

three

The Tale of ~~Two~~ Cities

**Decarbonising Auckland and Sydney (but not Christchurch)
and Consequences for Other Cities Around the World.**

Hugh Byrd

The Challenges for Cities

1. Cities have grown because of increases in population and due to agglomeration
2. Cities have been able to grow because of an abundance of energy:
 - food energy,
 - electricity,
 - fuel for transport,
 - embodied energy in materials
3. Cities are now reaching their limits to growth because of:
 - Economic depletion of finite resources (oil and minerals)
 - Climate change (food, water and renewable energy).

Towards Resilience of Cities

- 1) Business-as usual model cannot be sustained
- 2) Low or zero carbon resources for energy
- 3) Decentralised energy
- 4) Robust infrastructure (climate change, earthquakes)

This means looking at each city individually and assessing its needs and resources “**evidence-based**”:

- Climate: cooling, heating, flooding
- Resources: renewables, minerals
- Infrastructure: energy distribution
- Transport: public, private

This requires

- a) a change in behaviour (governance & personal)
- b) using emerging technologies to become more efficient with our resources.

Sydney

- Electricity produced by coal
- Cooling load in the Central Business district
- Good public transport
- Renewables: solar energy

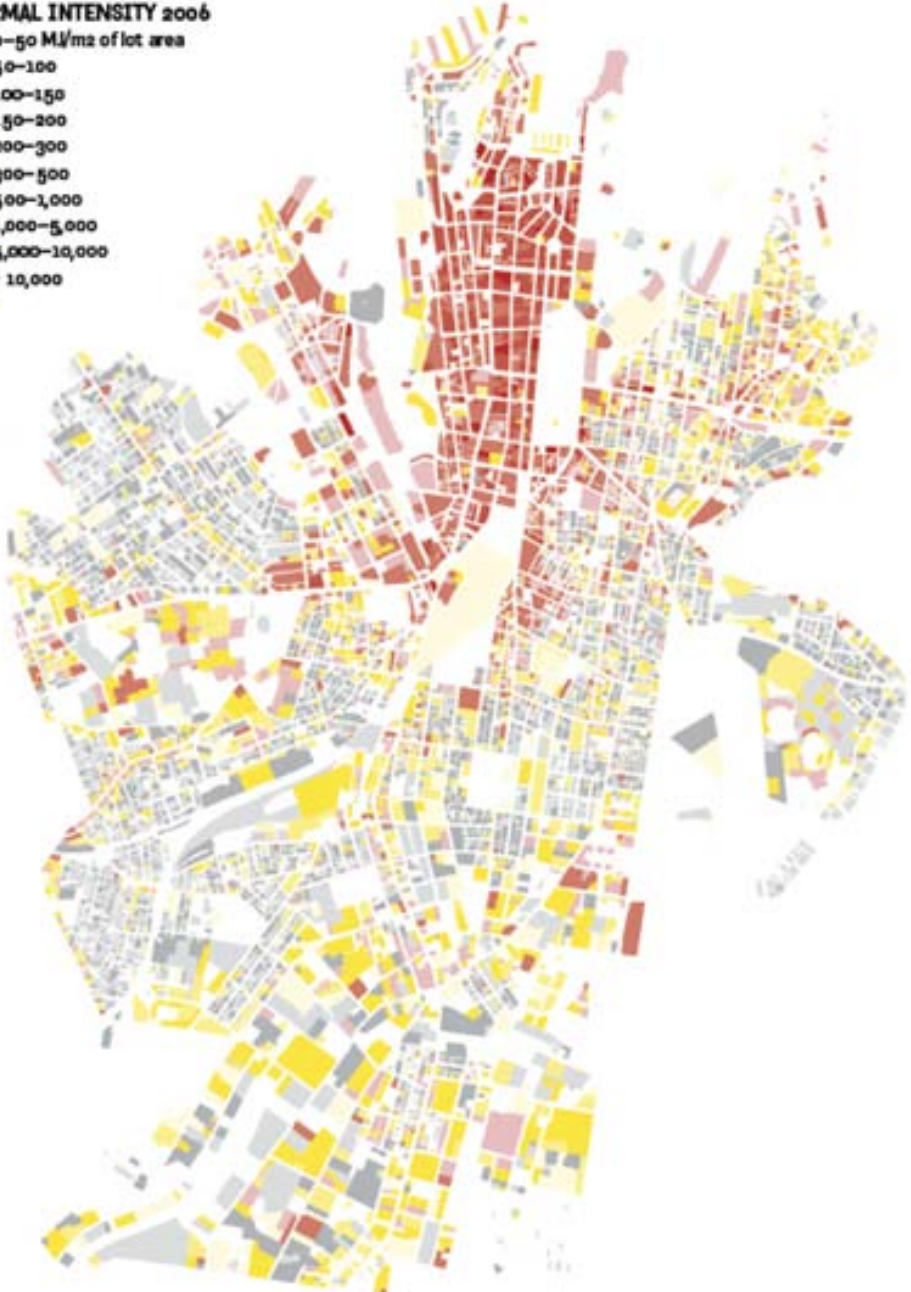
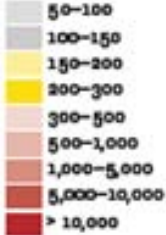


