalent (CO2-e) per unit trip km at the average speed with the shortest path trip length and number of trips. The carbon dioxide equivalent (CO2-e) is calculated as the sum of the quantity of greenhouse gas and the Global Warming Potential Index (AGO,2005,Appendix 3)

Figure 4 Environmental sustainability (Pillar1) – "Raw" accessibility (Pillar3) scatter plot visualisation

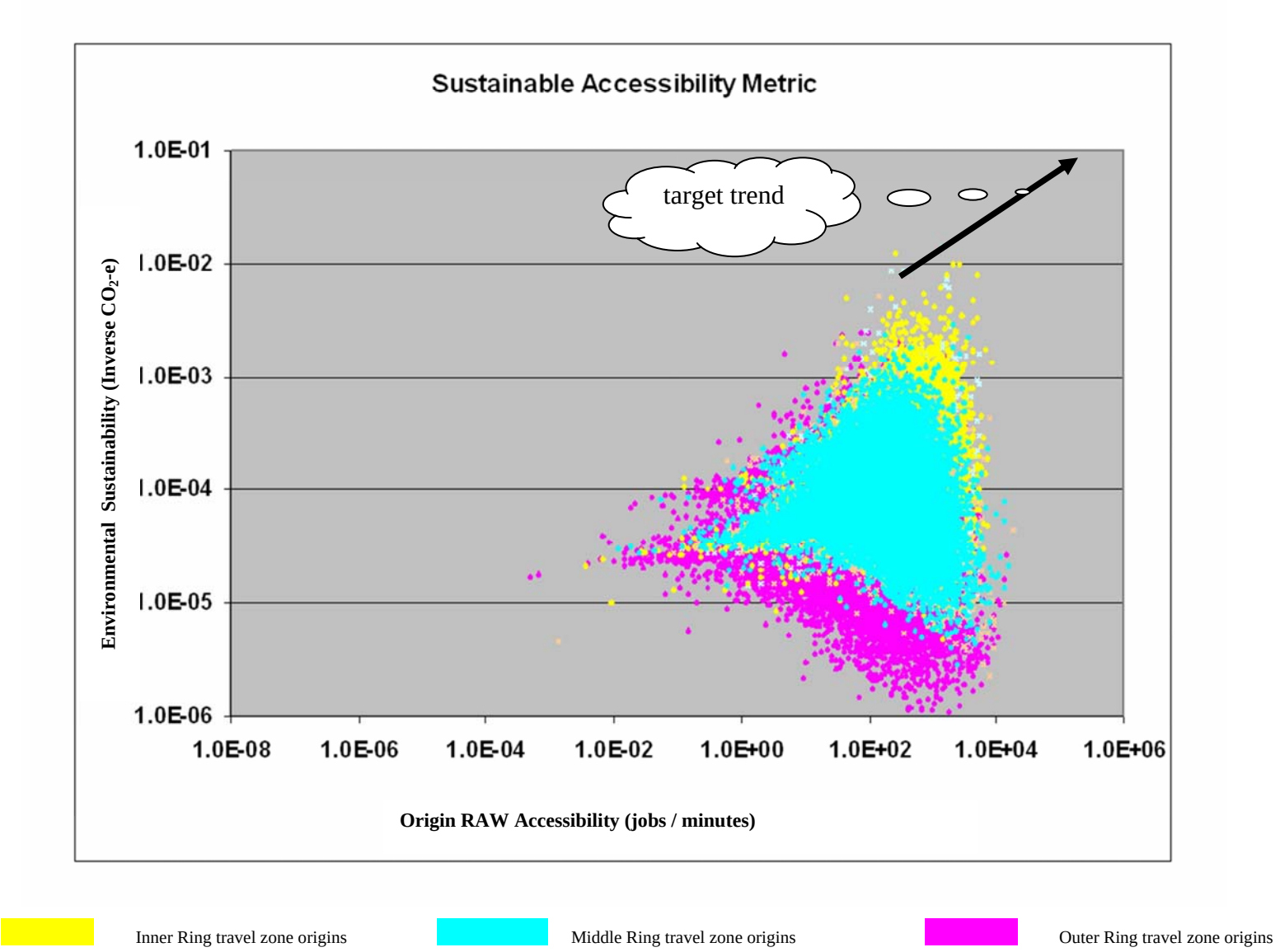


Figure 5 Pillars 1 & 2 sustainability performance. Comparison of Inner, Middle and Outer Ring areas of Sydney in 2001 from journey to work trips.

