CITIES : GREEN OR RED?

TRANSPORT AND URBAN DESIGN DRIVERS IN THE CONTEXT OF CLIMATE CHANGE

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BACKGROUND

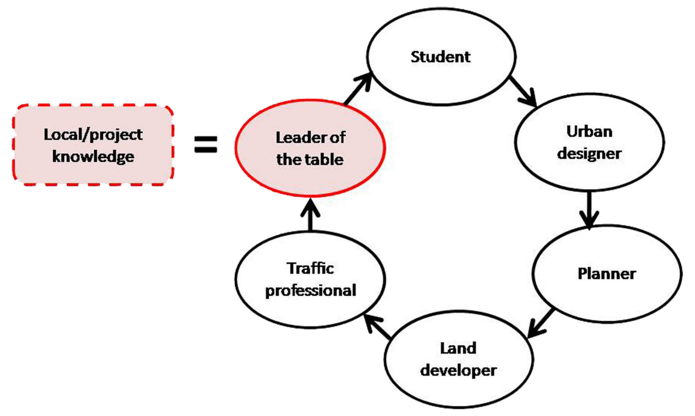
Can the climate problem be framed as an urban development and transport problem where CO2 reduction is understood as a co-benefit of good development and transport?

The aim of the Master Class (workshop with a mix of professionals from varying disciplines, decision makers like the Mayor of the local council, and Planning students) held at Perth in August 2009 on "Cities Green or Red, Transport and Urban Design in the context of climate change" was to find an answer to the above question. Could the application of the principles of sustainable urbanism (Density Diversity Design) when combined with ASIF strategies lead to a reduction in CO2 emissions? Application of ASIF and DDD and an audit on resulting CO2 emissions was done through a case study – Bentley Technology Precinct located in the car-oriented city of Perth in Western Australia by undertaking:

- Place – check audit
- Identify key connectors and nodes
- Strategy for development - applying ASIF and DDD
- Carbon, VKT and making place - making audit

WORK METHODOLOGY

Objective was to develop a multi disciplinary perspective by bringing together experts from varying disciplines to raise awareness of practices and debates in each area, in order to improve understanding of the relationship between disciplines.

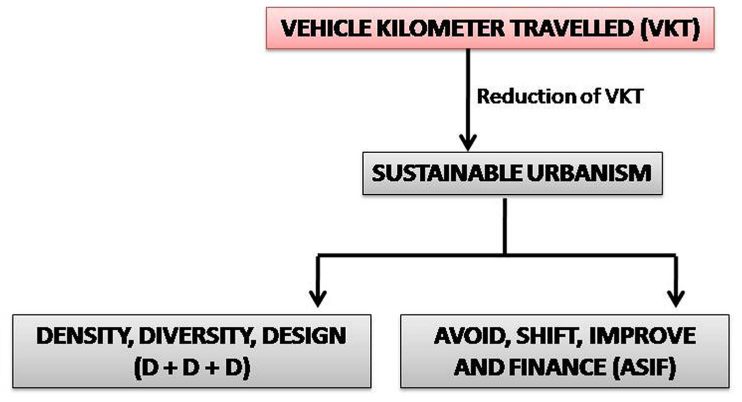


Group composition

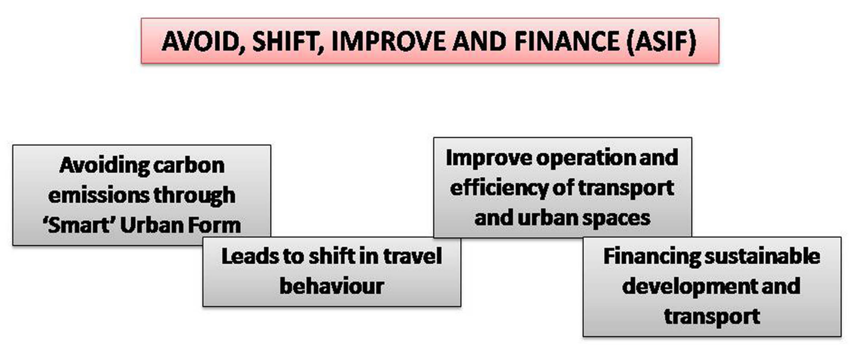
- State and local government representatives
- Industry professional – land developers, traffic & transport engineer, urban designers, planners
- Students and university academics