THERMAL ENERGY DEMAND

Heating, cooling & hot water

THERMAL INTENSITY 2006

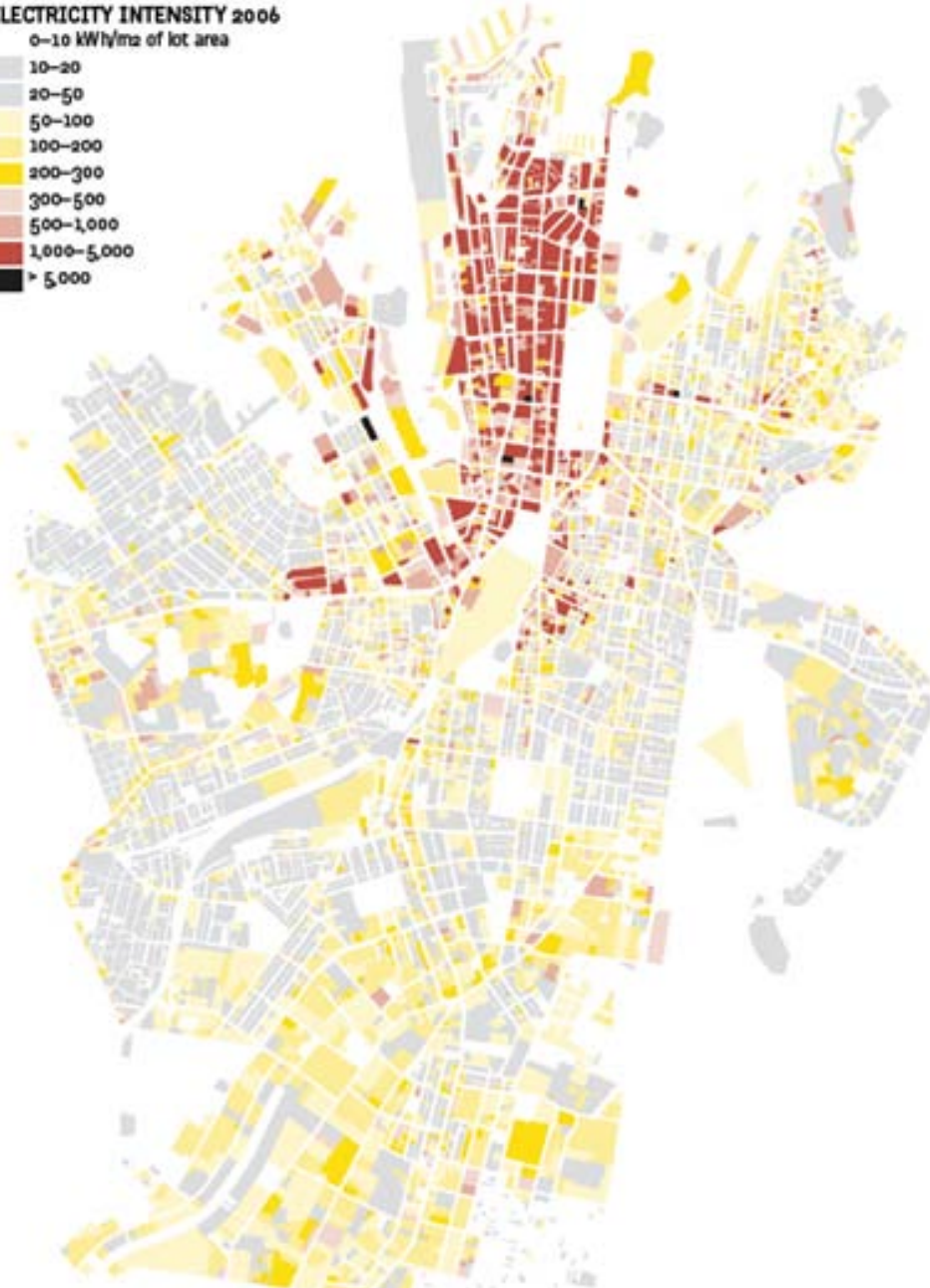
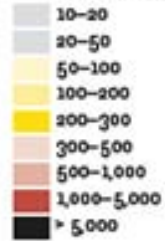
0-50 MJ/m² of lot area