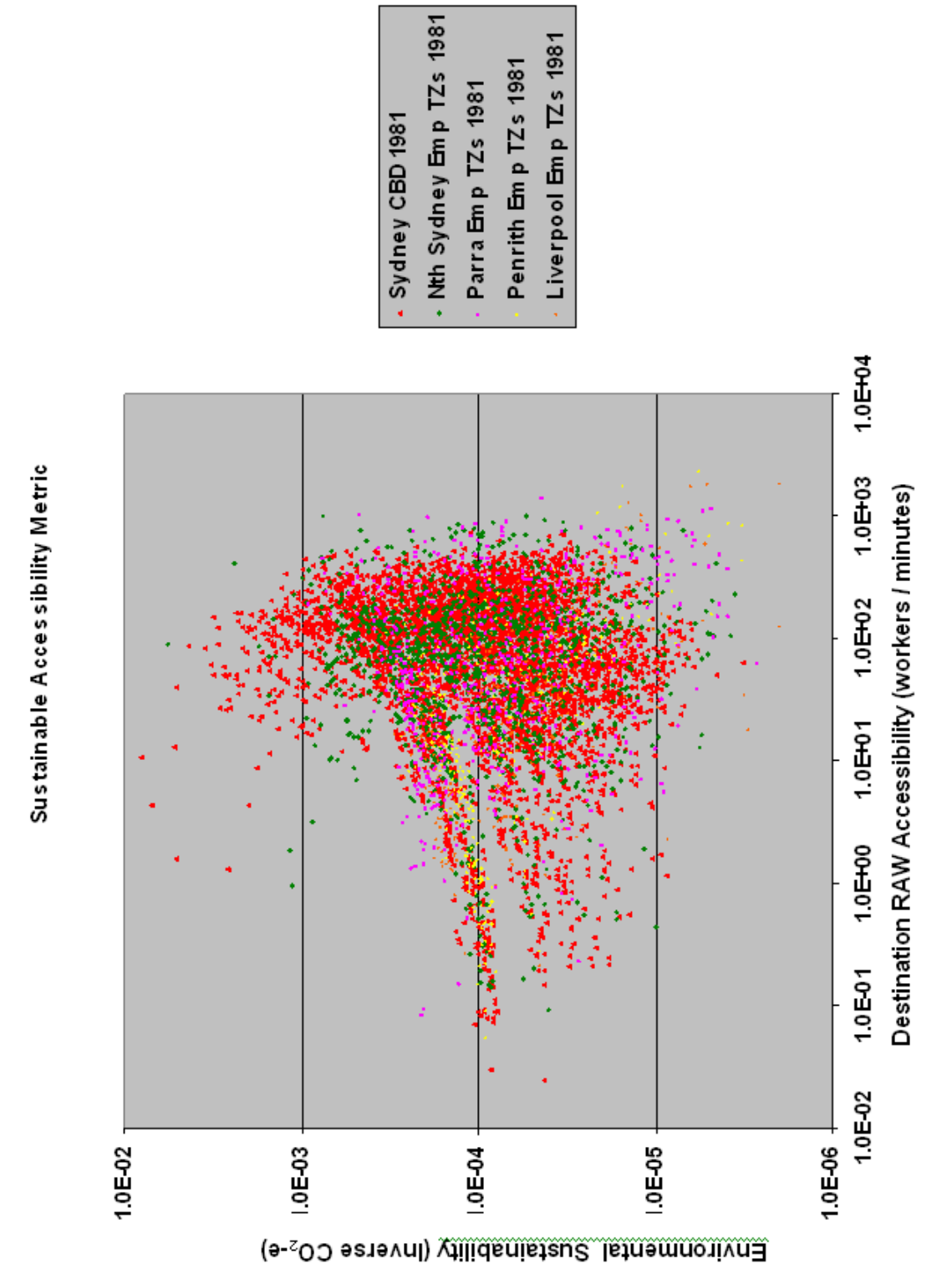