Inclusive approach

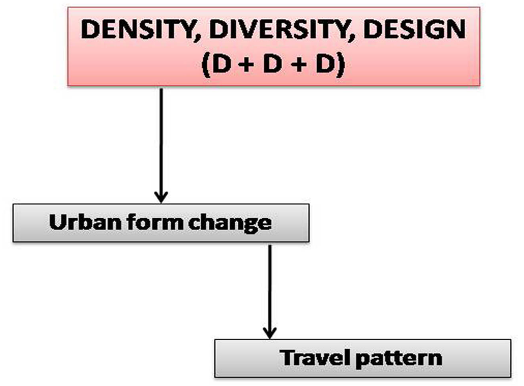
COUPLING THE BENEFITS OF THE DENSITY DIVERSITY AND DESIGN (DDD) MODEL AND THE AVOID, SWITCH, IMPROVE AND FINANCE (ASIF2) PARADIGM



Addressing transport CO2 conundrum



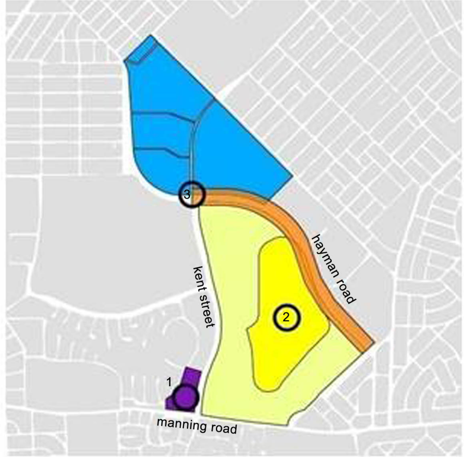
Avoid, Shift, Improve and FInance (ASIF)



Density, Diversity and Design (DDD)

APPLYING ASIF AND DDD PRINCIPLES TO THE BENTLEY TECHNOLOGY PRECINCT, PERTH AUSTRALIA.

Three scenarios were proposed based on three transport corridor options available which included the shift to bus rapid transit along Hayman Road (buses ply on this route currently, however there is no separate bus lane, thus this scenario was based on 'building up' on existing services), a bus rapid transit along Kent Street (shifting the bus route from Hayman Road to Kent Street with an objective of bridging the gap between University and the surrounding residential community) and a light rail based development with the main spine passing through Curtin University and Manning Road (University as a 'place' scenario)



1. commercial/business nodes 2. university/recreational nodes 3. technology nodes

Scenario 1
Building on the existing – bus based

Scenario 2
Bus rapit transit

Scenario 3
Light rail

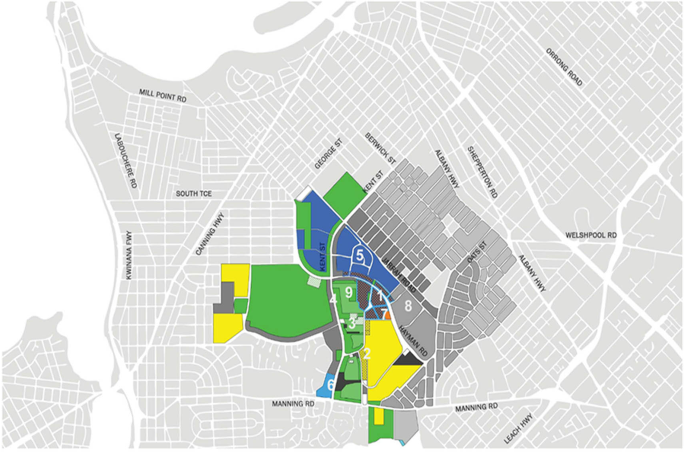
ASIF Application

The Avoid, Shift, Improve and Finance (ASIF) and Density, Diversity, Design (DDD) strategies are applied to the Bentley Technology Precinct. In terms of avoiding carbon emissions, the BTP will reduce emissions through sustainable urban development. As the biggest trip generator is the university, increasing student housing would reduce trip generation and subsequently a reduction in carbon emissions. The focus of the development on public transport would also encourage more sustainable forms of transport. In terms of shifting, changes in land use encouraging work and living in close proximity and the encouragement of sustainable transport is important in the BTP. The positioning of housing, workplaces, shops etc. within easy walk of each other, and from the public transport stops will avoid car travel.

