



**iHBE**

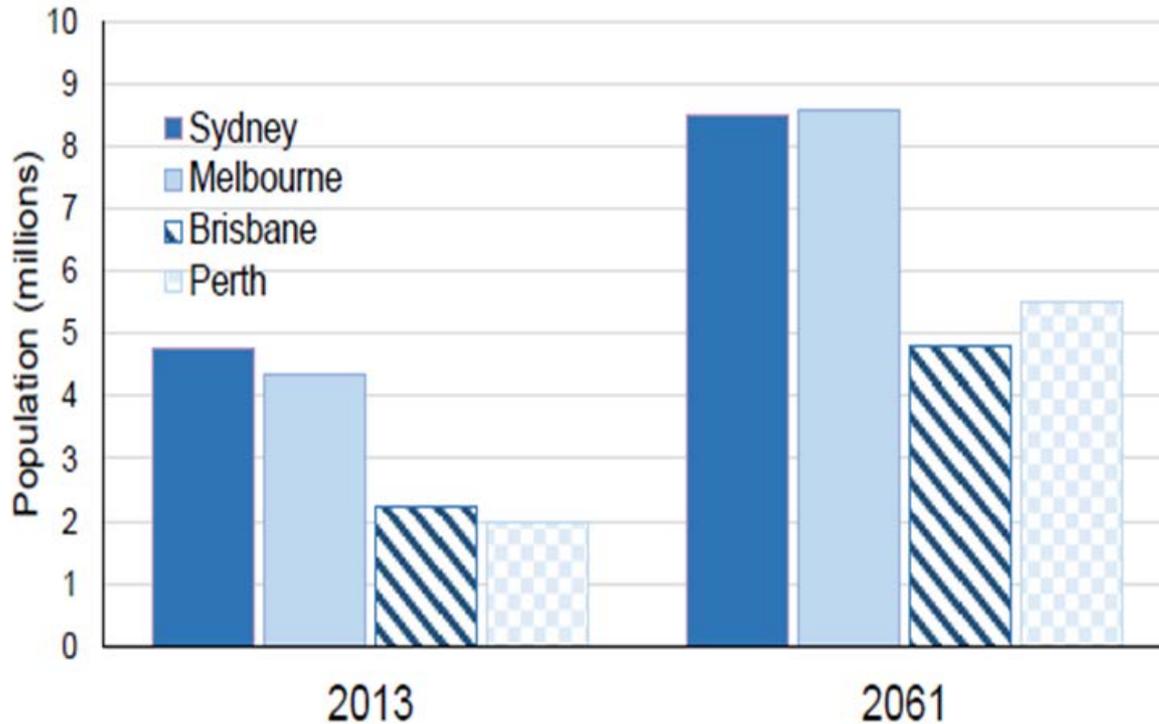
Sustainable Built Environment  
Conference Series 2016  
**SBE16 Sydney**

# Innovation for a Sustainable Low Carbon Built Environment Transition: Confronting the Challenges

Professor Peter W. Newton



# How to plan sustainably for a forecast doubling in major city populations in < 50 years? + transition to low carbon living



## 2 Key Urban Challenges

(as focus for this presentation) :

- **Increase housing supply in the right places - infill:**
  - access to jobs, services
  - medium density
  - affordability
- **Decarbonise built environment:**
  - housing
  - transport/mobility

## Required Urban Transitions:

- **Retrofit:** 70+% housing infill (brownfield + greyfield) vs. greenfield
- **Transformative:** from suburban to urban built environment form and fabric
- **Regenerative:** shrinking [> 50%] unsustainable urban (sprawl) and ecological (resource consumption and carbon emissions) footprints
- **Energy:** from fossil fuels to renewables [multiple targets – net zero emissions 2050 (NSW): 90% 2020 (ACT): 50% 2025 (SA): 40% 2025 (Vic) ]

# Sustainable urban development goals for [Australian] cities (COAG, 2009)



**Resource inputs**

- Population & human capital
- Land stocks
- Material stocks
- Energy stocks
- Water stocks
- Food stocks
- Industrial inputs

**Ecological Sustainability**

**Exogenous pressures**

- Health pandemic
- International Migration
- Capital investment, trade
- State of global & national economy
- Climate change, extreme events

**Resilience**

**Urban systems and processes**

- Urban governance
- Technical sophistication
- Urban design and development
- Industrial and organizational processes
- Household behaviour
- Energy supply and demand
- Water supply and demand
- Food supply and demand
- Transport supply and demand
- Housing supply and demand

**Smart  
Productive  
Livable  
Equitable  
Resilient  
Sustainable  
Urban  
System**

**Human well-being**

- Housing quality, affordability
- Transport access
- Congestion social & economic wellbeing, equity
- Environmental health
- Culture and heritage
- Neighborhood amenity

**Equity**

**Urban environmental quality**

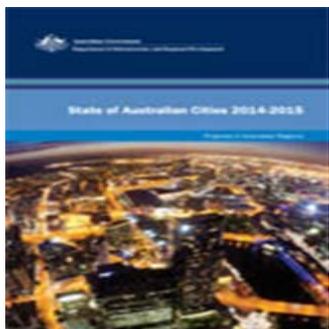
- Indoor air quality
- Noise
- Water quality
- Ambient air quality
- Green space

**Liveability**

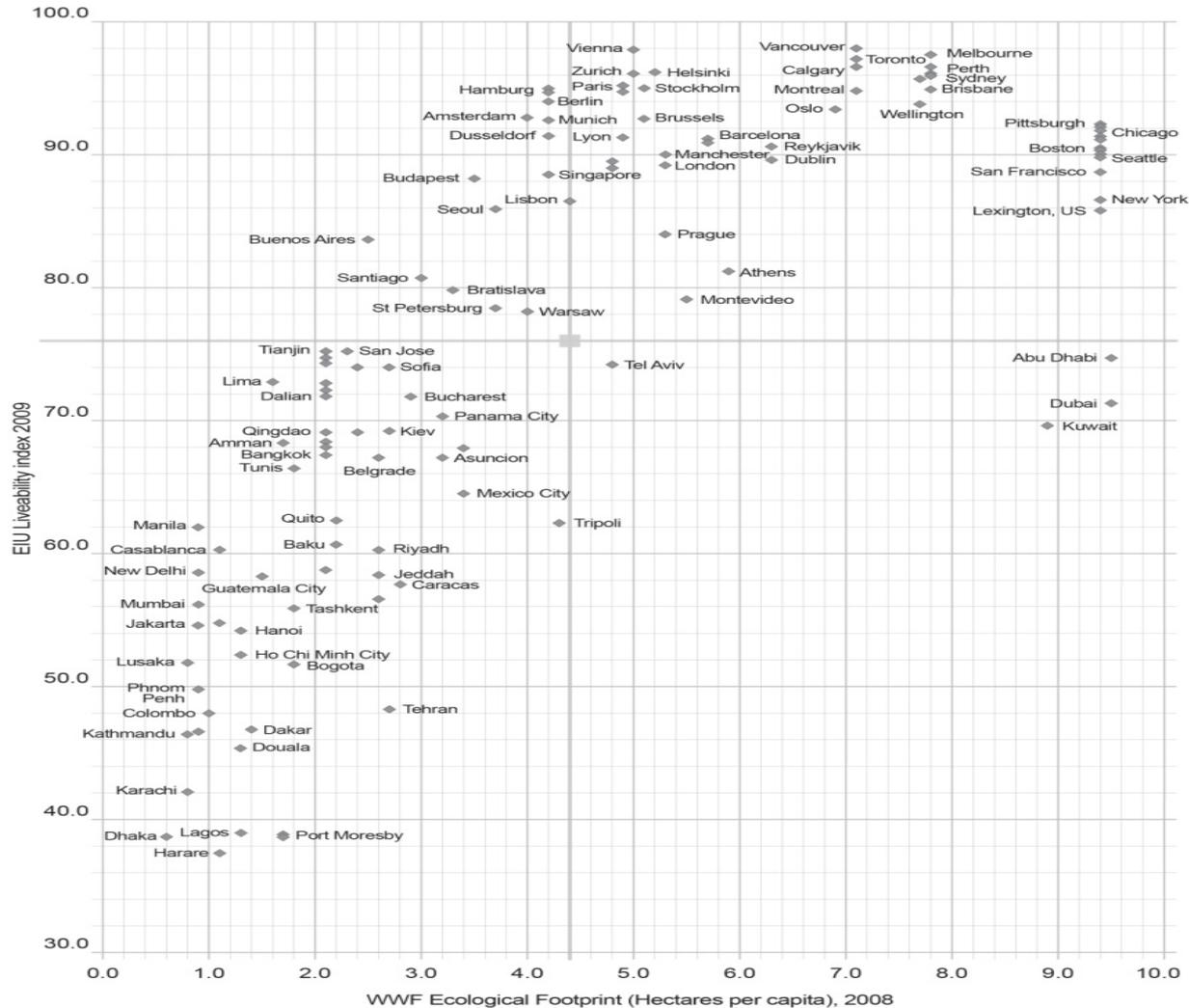
**Waste and emissions/  
recycling and reuse**