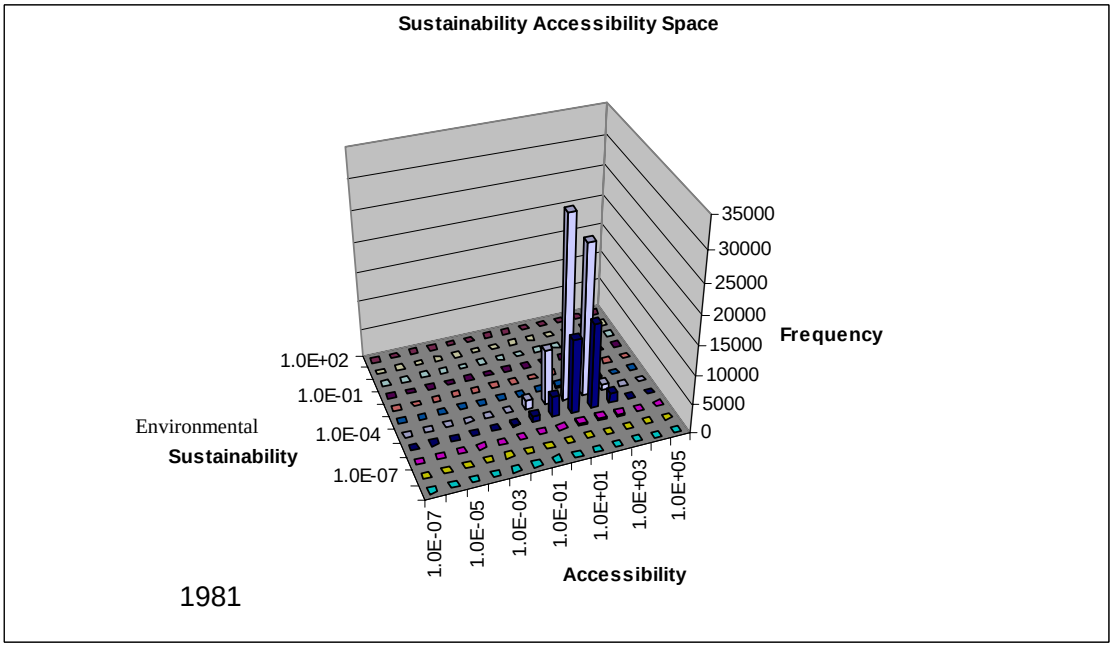