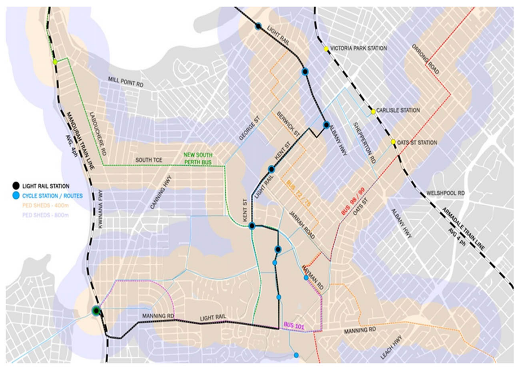
Carrots (integrated transport and land use, cycling amenities, pocket parks along paths, etc) as well as sticks (car restricted zones, increased parking charges) (Barlow 2009) will lead to a switch in travel patterns and behaviour by luring people towards buses, cycle paths and foot paths. Improvement in transport patterns and usage would be achieved through introduction of bus-only lanes. These will have the possibility in future to be converted into a light rail system once the BRT reaches capacity. The BRT would have a dedicated lane with signal prioritization and queue jumper lanes helping to speed up the journey to Perth CBD. The high frequency route would have real time passenger information, making it user friendly as well as providing seating and shelters. Financing would be achieved by the proposed development investing heavily in the BRT. Programs would be devised that encourage greener vehicles and green fuels. The funding for BRT would be contributed by pay parking, similar to the present system working in the Perth CBD, with parking funds going to the CAT Bus system.