ELECTRICITY CONSUMPTION

Total electricity consumption

ELECTRICITY INTENSITY 2006
0-10 kWh/m² of lot area

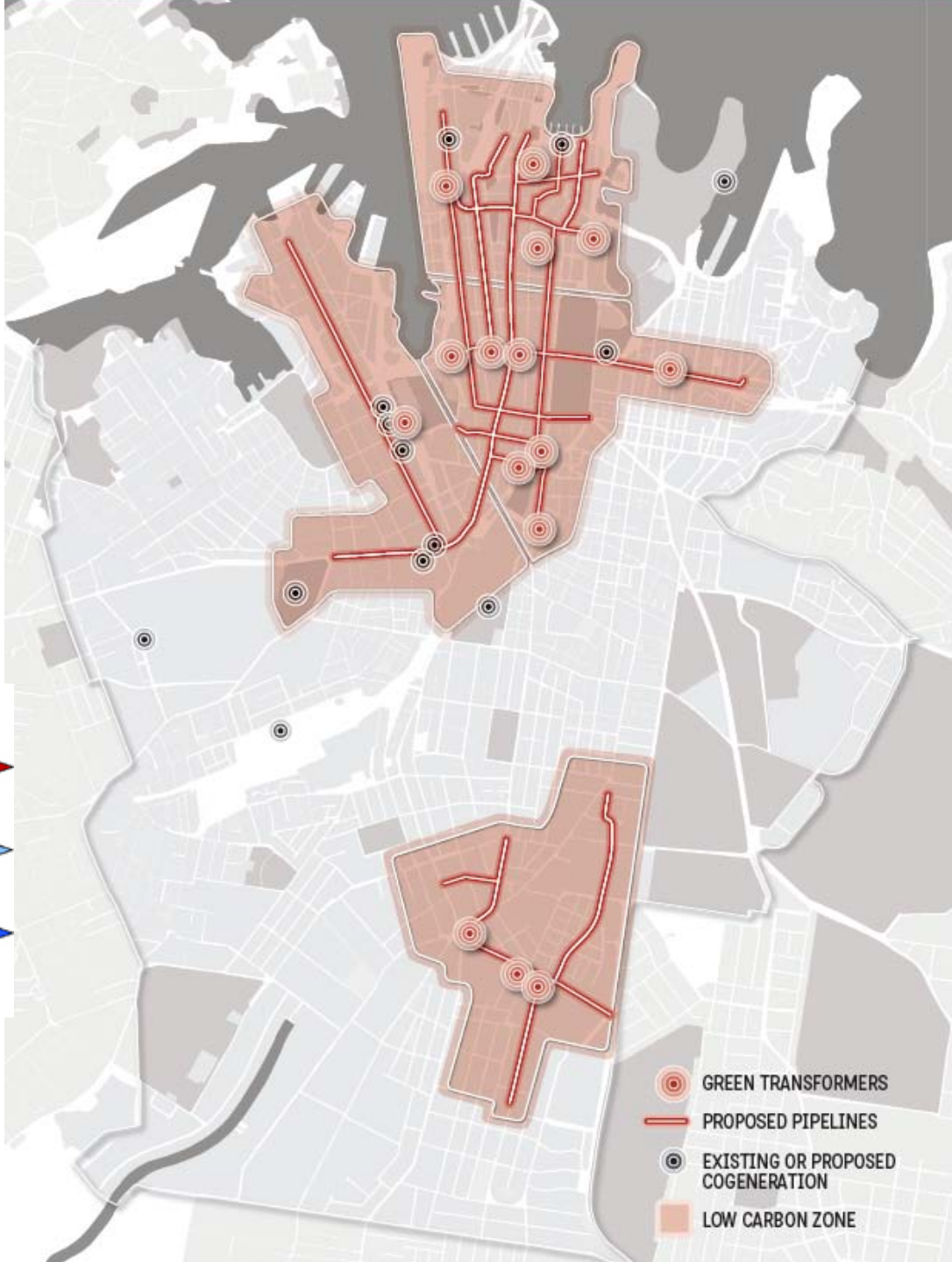
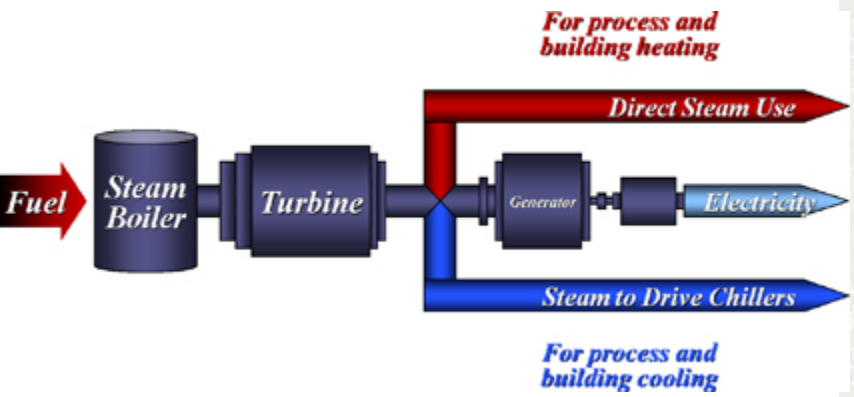