- Solid, liquid and hazardous waste
- Wastewater
- Stormwater
- Air pollution
- Greenhouse gases

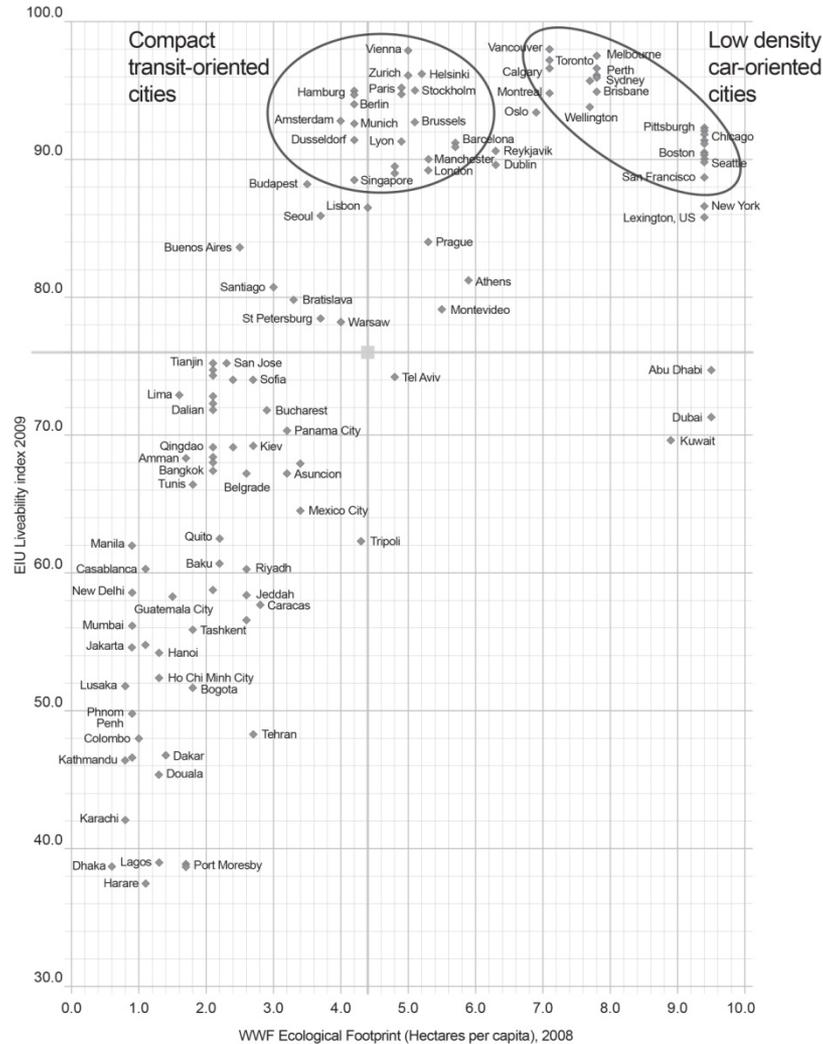
**Ecological Sustainability**



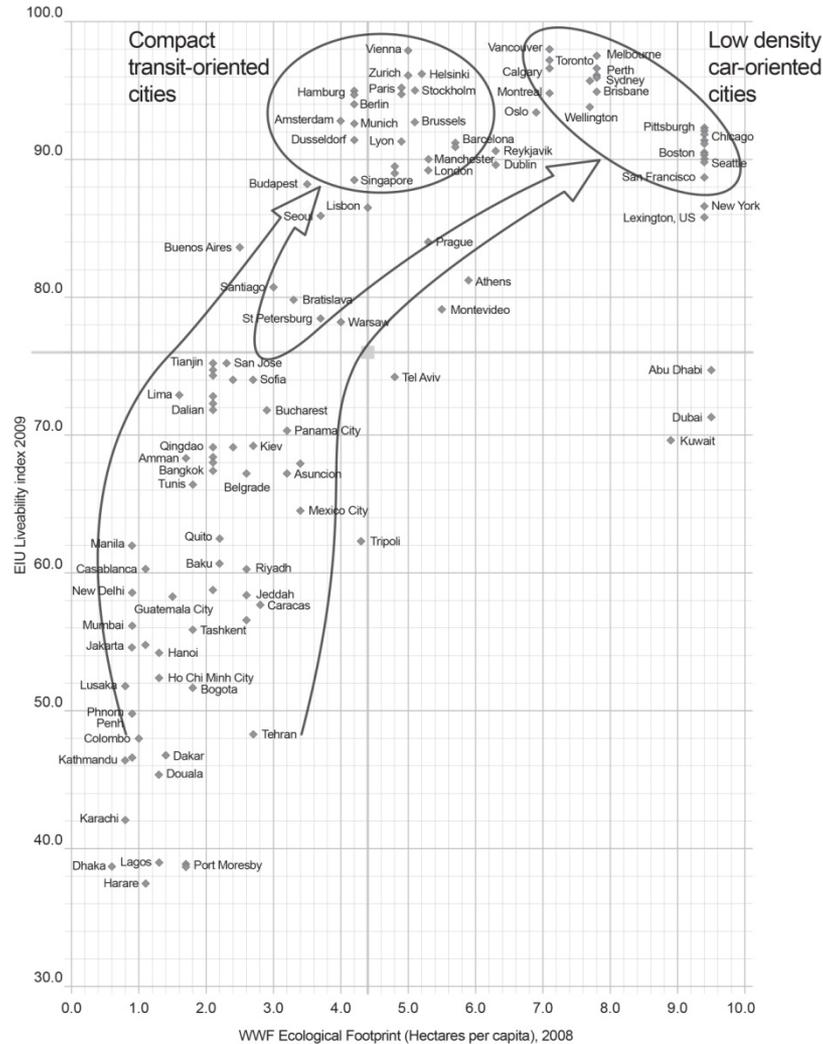
# Mapping Liveability (EIU Index) and Sustainability (Ecol. Footprint) for 140 Cities