Figure 6 Pillars 1 & 3 sustainability performance. Comparison of Sydney centres in 1981 from journey to work trips



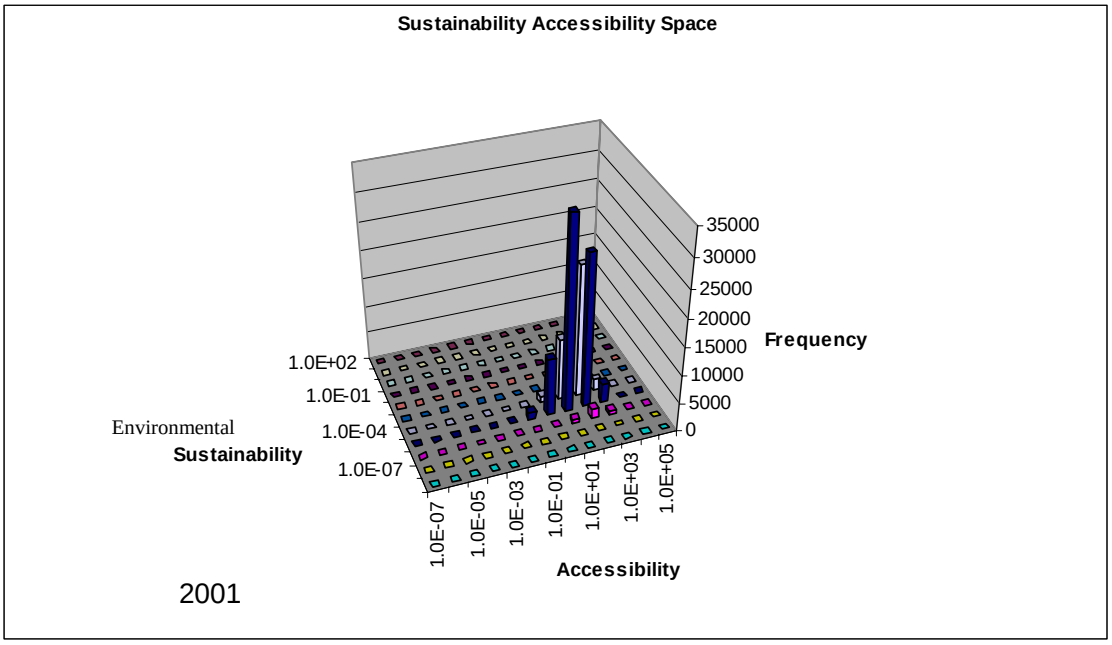


Figure 7 Prism map metrics 1981 and 2001 for all travel zones of Sydney from journey to work trips

The richness of travel zone pairs in these sets makes it difficult to interpret the data within the sets from scatter plots, unlike the smaller sets (Figure 4) where the internal

patterns of the scatter plot are visible. Therefore, to give a greater degree of visualisation of the data sets, the “environmental sustainability – accessibility space” was divided into a grid and plotted as a prism map with the frequency in “environmental sustainability – accessibility space” as shown in Figure 7. Through these three dimensional visualisations of the data sets, a number of additional differences between each set become visible. An increase from 1981 to 2001 in the number of travel zone pairs in the bins with lower environmental sustainability indicates a shift away from the target direction. In particular, an increase in the number of travel zone pairs with lower environmental sustainability values increases their frequency counts. Each of these visualisations provide insight into the position, spread and internal frequency trends for a city’s urban sustainability pillars of environmental stewardship, social equity and economic efficiency.

These metrics can also be applied in a way that expresses sustainability performance in terms of sustainability risk. High risk where sustainability performance is poor, indicated by low metric values. Low risk where sustainability performance is satisfactory, indicated by a higher metric value, above a community accepted minimum target. The grid concept can be likened to a risk matrix allowing each zone pair to be assigned a sustainability risk rating (Figure 8). This sustainability risk rating can then be plotted onto geographic space using geographic information system (GIS) thematic mapping. Figures 9, 10 &11 illustrate some examples of visualisations in geographic space.

For community and decision makers these visual differences give a simple snapshot of overall sustainability performance for each scenario being considered. It is straightforward to change the scenario, use the building block techniques, and produce a new metric plot to determine the sustainability effect. Stakeholders can see measurable change for their communities in relation to sustainability goals. The process provides another dimension to visioning and sustainability strategy development by adding the means by which community can measure and judge one infrastructure and urban form scenario with another.

Choice of boundaries between low, medium and high risk of unsustainability needs discussion as this may vary from city to city. For example, what are the points in environmental sustainability – accessibility space that moves a community from a low risk to a medium risk of being unsustainable? In the case of a city system with current scenario of transport and urban form a baseline assessment can be made.

An important aspect of the metric methodologies is their analytical basis. All visualisations have traceability back through the algorithms to the source inputs. This is a particular strength when checking results, making scenarios changes and applying different planning instruments. A particular strength of using the sustainability framework and the metrics demonstrated is that they are derived from data sets that have been commonly used by planners for many years. These are commonplace amongst transport and city planning departments. With these inputs and the assistance of readily available GIS/T software, all of the urban dynamics and sustainability metrics are able to be derived. The sustainability framework enables the holistic picture of sustainability to be maintained during the assessment process.