DDD Application

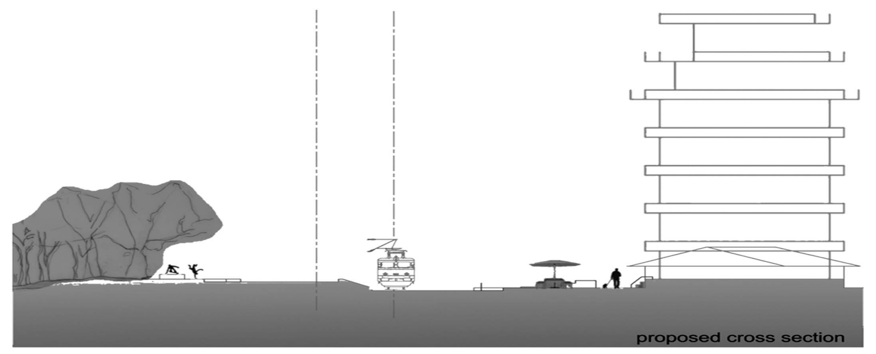
Density distribution



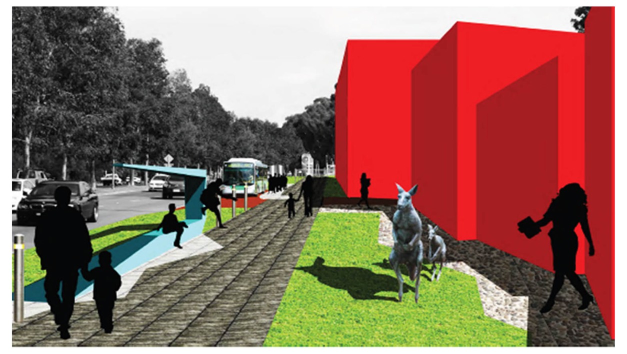
Land use and demographic Diversity



Design



Examples of design approach



Drawn by 4th year Architecture student

Before

After

AUDIT : CARBON AND VKT REDUCTION

	2009			Business as Usual (BAU) (car based development)			Mixed Use Transit Orientated Development (TOD)		
	Residential	Office and student	Retail	Residential	Office and student	Retail	Residential	Office and student	Retail
Number (dwelling/employee/employee)	**3,100.00**	**19,500.00**	**2,000.00**	**7,500.00**	**45,500.00**	**13,000.00**	**10,750.00**	**39,000.00**	**13,000.00**
Trip generation	10.00	3.00	15.00	10.00	3.00	15.00	10.00	3.00	15.00
Trip rate per day per dwelling	31,000.00	58,500.00	30,000.00	75,000.00	136,500.00	195,000.00	107,500.00	117,000.00	195,000.00
Average non-auto modal split (1=100%)	0.10	0.05	0.10	0.10	0.05	0.10	0.40	0.25	0.20
Vehicle trip adjustment	27,900.00	55,575.00	27,000.00	67,500.00	129,675.00	175,500.00	64,500.00	87,750.00	156,000.00
Average trip distance (km)	9.00	9.00	5.00	9.00	9.00	5.00	6.00	6.00	2.00
VKT estimates	251,100.00	500,175.00	135,000.00	607,500.00	1,167,075.00	877,500.00	387,000.00	526,500.00	312,000.00
TOTAL			**886,275.00**			**2,652,075.00**			**1,225,500.00**
VKT FOR TOD COMPARED TO BAU									**46.21%**
VKT for people who travel by cars (or VKT estimates)	251,100.00	500,175.00	135,000.00	607,500.00	1,167,075.00	877,500.00	387,000.00	526,500.00	312,000.00
Number of VKT for cars actually driven in precinct (assuming occupancy of 1.36 people)	184,632.35	367,775.74	99,264.71	446,691.18	858,143.38	645,220.59	284,558.82	387,132.35	229,411.76
Emission of CO2 (g) per kilometre travelled by each individual car	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
Car emissions per day (kg)	44,311.76	88,266.18	23,823.53	107,205.88	205,954.41	154,852.94	68,294.12	92,911.76	55,058.82
Number of trips on public transport	3,100.00	2,925.00	3,000.00	7,500.00	6,825.00	19,500.00	43,000.00	29,250.00	39,000.00
Number of trips on buses (BAU-100% of all public transport trips, TOD- 80% of all public transport trips)	3,100.00	2,925.00	3,000.00	7,500.00	6,825.00	19,500.00	34,400.00	23,400.00	31,200.00
Number of bus trips required (BAU- assuming occupancy of 8.1 people, TOD- assuming occupancy of 20 people)	382.72	361.11	370.37	925.93	842.59	2,407.41	1,720.00	1,170.00	1,560.00
Emission of CO2 (g) per bus kilometre travelled	840.00	840.00	840.00	840.00	840.00	840.00	840.00	840.00	840.00
Average trip distance for bus (km)	9.00	9.00	5.00	9.00	9.00	5.00	6.00	6.00	2.00
Bus emissions per day (number of buses in operation X average number of kilometres travelled X CO2kg per kilometre) (kg)	**2,893.33**	**2,730.00**	**1,555.56**	**7,000.00**	**6,370.00**	**10,111.11**	**8,668.80**	**5,896.80**	**2,620.80**
Number of trips on light rail (BAU-0% of all public transport trips, TOD- 20% of all public transport trips)	0.00	0.00	0.00	0.00	0.00	0.00	8,600.00	1,179.36	524.16
Number of light rail trips required (assuming occupancy of 65 people)	0.00	0.00	0.00	0.00	0.00	0.00	132.31	18.14	8.06
Emission of CO2 (g) per light rail kilometre travelled	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average trip distance for light rail (km)	9.00	9.00	9.00	9.00	9.00	5.00	6.00	6.00	2.00
Light rail emissions per day (CO2kg per kilometre X total number of kilometres travelled X number of trains in operation)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TOTAL EMISSIONS (ALL MODES) (kg per day)	**47,205.10**	**90,996.18**	**25,379.08**	**114,205.88**	**212,324.41**	**164,964.05**	**76,962.92**	**98,808.56**	**57,679.62**
TOTAL EMMISSIONS FROM ALL USERS (kg per day)			**163,580.36**			**491,494.35**			**233,451.11**
CARBON FOR TOD COMPARED TO BAU									**47.50%**

Audit scenario 3

ASSUMPTIONS

Please also refer the research paper.

Bus emission workings	
Number of people	25
Emissions per car (CO2 per kilometre)	240
Emissions for 25 cars	6000
86% off this value	
TOTAL: Emissions for one bus	840

Residential numbers 2009		**Office and student numbers 2009**	
Students	1200	Staff	3000
Non-students	0	Technology park	2500
Aged Care	5000	Student (non-residential)	14000
TOTAL	6200	**TOTAL**	19500

Residential numbers BAU 2031		**Residential numbers TOD 2031**	
Students	2000	Students	8500
Non-students	6500	Other	6500
Aged Care	6500	Aged Care	6500
TOTAL	15000	**TOTAL**	21500