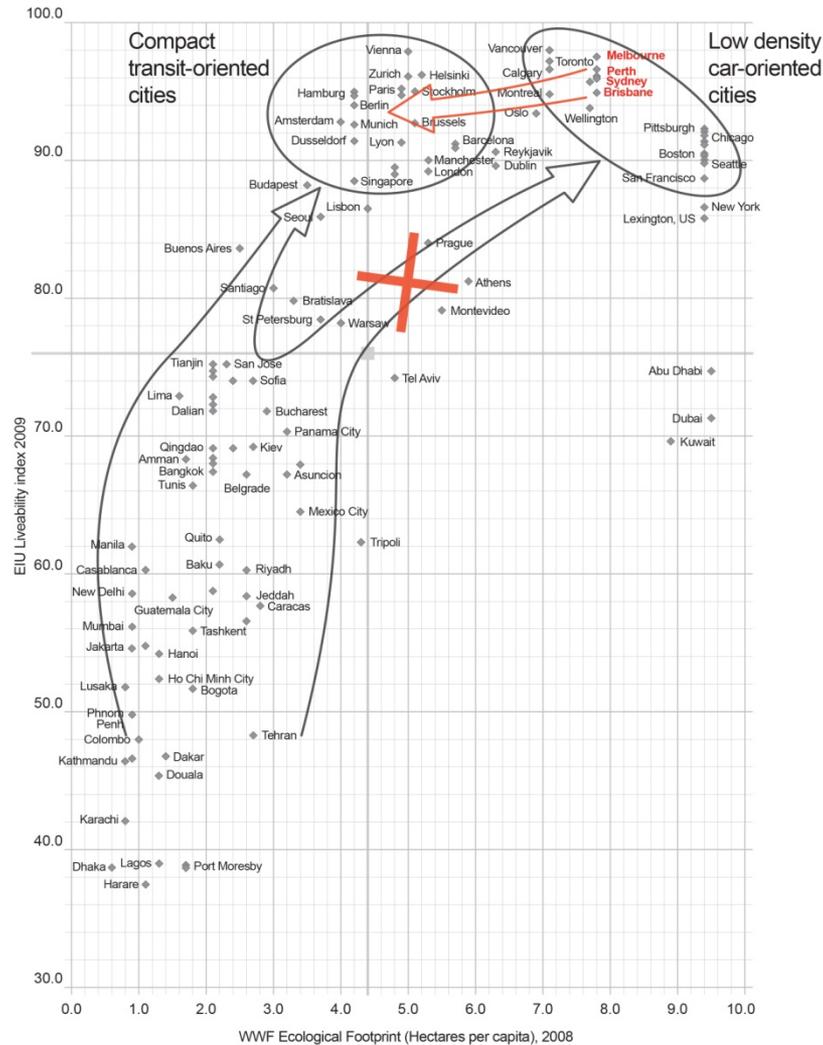
# Two clusters of 'high liveability' cities with contrasting ecological footprints



# Developing countries are rapidly urbanising + increasing ecological footprints



# Goal for city development: liveable + low carbon



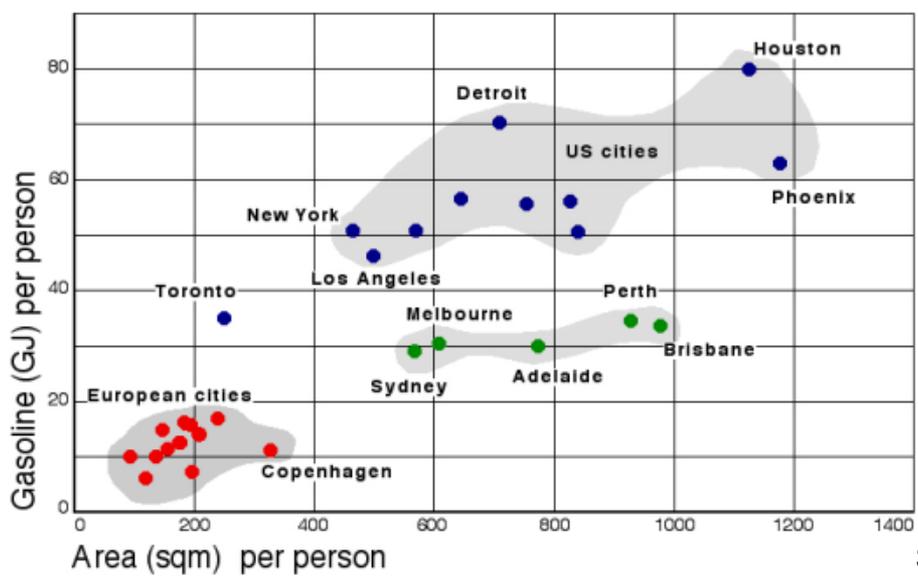
- ← **Challenge:**  
**Shrink those urban footprints-**
- finite planet
  - sustainable city
  - global social justice
  - ethical city
  - new green economy
  - carbon neutral city
  - climate change
  - resilient city

# Housing and Transport Contributions to Ecological Footprints in Australia, North America and Europe: a focus for Decarbonisation Innovations

**Housing:** Large (detached) dwellings consume more energy and resources; Trojan horse for household consumption



**Transport:** (ICE) Car Dependency; High VKTs; High Consumption of Petroleum / Fossil Fuels



**Housing + Transport** account for > 50% energy end use in Australia (Office of Chief Economist, 2015)

Source: Townsend (2006)

# Overview of Presentation: Pathways for Sustainable Low Carbon Built Environment Transition

## Multiple scales for intervention:

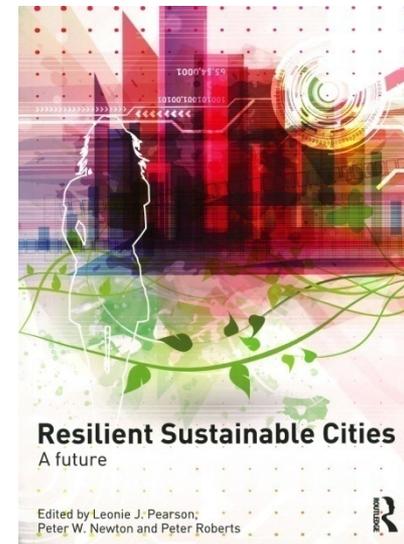
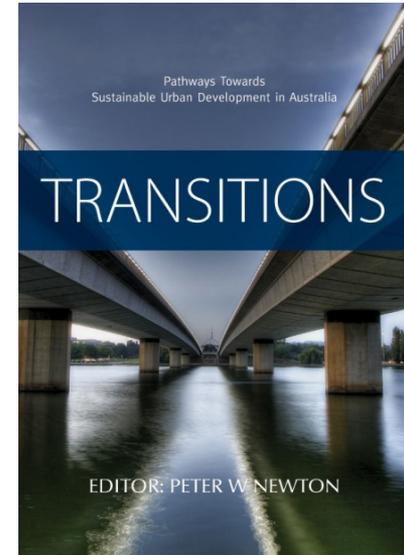
### 1. City level

### 2. Precinct/neighbourhood/district level:

Focus = regenerative retrofitting of established ageing urban fabrics [ brownfield + greyfield ]

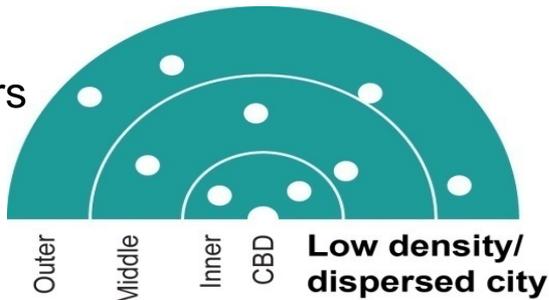
### 3. Building ( & material) level

### 4. Individual behaviour

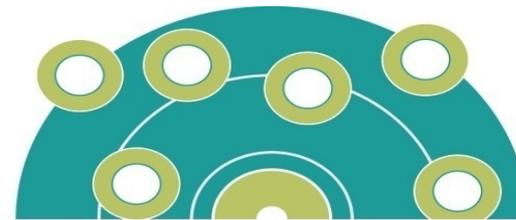


# City-scale planning for future urban *spatial development*

Planning deficit for past 50 years



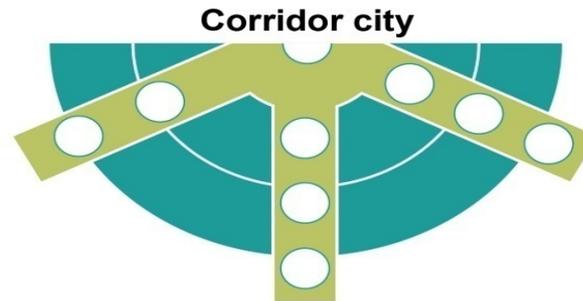
**Low density/  
dispersed city**



**Multi-centered city**



**Compact city**



**Corridor city**

← Urban form + landuse-transport integration + higher density housing MATTERS for energy use and CO2 emissions

Percentage improvement in CO<sub>2</sub> emissions compared to 'Low Density/Dispersed City' scenario.