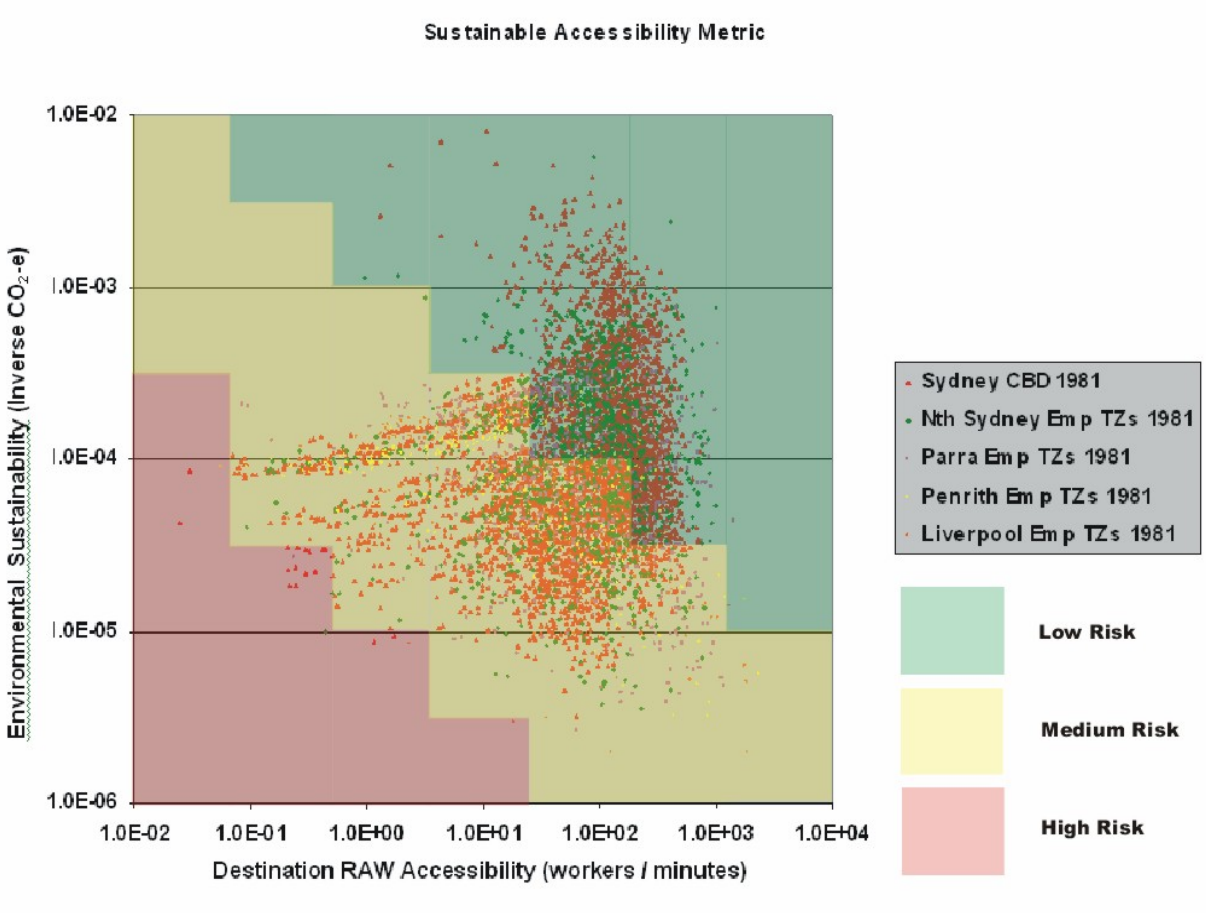


Figure 8 Sustainability risk matrix

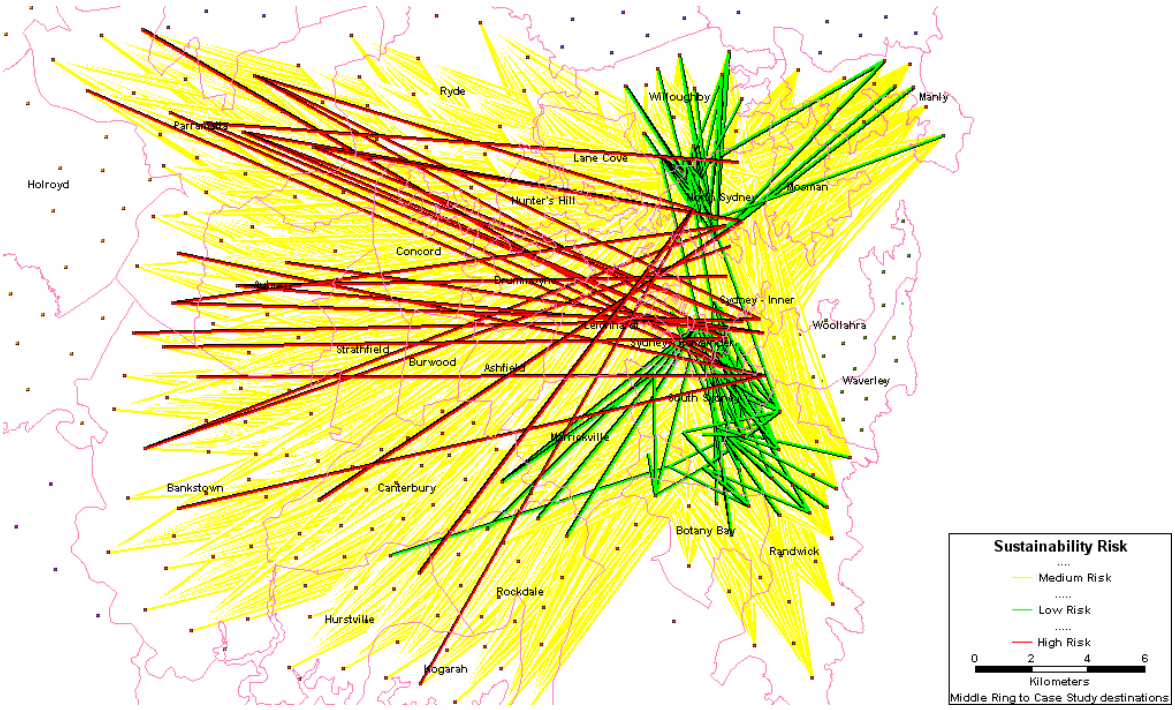


Figure 9 Sustainability risk GIS plot

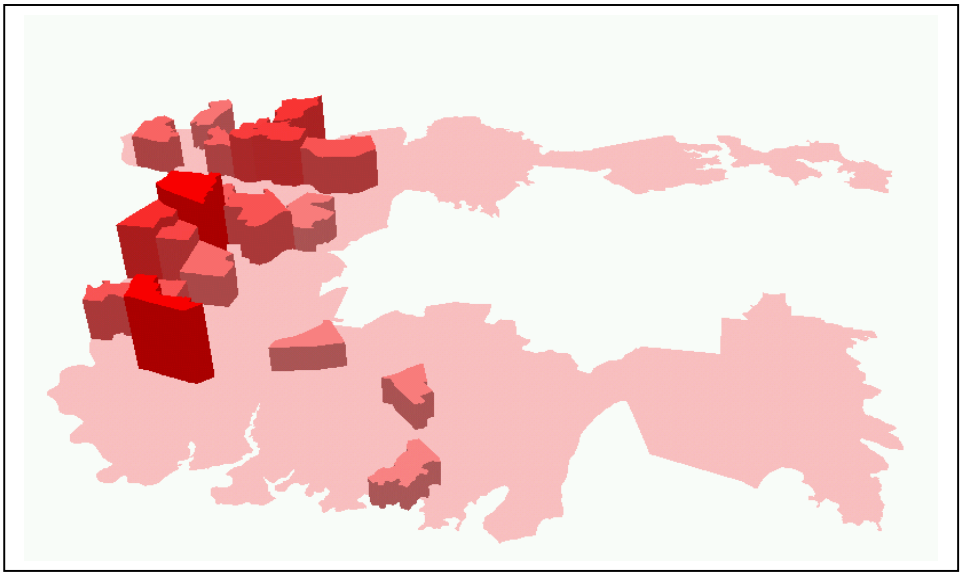


Figure 10 Sustainability high risk map

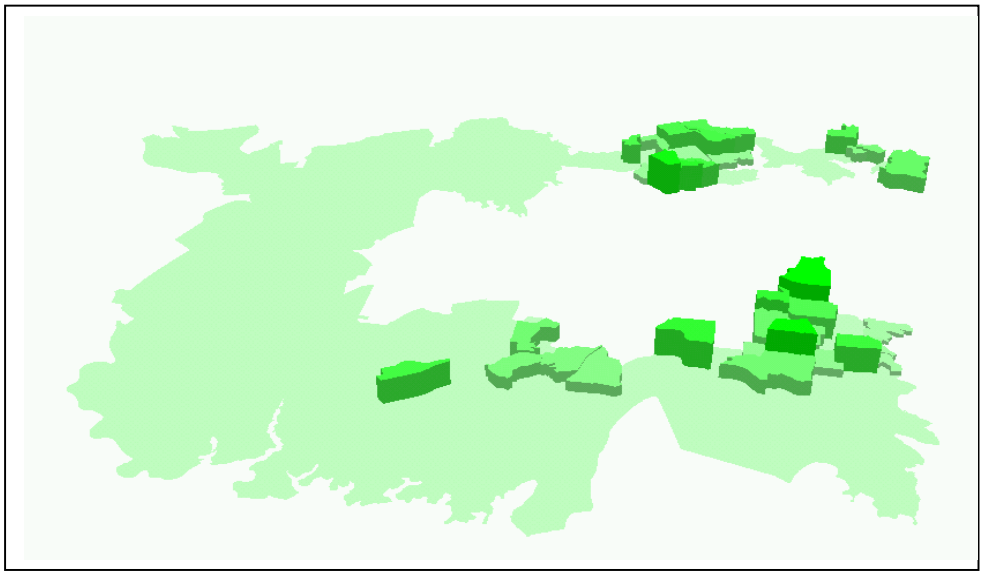


Figure 11 Sustainability Low risk map

Optioneering of changes in transport and urban form puts forward different possibilities for a cities future. This assessment methodology enables these scenario options to be assessed for change in sustainability performance over the system as it exists now. Not only can the snapshots of performance with current demands be made, but also as is done in traditional planning, the projected performance with projected demands. The sustainability assessment of various transport and urban form options is therefore seen as a valuable tool for comparing the relative performance where the variables are transport and urban system characteristics, urban dynamics associated with demand choices people make in place of living, where they work, relax, shop and visit and how and when they choose to travel. These variables we are familiar with. However, climate change adds another dimension with constraints and feedback effects to each of these variables which have not previously been assumed to occur.

CONCLUSIONS

