UNIVERSITY OF TECHNOLOGY SYDNEY

INSTITUTE FOR SUSTAINABLE FUTURES

Urban infrastructure for long-term climate change response

THINK.
CHANGE.
DO

Blueprints for Sustainable Infrastructure: NZSSES Conference

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Institute for Sustainable Futures

Urban infrastructure for long-term climate change response

Introduction

"The debate on climate change has shifted dramatically over the past five years. The strong evidence presented by the scientific community through the Intergovernmental Panel on Climate Change (IPCC) process has largely settled the discussion about whether the world needs to respond. The question now is what shape such a response should take" (Beinhocker et al 2008)

Beinhocker, E., Oppenheim, J., Irons, B., Lahti, M., Farrell, D., Nyquist, S., et al. (2008). *The carbon productivity challenge: Curbing climate change and sustaining economic growth*: McKinsey Global Institute.

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Introduction

- To reduce the risk of dangerous climate change, developed countries need to
  - Reduce GHG emissions to 25-40% below 1990 levels by 2020
  - And to 80-95% below 1990 levels by 2050 to allow some room for growth in emissions from developing countries (Gupta et al., 2007)
- A transformation on the scale of the Industrial Revolution but in one third of the time (Beinhocker et al 2008)
- Intelligent design of urban infrastructure can make a huge contribution

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Introduction

- Least cost pathway to achieving deep cuts is to gradually accelerate pace of reduction over the next four decades
- Long-lived urban infrastructure will need to be retrofitted at some point before 2050 to achieve deep cuts
- Alarming signs that climate change is accelerating and emission reductions may need to be achieved even more rapidly than is currently thought
- How should we balance upfront emission reductions with the flexibility and adaptability to achieve deeper cuts in future?
- How do short-term and medium-term infrastructure options open up or foreclose long-term options?

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Emission reduction strategies: Energy conservation

- Energy conservation
  - Reduces demand for energy services, e.g. through changing patterns of consumption or reducing population
- Simple options
  - Turning lights off when not in use
  - Relatively easy to encourage through building design
- Challenging options, requiring cultural change
  - Voluntary simplicity
  - Building designers could seek to encourage cultural transformation, e.g. devote retail space to low-carbon products

Energy conservation does not foreclose other options for deeper cuts

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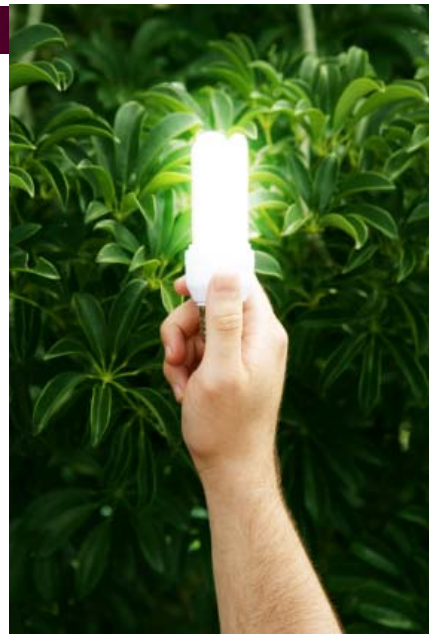
Emission reduction strategies: Energy efficiency



- Energy efficiency
  - Delivers the same energy services using less energy
- Avoid losses of energy during delivery
  - Distributed energy system
  - Potential to foreclose options depends on fuel
- Install efficient appliances and equipment
  - Typically replaced within a decade
  - Multiple opportunities to move to even more efficient options by 2050
- Passive building design
  - Buildings may be in place for 50-100 years
  - Attention to passive design now is critical
  - Building design will foreclose some retrofitting options

Energy efficiency leaves decarbonisation and sequestration options open

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Emission reduction strategies: Decarbonisation

- Decarbonisation of fuel sources
  - Reduce greenhouse intensity of energy used to provide energy services
- Shift to renewable energy
  - Consistent with long-term deep cuts
- Switching to natural gas, e.g. cogeneration
  - Only delivers 40-50% reduction in emissions, not deeper cuts
  - However, can contribute to deeper cuts
    - As a limited contributor (e.g. 20%) alongside energy efficiency and renewable energy
    - As a transitional measure, to be replaced before 2050
      - Beyond about 2015, this will mean early replacement
    - By designing to allow future retrofitting with lower carbon fuels

We need to start considering transition strategies for urban infrastructure

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Emission reduction strategies: Sequestration