LOW CARBON ZONES

Policy:
Connected to Low Carbon Zone by 2030

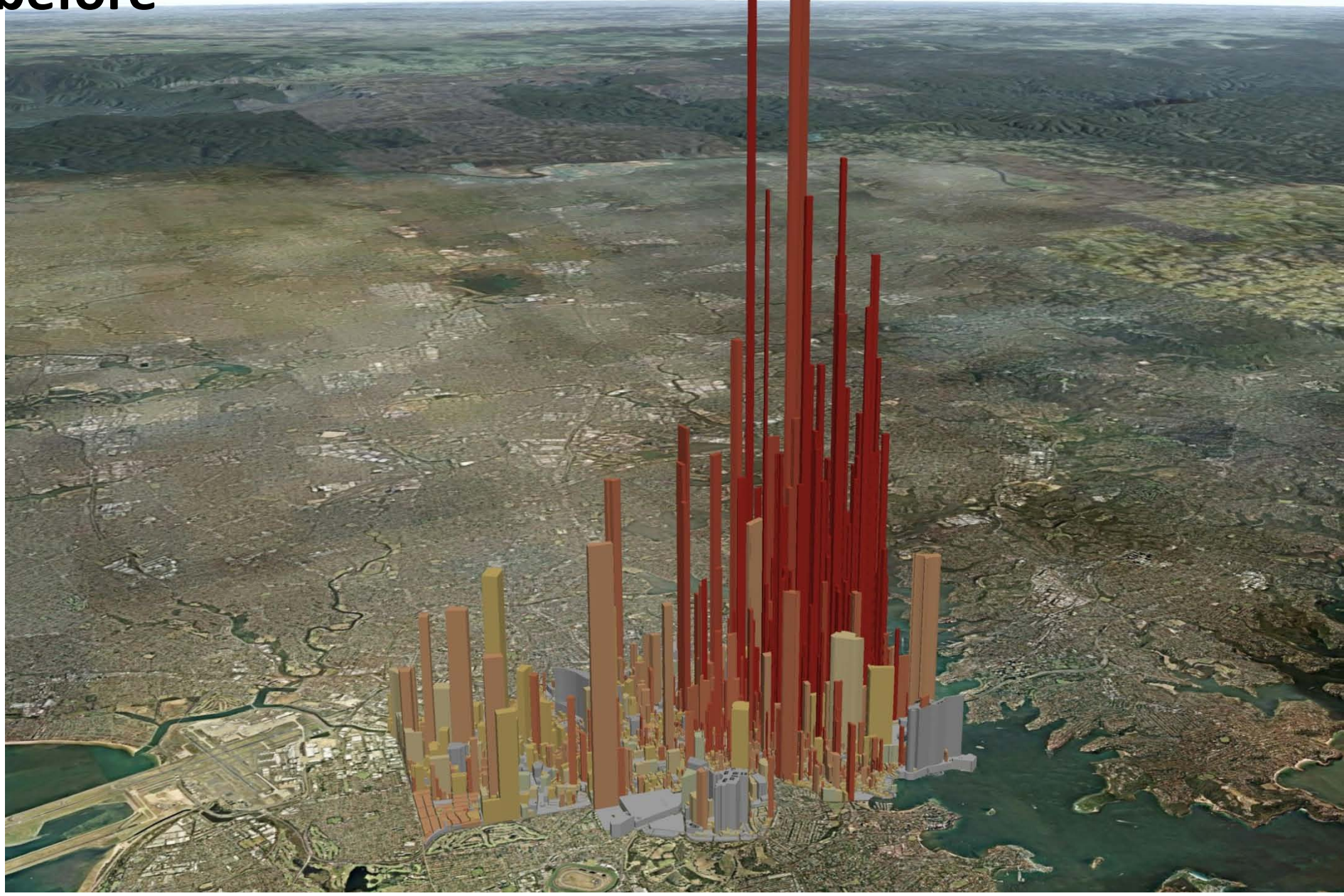
- 65% of commercial
- 50% of retail
- 30% of residential