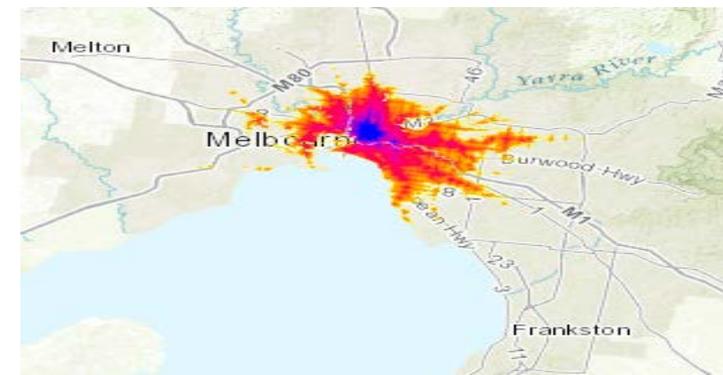
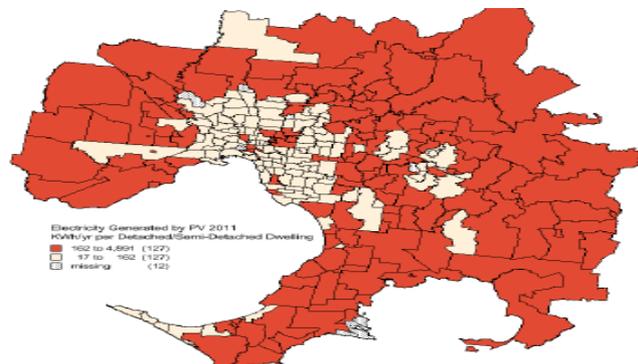
Future scenario related to urban form	Reduced CO <sub>2</sub> emissions from transport (%)
Compact city	31.5
Multi-centred city	21.7
Corridor city	15.5

← **Compact city policy (+ infill strategy)** delivers best outcome for carbon mitigation

Source: Newton (1997, p. 114); application of CSIRO LUTE model

# City Scale ‘envelope’– where to intervene: Decarbonising *urban fabrics* with low carbon housing and transport solutions

Built Environment Fabric	Suburban	<ul style="list-style-type: none"> <li>• <b>Renewable energy technologies for individual buildings, e.g. solar PV</b></li> <li>• Precinct scale technologies</li> </ul>	<ul style="list-style-type: none"> <li>• EVs, hybrid, hydrogen vehicles and associated infrastructures</li> <li>• Active transport (walk, cycle)</li> <li>• Smart buses</li> <li>• New TODs (heavy, light rail)</li> <li>• Car sharing</li> <li>• AVs</li> </ul>
	Urban	<ul style="list-style-type: none"> <li>• Precinct scale low emission energy technologies, e.g., co-generation; tri-generation</li> <li>• building skin-integrated solar PV fabrics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Public transit</b></li> <li>• <b>Active transport (walk, cycle)</b></li> <li>• EVs, hybrid, hydrogen vehicles and associated infrastructures</li> <li>• Car sharing</li> <li>• AVs</li> </ul>
		Housing	Transport
Low/Zero Carbon Technologies			



Source: Newton & Newman (2013)

# City Scale - How to Intervene ? : Retrofit and Regenerate + Where to intervene?: Brownfields and Greyfields

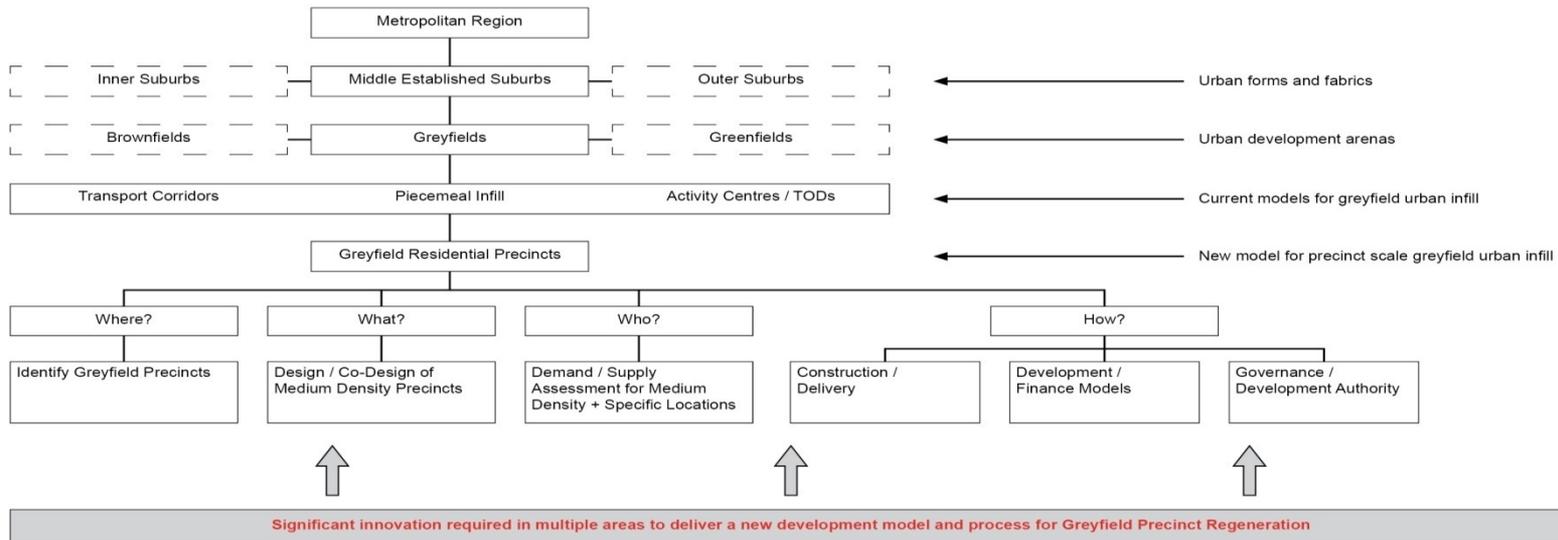
## Why Retrofit?

- Need to halt low density car dependent greenfields sprawl
- Housing infill targets of 60-85% for new dwelling construction → more compact cities
- Redirect population and urban investment inwards + upwards rather than outwards
- Inject new eco-efficient housing and infrastructure + activate neighbourhoods

## Why Regenerate ? (vs. re-develop)

- Need to shrink ecological footprints of Australian cities
- Renew/restore ecosystem supports of cities
- Redress the socio-spatial disadvantage of outer suburbs/greenfield living

## Where to Intervene?



# Why Precincts?

Performance assessment of urban precinct design: a scoping study



Peter Newton, David Marchant, John Mitchell, Jim Plume, Seongwon Seo and Rob Roggema



**Precinct** regeneration (compared to KDR) offers the prospect for the (re-) *design* of more sustainable, resilient, low carbon neighbourhoods:

- **Housing** (greater yield, variety, affordability)
  - **Energy** (low/zero carbon; distributed generation & storage; community renewable energy)
  - **Water** (integrated stormwater/ rainwater/ greywater; water sensitive design)
  - **Waste** (optimise recycling of C&D waste; food composting)
  - **Mobility** and health (more walkable; fewer cars; car sharing)
  - **Green space** (maintain rather than lose; activate local streets)
  - **Neighbour contact** (new community spaces, shared gardens)
- ← **Informs National Carbon Offset Standard (Precincts)**
- ↓ **Meshes with emerging distributed infrastructures**

## NCOS Precincts

Scoping paper

Prepared for:  
Department of the Environment

Prepared by:  
Point Advisory Pty Ltd

Report Issued:  
18.04.2016

# + Precincts align with emerging distributed + regenerative technologies/services → REDUCE METABOLIC INPUTS & OUTPUTS

## RENEWABLE ENERGY

Rooftop solar PV + storage

Community renewable energy networks

## INTEGRATED WATER

Stormwater/rainwater/greywater capture & re-use (+ potable)

Water sensitive landscape design

## DIVERTING WASTE FROM LANDFILL

Recycling C&D waste

Composting food waste

## LOW/ZERO CARBON MOBILITY

Active transport

Car sharing (eg GoGet)

Automated electric vehicles

# Brownfield Precinct **Regeneration**: Fishermans Bend, Melbourne



## Government Strategic Planning Objectives

- 260ha site
- 40 year development
- 120,000+ population
- 60,000+ commercial jobs
- Multiple aspirational performance criteria...