The sustainability framework and visualisation methods described provide a suitable methodology to support informed decisions by communities, businesses and government and help chart the most appropriate options from the challenges of global environmental change. Climate change effects impose constraints and changes to the urban system that directly affect its characteristics but also change the urban dynamics that effect demand for transport (see Figure 2). These changes, and the feedbacks, need to be included in any optioneering of scenarios to support the vision of a sustainable city, such as that described for Canberra, Australia's capital city.

A second imperative is that the agencies and businesses that deliver and operate the transport system be actively involved in early stage planning to incorporate the effects of global environmental change, especially climate change, in their business, to minimise

the risks to their customers and themselves. This also provides a take up of opportunity that responding to climate change provides for businesses which have low carbon services and systems.

The overall aim of the approaches described in this paper is to help to deliver the types of visions for a sustainable city as expressed in the Canberra community, and to do so in the complex setting of the real world of trade offs between environmental sustainability, social equity and economic efficiency. The urban sustainability framework with its three pillars of sustainability and associated modelling and visualisation techniques is designed to meet these trade-off challenges as cities enter into a future period driven by climate change imperatives.

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APPENDIX A ACT Government Goals for a Sustainable Canberra

1. To build resilience and responsiveness to change - climate change, climate variability, peak oil, demographic changes and changes to the economic base.

Built Form

By establishing a pattern of development and practise in design and building that

- continually improves environmental performance and reduces reliance on non-renewable energy sources;
- promotes healthy lifestyle choices in transport, housing, work, leisure and social exchange;
- allows for a diversity of land uses and encourages enterprise, innovation and increasing self-sufficiency within the local community;

Urban Ecology

By planning and managing the 'land base in the Territory in a manner that:

- will conserve the natural systems so they continue to function and are sufficiently robust (i.e. in extent, distribution and diversity) to evolve;
- recognises the inherent climatic/bio- physical attributes of the region;
- builds bio-diversity in the urban open space – both the private and public realms, to complement and extend the natural systems;
- improves the capacity of the urban open spaces – private and public realms, to contribute to self-sufficiency and economic resilience.