Tri-generation fuelled by natural gas

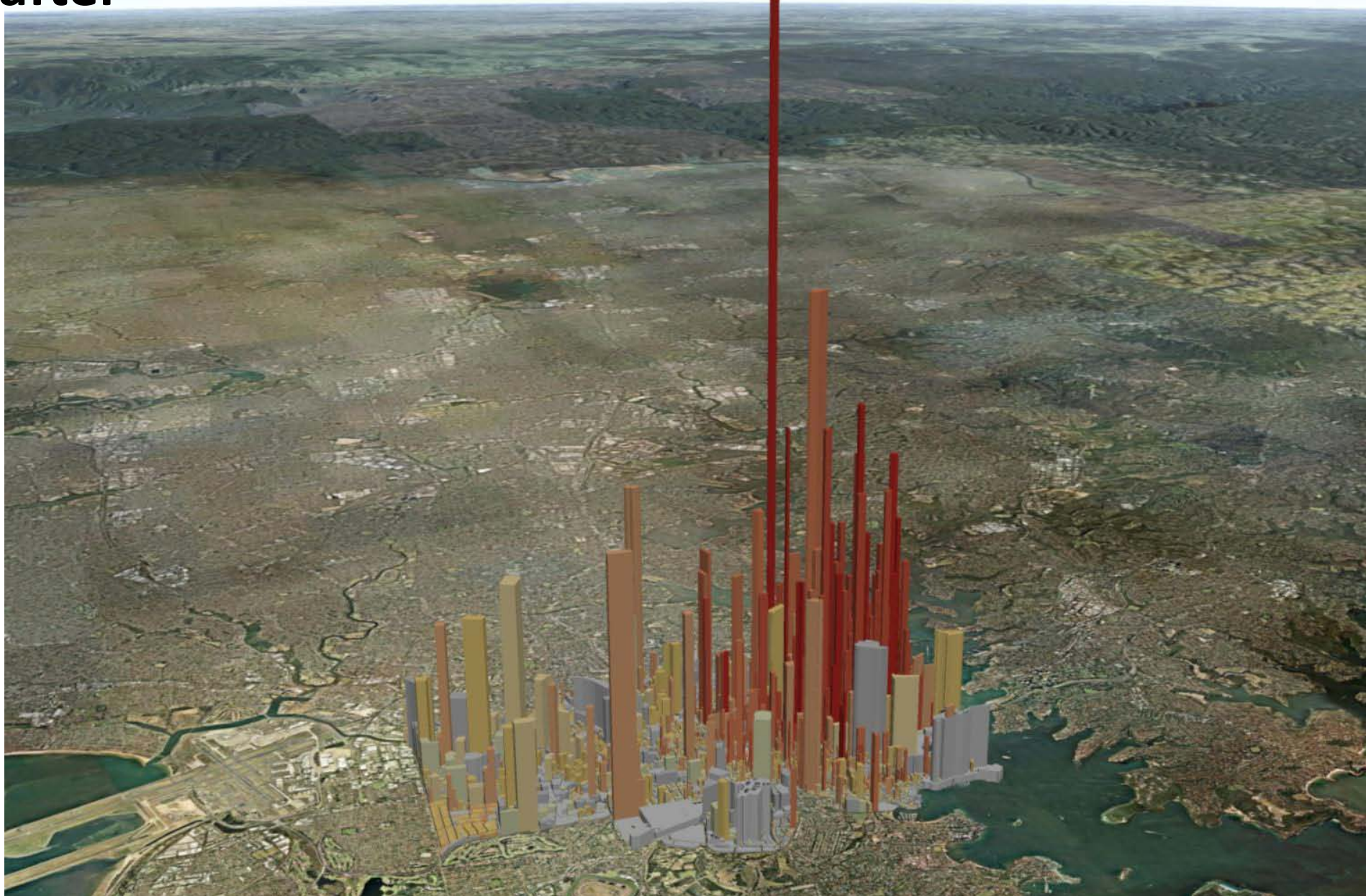


GREENHOUSE GAS EMISSIONS

before



GREENHOUSE GAS EMISSIONS after