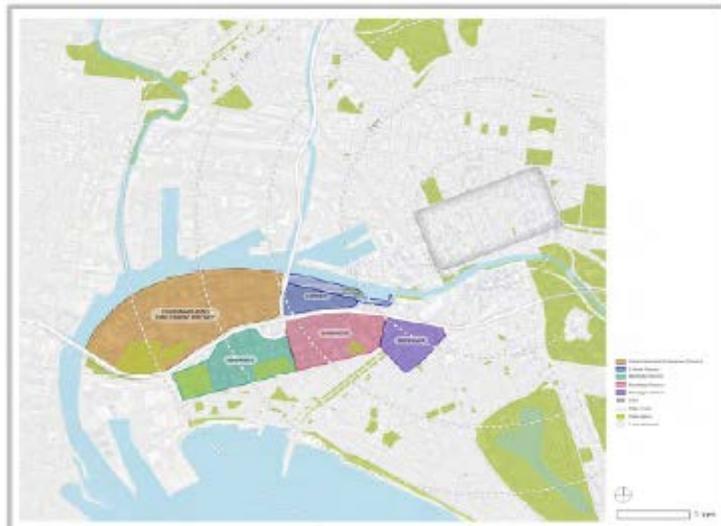
## IDEAS FOR FISHERMANS BEND

CRC for Water Sensitive Cities

Business Growth and Innovation  
Government of Victoria  
Business Growth and Innovation  
Quality Programme

LOW CARBON LIVING  
CRC

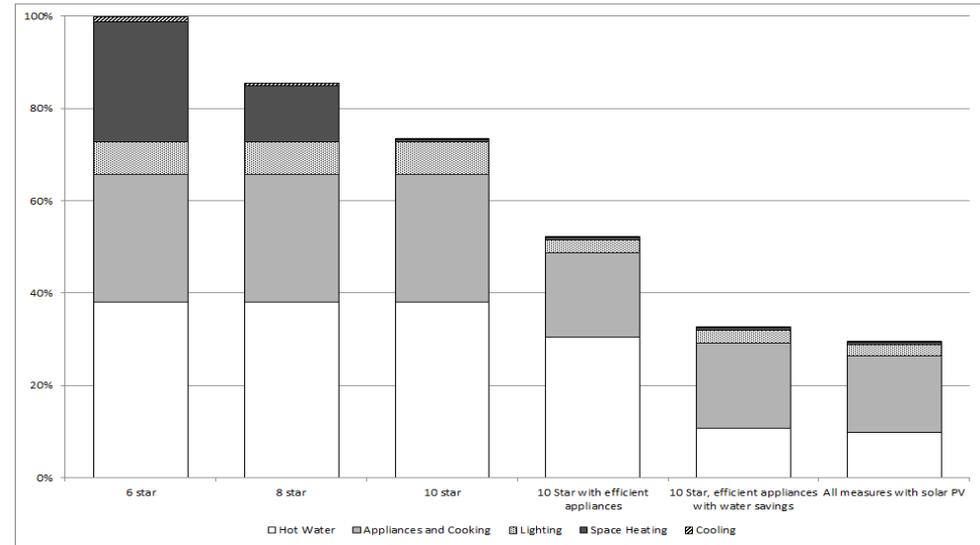
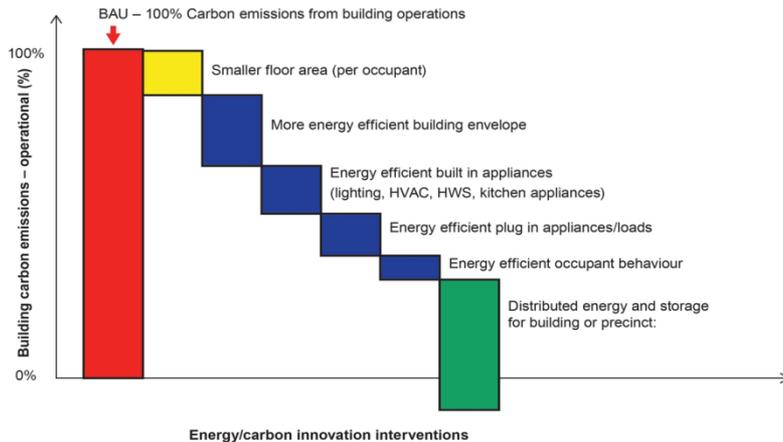
A Research Synthesis project involving experts from 2 CRCs over 3 months



- **Water sensitive** - minimising the import of potable water into; and export of wastewater, mitigating flood hazards and avoiding stormwater pollution of urban waterways;
- **Carbon negative** - generating electricity from renewable energy that is surplus to the requirements of building; and
- **Biophylic** - optimising the exposure of the community to natural elements e.g. vegetation, water features, natural ventilation and light.

# Fishermans Bend : Low Carbon Built Environment (CRC Low Carbon Living)

## Buildings



Building energy modelling identified opportunities for **70% reduction in operating energy** demand compared to BAU practices and regulations (10 star NatHERS, EE built-in & plug-in appliances, rooftop solar PV)

## Transport

Government Master Plan is proposing:

- 2 new heavy rail metro stations
- Light rail connections to existing CBD tram network
- **75% active/ public transport**: 25% walking, 20% cycling, 30% public transport, 25% car

# Fishermans Bend : Water Sensitive Design (CRC for Water Sensitive Cities)



## Streetscape:

- Blue + green corridors
- Green walls
- Vegetated podiums

**Potable water:** **62% reduction** in demand for imported potable water due to greywater harvesting and local treatment using 3<sup>rd</sup> pipe as a collection system

**Sewerage:** **70% reduction** in discharge to centralised treatment plant

**Microclimate:** **~ 2° centigrade mitigation** of urban heat island stress through irrigated green space and shaded urban environment

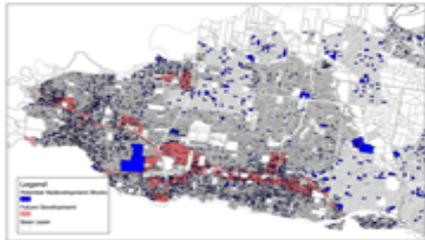
**Flood resilience:** determining appropriate land uses and locations for flood detention

# Precincts: Beyond Greenfields & Brownfields – the Challenge of Greyfield Regeneration

**Greyfields** are those established areas of cities that have built assets that are physically technologically and environmentally poor performing and where the asset value resides in the land (typically >70%) rather than the building. They represent under-performing assets, but are occupied – in contrast to the brownfields (Newton, 2010).



**Activity centres** and **transport corridors** are both **necessary but not sufficient** instruments for meeting infill targets and delivering more compact cities. They are not acting as the ‘twin magnets’ planning policy and zoning has articulated.



Most residential redevelopment can be expected to continue to occur **OUTSIDE** current designated development zones ... as **fragmented, sub-optimal ‘knock-down-rebuild’**



**WHY?** Currently there is **no operational model** for medium density residential **precinct** redevelopment/ Renewal/regeneration in the Greyfields [ in Neighbourhood and General Residential Zones]

# Urban infill: what's actually happening?

- **Current infill targets** for the major capitals:
  - Adelaide (2016) 85%
  - Melbourne (2015) 70%
  - Sydney (2010; subsequently omitted) 70%
  - SEQ (2016) 60%
  - Perth (2010, 2015) 47%
- Available evidence suggests all major cities are failing to meet their infill targets
- + Current pattern of **greyfield infill** failing to achieve strategic planning objectives

Development Arena	Net new residential construction, 2005-2014	
	Number of new dwellings (net)	Percentage change 2005-2014
Greenfield	142,819	47%
Brownfield (B'field)	78,714	26%
Total Greyfield (G'field)	82,312	27%
• Activity centres	10,120	12%
• Transport corridors	15,123	18%
• Ad hoc infill (KDR)	57,069	70%
Total Infill (B'field + G'field)	161,026	53%
<b>Total metropolitan area</b>	<b>303,845</b>	<b>100%</b>

Source: Newton & Glackin (2016)