- Sequestration of emissions
  - e.g. carbon capture and storage at power stations or uptake of carbon by forest plantations
- Not feasible in urban areas but can be used to offset emissions

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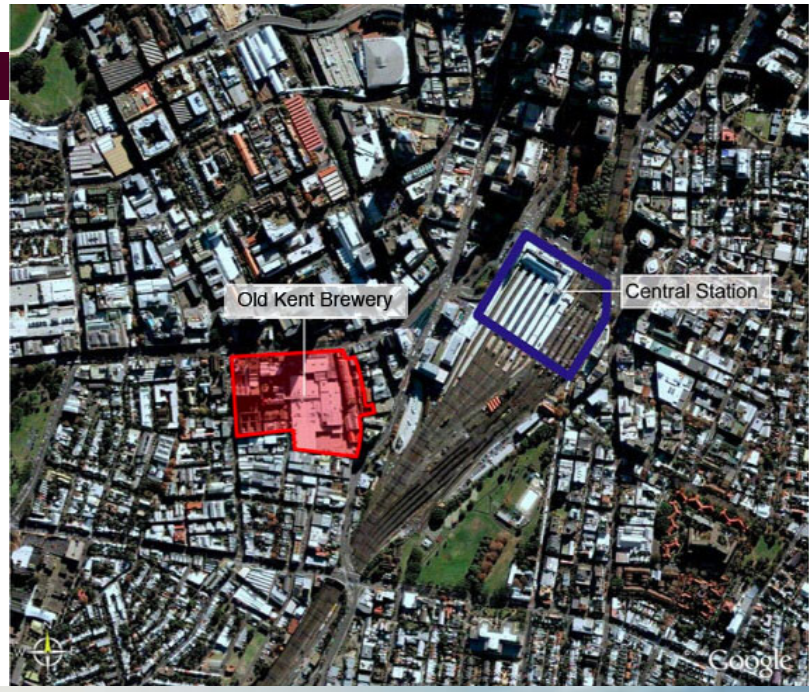
Case study: Frasers Broadway



- 6 ha former brewery site on western edge of Sydney CBD
- Mixed use development, seeking a 6 star Green Star rating at the precinct level
- Future-proofing has been discussed
- What mix of strategies are being pursued and are they consistent with deep cuts?

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Frasers Broadway: energy conservation

- Energy conservation
  - Automated lighting control
  - Smart metering and cost-reflective tariffs
    - Reduce peak demand
    - Some evidence of reductions in energy use
    - Smart meters in Australia must be able to interface with an in-home display, which opens up greenhouse abatement options

  - Interpretive signage, green leases, owner's manuals
    - May or may not focus on energy conservation
- No attempts at cultural transformation
  - Developers do not see this as their role

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Frasers Broadway: energy efficiency

- Strong focus on efficiency in building design
  - Ideal of having low buildings to north and increasing height to the south is not possible due to overshadowing of Chippendale
  - Non-ideal orientation will be locked in place for decades
  - Issue of solar access is one that city planners need to grapple with
- Specification of efficient appliances and equipment
  - LED lighting is emerging as the next efficient lighting technology
    - Ensure buildings are “LED-ready”?
    - Install some to gain experience?
- Reductions in motor vehicle use through provision of access to public transport, cycling networks and car sharing
  - Specific consideration of future conversion of car spaces
  - Design of shared basements to facilitate this

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Frasers Broadway: decarbonisation

- On-site, natural gas trigeneration facility
  - Would be due for retirement between 2035-2045
  - Need to plan for replacement with lower carbon option
    - Upgrade to use lower carbon fuel, e.g. Hydrogen
      - Relatively straightforward once space is set aside
    - Retirement and grid connection
      - At what point will grid deliver lower greenhouse intensity than on-site trigeneration?
      - If sooner than retirement date, then continued operation of trigeneration would become an inhibitor of deep cuts
- Some investment in on-site renewables
  - Photovoltaics
  - Organic waste to biogas

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Frasers Broadway: decarbonisation

- Is investment in transitional options the best use of societal resources?
  - Natural gas is more cost-effective at present but its potential to deliver deep cuts is limited
  - Natural gas is a finite resource
  - Prices are rising and cost advantage may be eroded
- Are we just putting off the inevitable transition to renewable energy?
- While on-site renewable energy options are limited, Frasers could invest in off-site renewables and assign the greenhouse abatement to the development at a cost that is comparable to on-site trigeneration.