Auckland

Electricity: 75% renewable

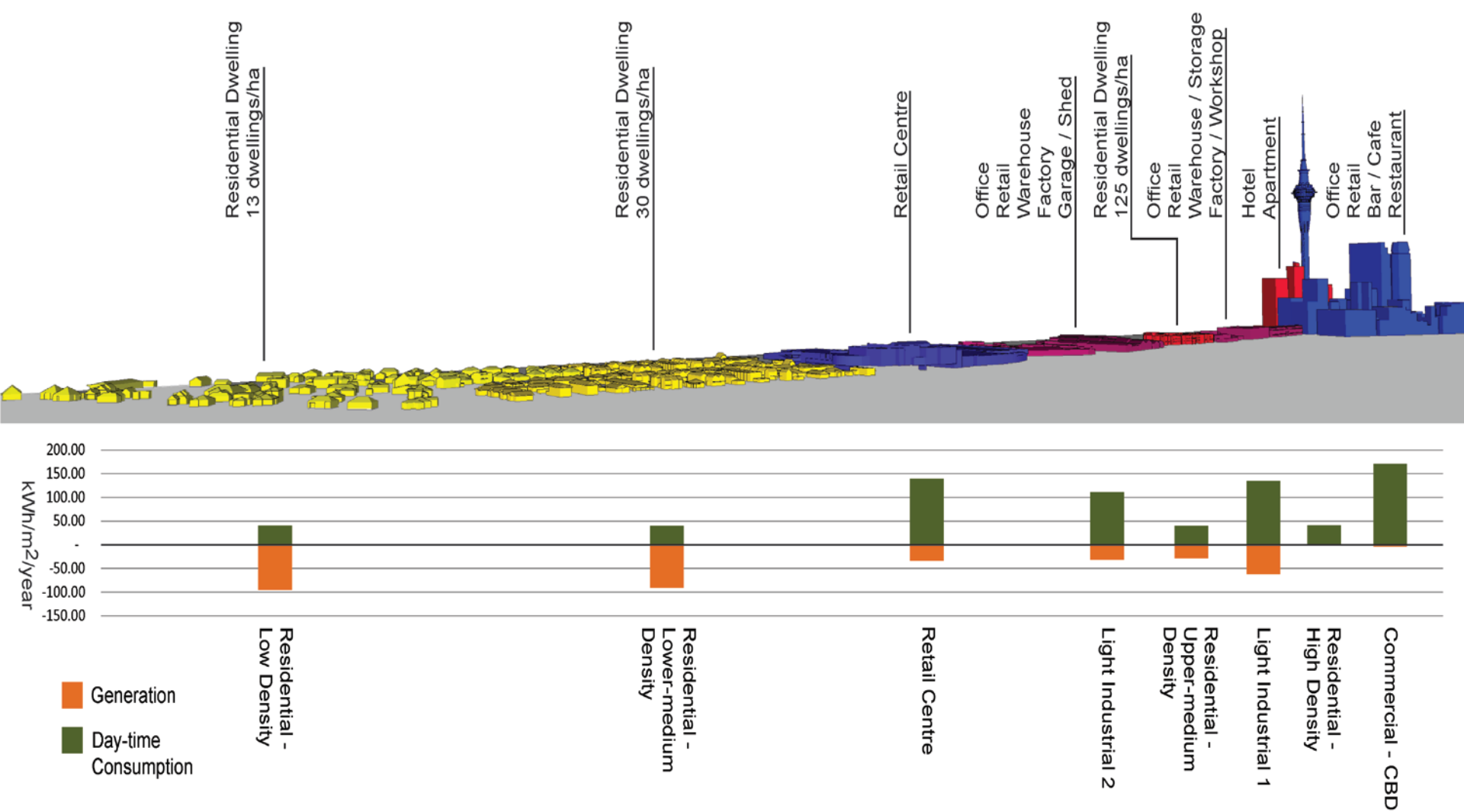
Buildings: slight cooling in summer, slight heating in winter