# Urban infill: what's actually happening with new housing projects?

Residential infill yields of Projects, Melbourne, 2004-2010 (% total infill)								
	1	2-4	5-9	10-19	20-49	50-99	100+	Total
Brownfield	1.3	0.5	0.7	2.8	4.1	5.9	19.2	34.4
Greyfield	17.9	32.3	6.3	2.3	3.2	2.3	1.3	65.6
Totals (%)	19.2	32.8	7.0	5.1	7.3	8.2	20.5	100.0
(N)	21,947	37,614	8,029	5,833	8,309	9,374	23,487	114,593

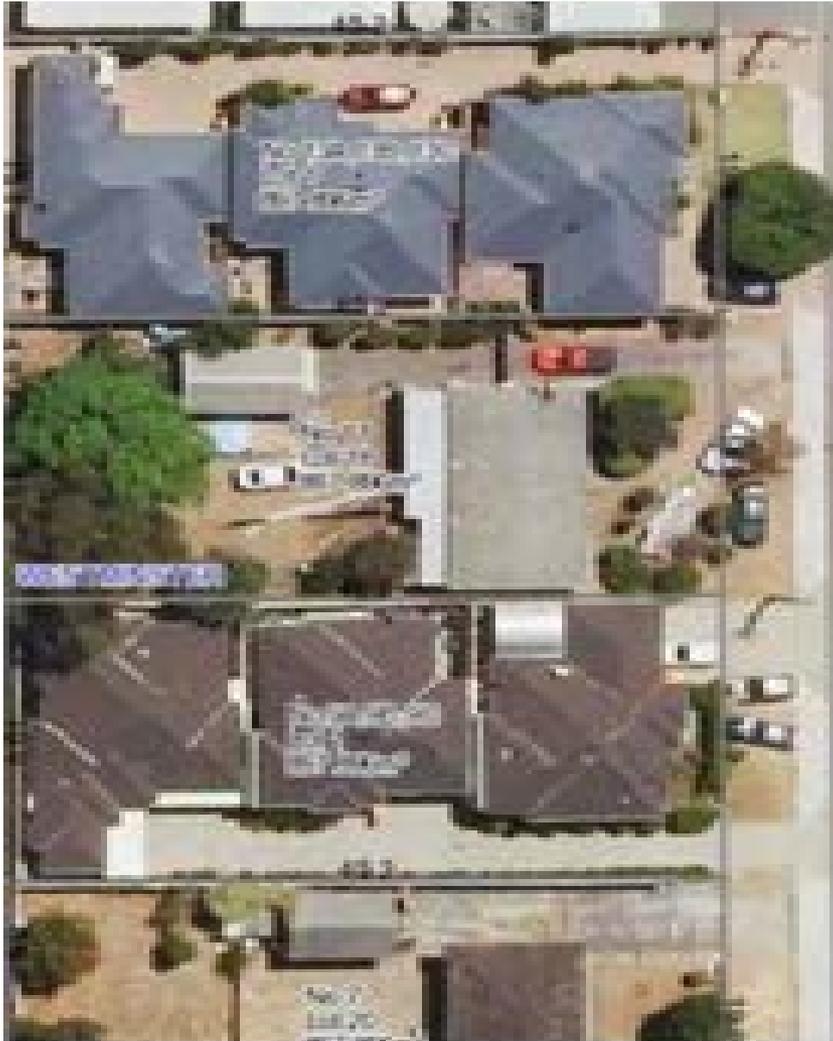
- Net new housing infill < 50% (Melb.)
- Brownfields attractive for high rise
- Most greyfield redevelopment = KDR (low yield: 1:1, 2-4:1)
- Public transport access not a magnet for attracting high levels of infill
- CBD is only activity centre with high infill
- Medium density precinct scale infill projects significantly under represented



↑ Medium density precinct scale infill projects significantly under represented: **the MISSING MIDDLE**



## Environmental Impact of Current Greyfield Infill (Knock Down Rebuild)



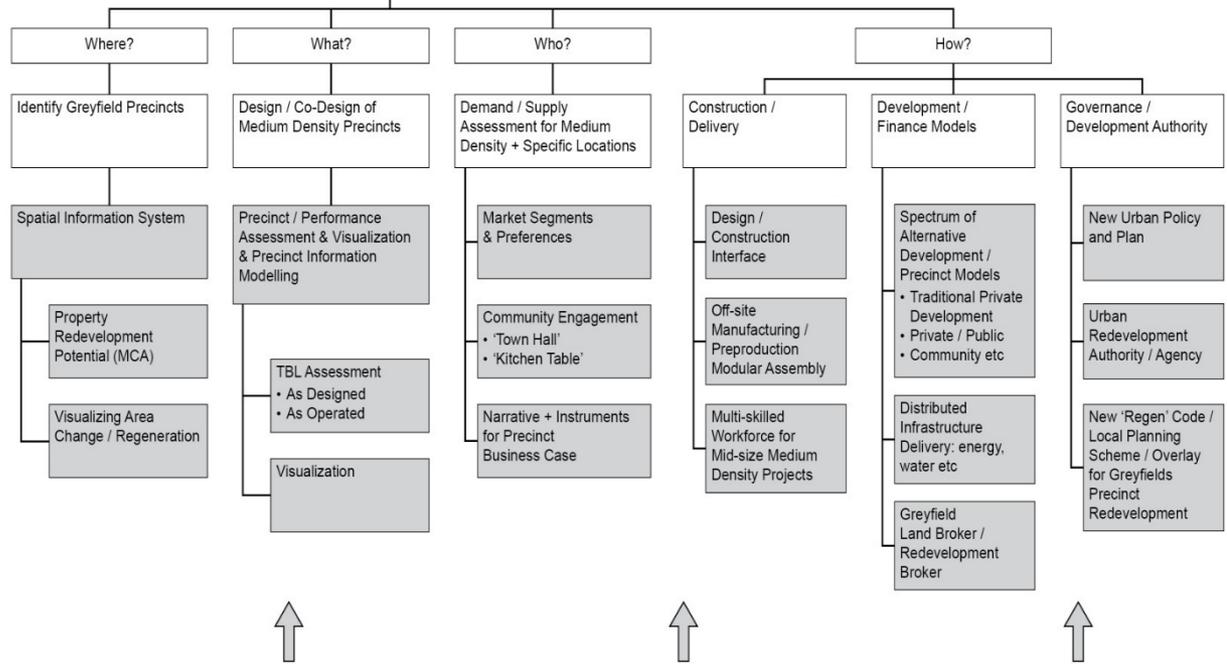
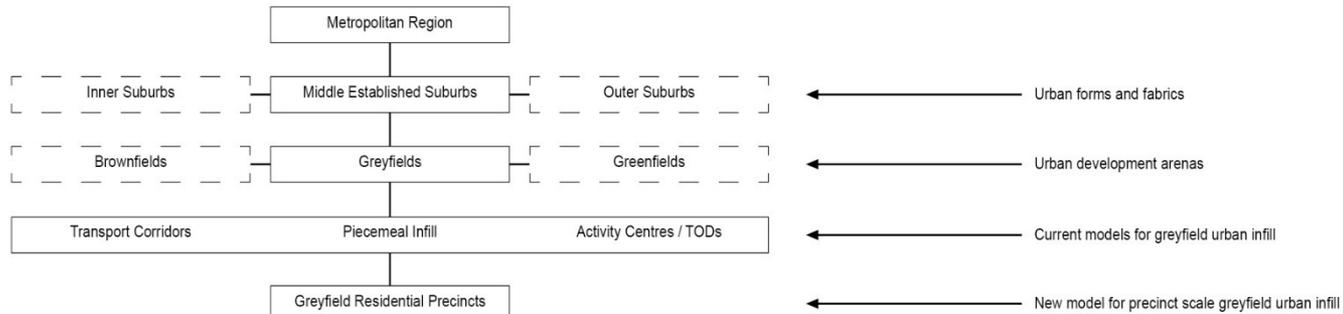
Piecemeal, single lot (K-D-R) residential redevelopment is **significantly reducing private open (green) space** – replaced with paved surfaces that continue to accommodate the private car.

Between **0.5 and 1.0 hectares/year/suburb are being lost** in middle ring residential areas of Melbourne (Witheridge, 2016; based on period 2004-2012 ).