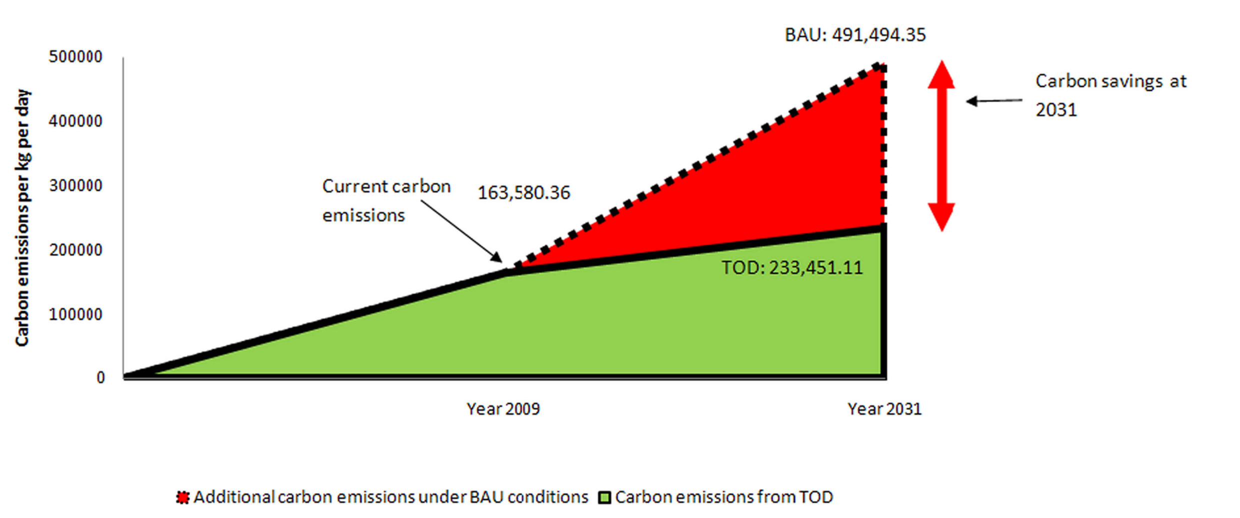
Office and Student numbers BAU 2031		**Office and student numbers TOD 2031**	
Students	23000	Students	16500
Staff	5000	Staff	5000
Tech	17500	Tech	17500
TOTAL	45500	**TOTAL**	39000

Dwelling Calculations	2009	2031 Business as usual	2031 transit orientated development
Number of residents	6,200.00	15,000.00	21,500.00
People per dwelling	2.00	2.00	2.00
Number of dwellings	3100.00	7500.00	10750.00

Note: The Greens (2008, 14) state that 1 bus with 25 people produces 86% less greenhouse emissions as compared to 25 individuals in cars.

FINDINGS

Carbon Emissions: Scenario 3



The growth of carbon emissions in 2031 BAU situation pose no surprises given the policy to grow an inner BTP population aggressively with a large number of students and workers residing in the precinct and the enlargement and diversification of jobs. Residential and office/student (non residential) emissions jump over 130% while retail/commercial/service increase by 500%. The estimated affect of TOD 2031 leads to an aggressive scenario of reduced dependency on private motor vehicles and a significant uptake of alternative transportation modes. Residential and office/student (non residential) carbon numbers drop by 30 – 50% while the major drop of 65% is in the retail/commercial/service sector. This is largely because of greater influx of population and better access to amenities and services. The graph from the audit shows that transit orientated developments can almost halve the amount of carbon dioxide produced by transport compared to a business as usual scenario. Transit orientated development can greatly slow the increase in carbon emissions produced by a development, even with large increases in activity. The large carbon reductions are largely due to the self-containment of activity in the Precinct (as large numbers of people who work or study in the Precinct no longer drive) as well as increased occupancy of public transport. In our study it was interesting to note that the percentage of carbon reductions in the Precinct were very similar across Scenarios 1 and 3 (45% to 48% reduction compared to business as usual) despite heavy investment in light rail infrastructure in Scenario 3.

CONCLUSION

Master Class audited the three scenarios for VKT and CO2 reduction. The light rail scenario, although exceedingly expensive, had a similar reduction of carbon emissions as the bus-based scenarios; however its place-making contribution is immense. BRT is a cheaper alternative to light rail and serves the same purpose. The key to its success, however, is achieving a high patronage to reduce the overall carbon footprint per rider and running costs. Furthermore, part of its success is making public transport appealing to the masses and user friendly, which could be achieved by a public relations campaign as well as making improvements to the BRT to make the journey quicker than private vehicles.

The Master Class, applying an integrated approach to climate change, land use and transport, brought in the fourth dimension of city design, with an understanding that the macro-level structures of climate, transport and land use rest on the micro-level foundations of densities, job-house balance, a balanced demographic distribution, affordable housing, walk-ability, safe and secure built environment and place-making.

ACKNOWLEDGEMENTS

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