Transport: 95% private transport (50% of NZ energy use is oil for vehicles)

Renewables: solar

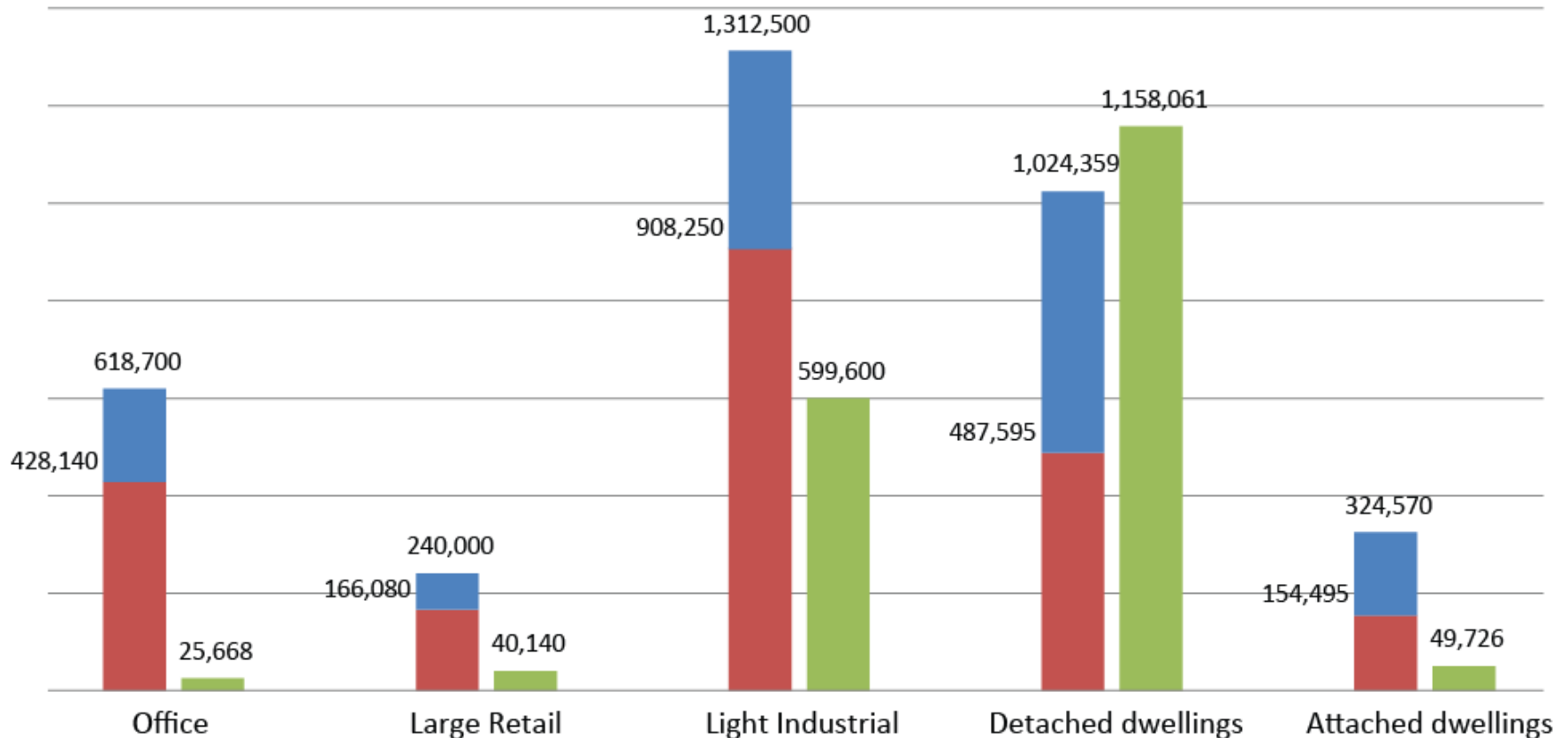


- Comparing the potential energy generated from PVs with the energy consumed by the building.