### ENVIRONMENTAL IMPACTS:

- Greater stormwater runoff from increased impervious surfaces
  - local flooding
- Intensified urban heat island effects:
  - human health
  - increased electricity use/CO2 (aircon)
- Increased traffic densities, emissions

# Need for a new “Greyfield Precinct Regeneration” Model → multiple innovation arenas



Significant innovation required in multiple areas to deliver a new development model and process for Greyfield Precinct Regeneration



← R&D framework for *Greening the Greyfields* project (2011 →)

**Objective:** convince state and local government planning agencies that there was a *feasible model* for Greyfield Precinct Renewal

# Where? Locating precincts with high redevelopment potential

GreeningTheGreyfields

Introduction | Planning / MCE tool | Market / Redevelopment Tool | Zoning / Capacity Tool | Housing Typology / Design Tool | Econo

This section allows users to select which primary indicators they would like to query and to what level. It also allows users to make the query AND (ie refining a selection) or OR which adds more variables to the query.

Primary Indicators

Age of dwelling $\geq$ <input checked="" type="checkbox"/> <input type="range" value="40"/> 40	RPI $\geq$ <input checked="" type="checkbox"/> <input type="range" value="0.8"/> 0.8
Age of dwelling $\leq$ <input checked="" type="checkbox"/> <input type="range" value="70"/> 70	Relative Density $\leq$ <input type="checkbox"/> <input type="range" value="1.0"/> 1.0
Zoning (WA) $\geq$ <input type="checkbox"/> <input type="range" value="0"/> 0	Nearby demolitions $\geq$ <input checked="" type="checkbox"/> <input type="range" value="9"/> 9
Net increase $\geq$ <input checked="" type="checkbox"/> <input type="range" value="9"/> 9	Area (sqm) $>$ <input type="checkbox"/> <input type="range" value="0"/> 0
Frontage (m) $>$ <input type="checkbox"/> <input type="range" value="15"/> 15	Dev't efficiency $<$ <input type="checkbox"/> <input type="range" value="0.0"/> 0.0
Rel. extra land index $>$ <input type="checkbox"/> <input type="range" value="1.0"/> 1.0	Slope $\leq$ <input checked="" type="checkbox"/> <input type="range" value="1"/> 1
Extra land $>$ <input type="checkbox"/> <input type="range" value="0"/> 0	

LGA owned  Vacant land  Non-Sensitive  Non-heritage  Non-strata  Serviced

Summary

Property count:	553
Total area (ha):	40
Dwelling count:	533
Dwelling capacity:	0
Achieved density:	13

Current Query

```
INSERT INTO susip.susip_manningham_results SELECT * FROM
susip.susip_manningham WHERE residentia = 1 AND rpi  $\geq$  0.8 AND vacant = 0
AND yearbuilt  $\leq$  1972 AND vacant = 0 AND yearbuilt  $\geq$  1942 AND recentdemo
 $\geq$  9 AND netinc  $\geq$  9 AND slope  $\leq$  1 AND heritage = 0 AND sensitive = 0
AND strata = 0
```

Show map



↑  
Multi-criteria spatial analytics tool  
[ENVISION]

- ↑
- Locates parcels where land value  $>70\%$  total property value
  - Further highlights areas close to schools, transport, shops etc where higher densities can be encouraged/ accommodated/ planned for by local government

# What? Designing regenerative and affordable medium density housing that is acceptable to local communities



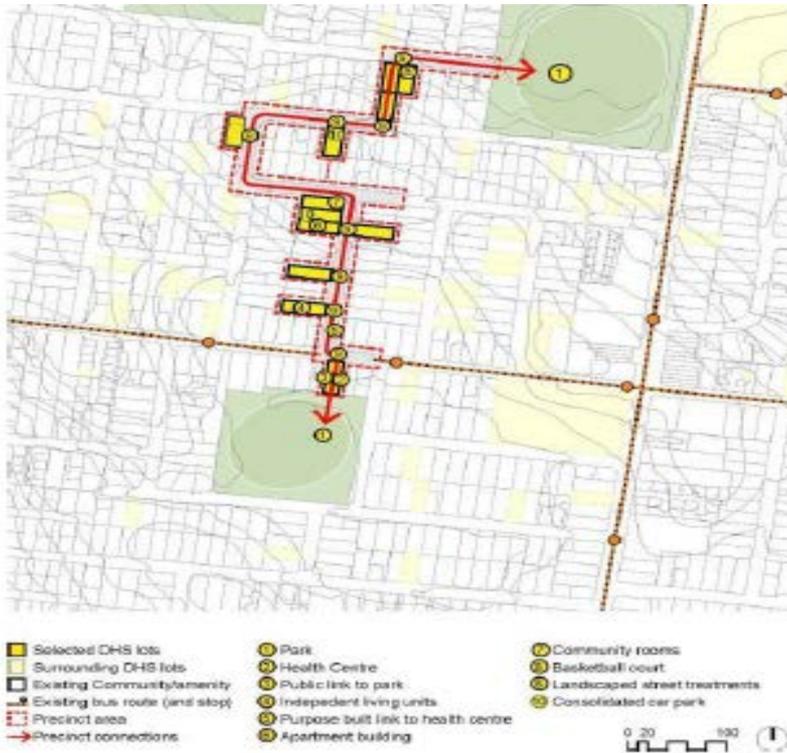
## Required design principles:

- Zero carbon/carbon negative
- Green space; water gardens
- Minimise allocation of space to cars/parking
- Water sensitive design; rainwater harvesting
- Walkable density
- Smaller floor areas/smarter layout
- Modular construction
- Activate immediate streetscape for pedestrians and play

Image sources:  
Monash Architecture/  
Architectus

←↑ **Objective:**  
**Enhancing the character & liveability of established localities as they transition from suburban to urban**

# How? Greyfield public housing stock as catalyst for neighbourhood regeneration



Multiple benefits deriving from precinct scale regeneration of public housing:

- Area uplift; increased yield through mid rise medium density; increased quality of public realm open space, amenity, increased safety, connectivity, walkability

# How? Demonstrate to government planning agencies that there is a viable new model/process for greyfield precinct regeneration capable of community support



Greyfield renewal

## OPTIONS FOR DISCUSSION

41 Introduce a policy statement in Plan Melbourne 2016 supporting greyfield renewal and investigate planning scheme mechanisms to achieve coordinated and sustainable renewal of established suburbs.

- ← Demonstrate the **additionality** of benefits capable of flowing from precinct scale regeneration compared with BAU knock-down-rebuild [**precinct assessment tools**]:
  - Higher dwelling yield + variety PLUS
  - Zero carbon
  - Water sensitive
  - Added green 'infrastructure'/ cooling, more walkable
  - Some mixed use
  - Precinct composting of food scraps.....etc

← New government planning instruments (eg. greyfield precinct **overlay**) capable of encouraging this class of urban Redevelopment [*Plan Melbourne Refresh*]

# Who? Can citizen-led land amalgamation become a springboard for precinct-scale regeneration in established greyfield suburbs?



Small text caption for the excavator image.

## THE AUSTRALIAN BUSINESS REVIEW

Neighbourhoods are joining forces to sell their homes together, an approach that is yielding tens of millions of dollars in profit.

A group of six home owners on Wallington Road in Rowville in Melbourne's outer east have approached agents at Jones Lang LaSalle to market their properties as one.

The blocks, which range from 2500 to 6000 square metres and combined span 2.22 hectares, are advertised as "a prime infill development site" ideal for a residential project and other redevelopment opportunities.

Agents Joshua Tebb and Peter Spinks are expecting more than \$16.5 million for the parcel, which has the capacity for between 40 and 60 lots in which to build a mix of houses and townhouses.

They said interest so far had been from residential developers and aged care and retirement villages.

### Residents in \$30m bonanza

### The Sydney Morning Herald BusinessDay

AN extended family in Sunbury are on the brink of becoming multi-millionaires by cashing in on a large tract of land they have owned for 30 years.

The family firm, made up of 10 blocks stretching across more than 1000 in along Brookland Way, was bought for just \$300,000 but is now a prime housing development site with a \$70 million price tag.