Community

By improving people's preparedness to take up more sustainable lifestyle choices and manage their actions through:

- investing in people's knowledge, ability and capacity to access and apply new information and technologies;
- a system of incentives (and disincentives) to reward more sustainable decisions;
- increasing the options provided in the market for more sustainable housing, transport and even work regimes.
- accounting for all the environmental costs in our economic transactions.

2. To provide 'insurance' for the future, minimising redundancy and maximising adaptability - to ensure generational equity, to account for embodied energy in urban form and more effectively plan for opportunities and 'potentialities' for the future

Built Form

By adopting a 'timeless' approach and system in planning, development and building which:

- in the first instance seeks to reuse or improve the environmental performance of the existing building stock and civil infrastructure;
- facilitates the easy modification of the building stock to respond to people's changing needs and circumstances (e.g. the expansion of a house or the modification of a building to allow for a change in use);
- anticipates the progressive modification of the civil infrastructure as the environment, technology and requirements of future generations change;
- use sustainable materials and processes throughout the life-cycle

- distributes key community services (health, education, worship) and amenities (shops, parks) so as to maximise social interaction within a precinct and minimise repeated and extended vehicle trips.

Urban Ecology
By reinforcing and expanding the environmental value and significance of Canberra's open space system through:
- protecting those areas of ecological and or cultural value;
- ensuring there is diversity in the natural and urban habitats within the system;
- matching the patterns and extent of use with the bio-physical attributes and constraints;
- maintaining both the physical and biological connection in the open space system by using all elements in the public realm (i.e. streets)

Community
By increasing people's awareness of the impacts of their actions and their capacity to adapt as circumstances change through
- reporting on our 'ecological' footprint';
- implementing 'whole of life' accounting to capture the capital, running and embodied costs;
- monitoring the effectiveness of our administrative services and updating these to respond to new technologies and changes in the community's requirements;
- identifying advisory services and incentives that will allow people to meet there changing needs (e.g. adaptive housing…)

3. To take action that abates the causes of climate change - to reduce greenhouse gas emissions

Built Form
By identifying the opportunities for new development and redevelopment that will:
- integrate land uses, transport and communication systems to improve accessibility while reducing the dependence on fossil fuels technologies;
- give priority to low carbon emitting transport;
- increase the opportunities to incorporate more sustainable technologies (e.g. renewable energy sources) at the household, precinct and metropolitan scales.

Urban Ecology
By using Canberra's open space system, including its streets and parks to:
- establish an urban forest that will ameliorate extreme weather conditions;
- providing 'green banks' to offset carbon emissions;

Community
By promoting and supporting people's decisions and activities to reduce carbon emissions through:
- monitoring and reporting on our carbon emissions per capita;
- more effectively utilising new technologies (e.g. internet) to provide information, access to services and work within community;
- policies and incentives that create competitive options and greater choice for taking up energy efficient choices and behaviours (e.g. appliances, housing etc)
- providing convenient and realistic alternatives to the car in transport modes and networks;

- accounting for the cost of carbon emissions in our economy.

To foster a consciousness of sense and responsibility to community, place and self - to build on what is special in Canberra – its landscape setting and the egalitarian values of the community

Built Form
By cultivating in planning, design and building an approach that:
- is localised, responding to the specifics of the climate, geography, ecology and scenic qualities of the region and precinct;
- respects the 'past', allowing for progressive change;
- places social inclusion and engagement as paramount and provides good accessibility to services and choice in movement across the spectrum of socio-economic backgrounds;
- enhances our well-being by creating pubic spaces which support individual activities, have meaning and engage our senses.

Urban Ecology
By recognising and respecting the significance the landscape has and continues to play in the lives of the Canberra community through:
- identifying and conserving the ecological and cultural values in our landscape setting;
- preserving the network and connection in the system of landscape spaces;
- retaining and enhancing access to both natural and urban places that are diverse in character; and function;
- improving our understanding of the natural systems.

Community
By improving people's ability and capacity to exercise their 'citizenship' through:
- inclusion in policy formulation
- showing leadership in policy direction
- accountability in administrative and financial systems.