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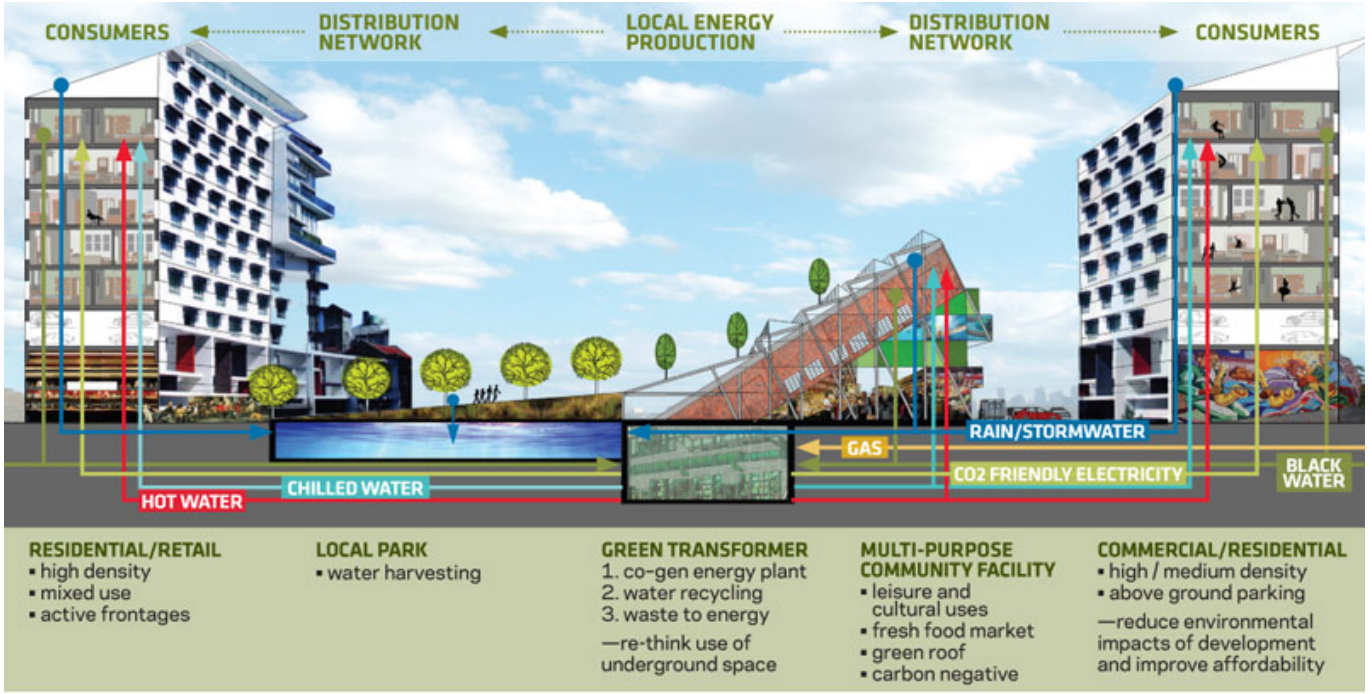
Case study: Sustainable Sydney 2030 – Green Transformers

- Vision for 330MW of trigeneration in Sydney by 2030
- Low-carbon energy
- Rainwater harvesting
- Recycled water
- Waste to energy
- 20% reduction in BAU emissions by 2030



Is there a risk that the carbon footprint of the Green Transformers will hinder deeper cuts beyond 2030?

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Green Transformers

- Network of supporting infrastructure
  - Hot and chilled water pipes
  - Natural gas infrastructure
  - Longer lifetime than Green Transformers themselves
  - Will this infrastructure meet the needs of future low carbon technologies?
- Assuming future retrofitting of hydrogen fuel cells or solar thermal, natural gas pipes could become obsolete or require retrofitting to carry hydrogen

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Conclusion: long-term design principles

- Prioritise strategies that do not foreclose future emission reduction options, including energy conservation, energy efficiency and renewable energy
- When a particular technology is selected for a development, consider the technology that is likely to replace it in the future and how the design might be revised to ease this replacement
- Understand new urban infrastructure as an opportunity to develop experience and familiarity with technologies that have the potential to deliver long-term deep cuts in GHG emissions, even if this results in lower short-term cuts
- Develop a deeper understanding of viable pathways to a low carbon future as a framework for assessing the contribution of alternative infrastructure options
- Revise urban planning strategies to maximise solar access and to consider future uses of supporting infrastructure
- It is better to begin investment in development of a long-term response to climate change than to spend money on a transitional response that will become obsolete