Demand for apartments is good news for some homebuyers. Source: News Corp Australia

**POCKETING \$3 million** from the sale of an old brick bungalow at Lane Cove in Sydney's lower north shore should put a smile on the face of any resident, given the price is more than double the suburb's median \$1.4m value.

Seven residents in two Lane Cove streets banded together to sell their homes to a developer for a combined price of at least \$6m, having been paid about \$400 a square metre for their property — regardless of whether their home was a dilapidated wreck or a contemporary triple-story mansion.



Four residents bring together their own cash to set up an entity to buy the properties in a row to attract higher price and better time to develop.

**HILLS residents are selling their homes together to maximise the potential profit in Sydney's booming real estate market.**

Agents say being friendly with your neighbours could triple the value of your property in suburbs need for redevelopment.

It follows a record \$25.5 million sale last December of five houses in Garthwood Cove, Castle Hill just a street away from the North West Rail Link.

### Finance Residents band together for multi-million dollar deal

Twenty home owners in Sydney's north are selling up in a single sale in the hope of securing a multi-million dollar deal with a property developer.

The agreement, made between residents of three streets in the Castle Hill area, has been described by a local real estate agent as "a godsend", *Domain* reports.

### FINANCIAL REVIEW



It is every homeowner's dream. A group of eight residents in Sydney's Epping had their homes undervalued at about \$1.2 million in early 2012. This week they netted more than three times that amount when their homes sold in one lot for a price believed to be higher than \$30 million.

**How to double the price you - and your neighbours - get for your house**

### The Daily Telegraph Residents v developers: Castle Hill home owners band together to triple money by selling whole street

Residents v developers: Castle Hill home owners band together to triple money by selling whole street

By Glenn Durrant



### Residents band together to cut 'exceptional' deals

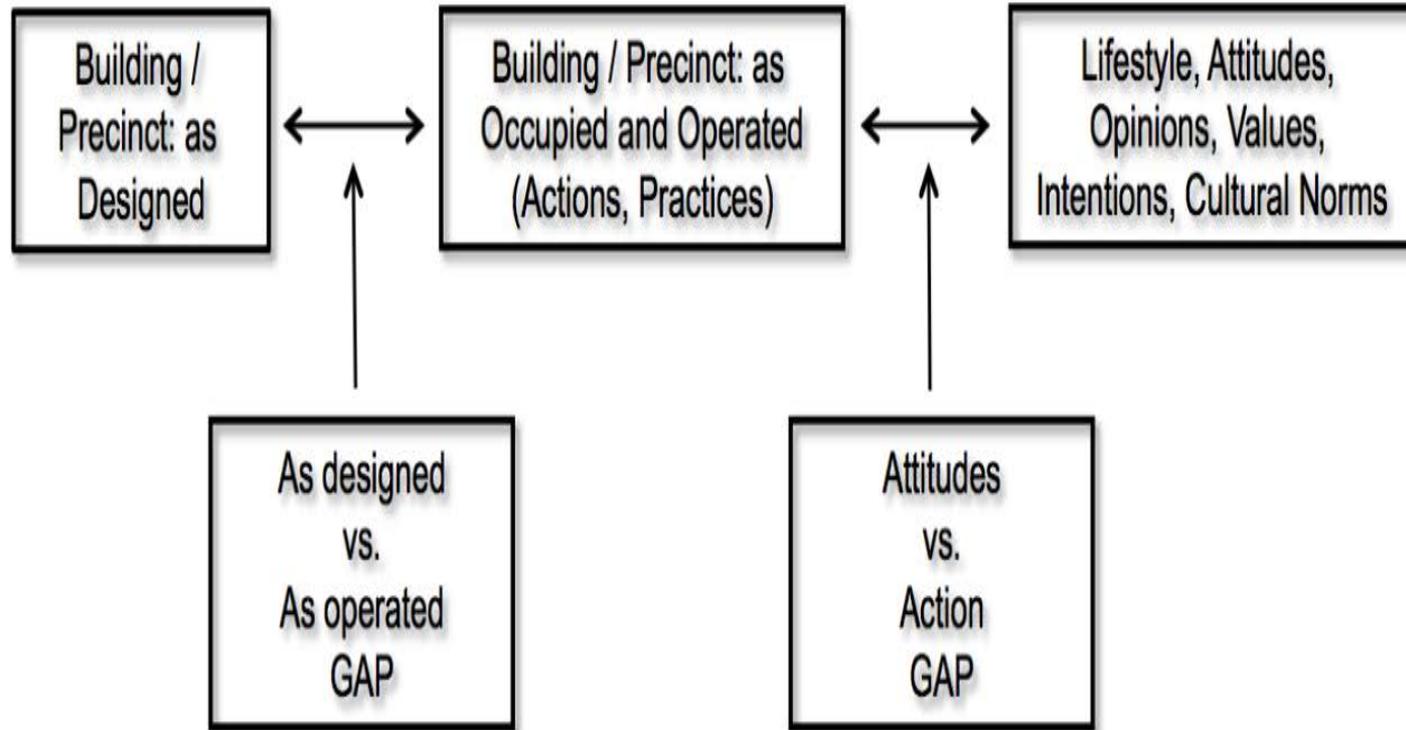
**Herald Sun Bentleigh trio sell their properties together as one and strike it rich**

### Family will become instant multi-millionaires in Sunbury property deal

- Site consolidation between neighbours can deliver 50+% greater return than individual sales
- Growing number of examples of neighbours beginning to capitalise on this by selling their properties together
- Local Government 'town hall' / 'municipal festival' community engagements on future change directions [link with strategic Metropolitan Plan for city]
- Need for new planning instruments [eg. Greyfield Precinct Renewal 'overlay'] and tax instruments to help accelerate this process
- Opportunity for qualified, trusted brokers: 'kitchen table' engagement; co-design/development options

# Who Us? ..... Can urban residents act sustainably ???

- Building designs more energy/carbon efficient →
- Pathways to zero carbon buildings established [OE] (Newton & Tucker 2011)
- Need to focus on embodied energy [EE] (Newton et al 2009, 2012)
- Need to close 'as built/ as designed' gap (Newton & Meyer 2016)



# Attitude/Intention-based Environmental Lifestyles ('Segments') vs. Actual Consumption of Urban Resources

## “COMMITTED” GREENS

- Prepared to pay more tax/higher charges if the environment benefits
- Environment should be highest priority even if it hurts economy
- Pro green choice behaviour (labelling, no plastic bags, volunteer time to projects)

## “MATERIAL” GREENS

- Vehemently opposed to paying more taxes, utility charges
- Moderate support for environment; but expense probably not worth benefits
- Pro green choice except for volunteering time

## ENVIRO-SCEPTICS

- Reconciled to paying more
- High percentage see environmental crisis as exaggerated; its not their responsibility; no regulation forcing them to change
- Little involvement in pro-green choice activities

Predominantly inner city residents

High % university graduates

Higher income

Younger

Higher % couples with no children and living alone

Predominantly outer suburban

Low % university graduates

Lower incomes

Younger

Family with children

Dispersed locations

Average % university graduates

Lower incomes

Older

Higher % couples with no children and living alone

**NO STATISTICAL DIFFERENCE BETWEEN LIFESTYLE GROUPS  
IN TERMS OF ACTUAL PER CAPITA CONSUMPTION**

## Attitude – Action Dissonance

Per capita consumption measure	Lifestyle cluster means		
	“Committed” greens ~33%	“Material” greens ~40%	“Enviro-sceptics” ~26%
Water (\$)	58.7	55.0	55.1
Energy (\$)	123.4	123.9	137.5
Appliances (number)	4.82	4.78	4.95
Carbon intensity of travel score	17.0	19.4	17.8
Housing space (m <sup>2</sup> )	97.2	91.6	101.3

In conclusion.....

My proposition for a sustainability transition in 21<sup>st</sup> century high income urban societies:

***“ NO SUSTAINABLE LOW CARBON LIVING***

***WITHOUT A SUSTAINABLE, LOW CARBON***

***BUILT ENVIRONMENT”***

..... **THE CONTEXT FOR OUR BEHAVIOUR & SOCIAL PRACTICES**

# THANK YOU.....and Acknowledgements