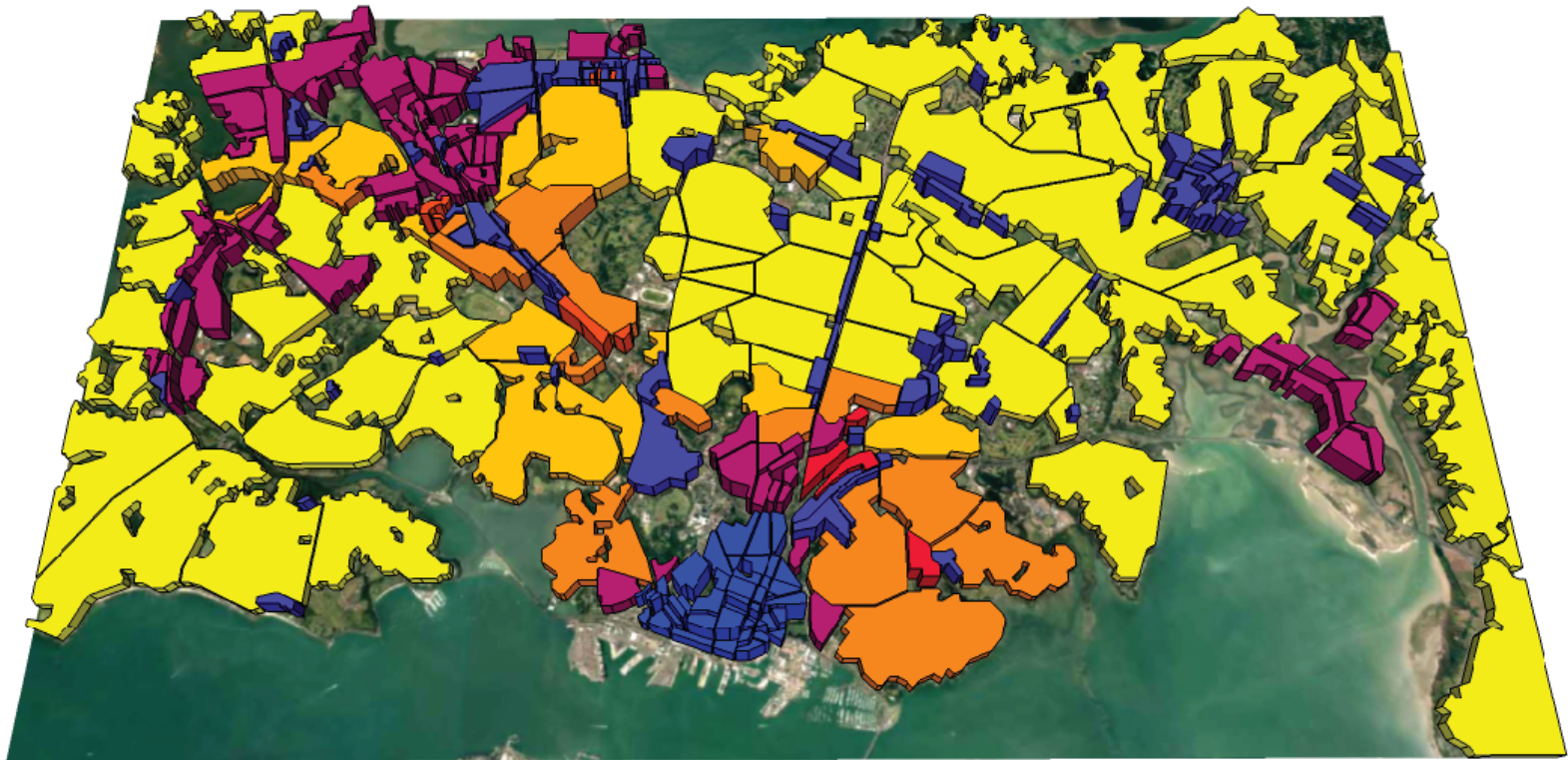


Annual Energy Consumption & Maximum Generation by PV (GWh/year) Extrapolated for the whole City

■ Total Consumption ■ Day-time Consumption (6am-6pm) ■ PV Generation

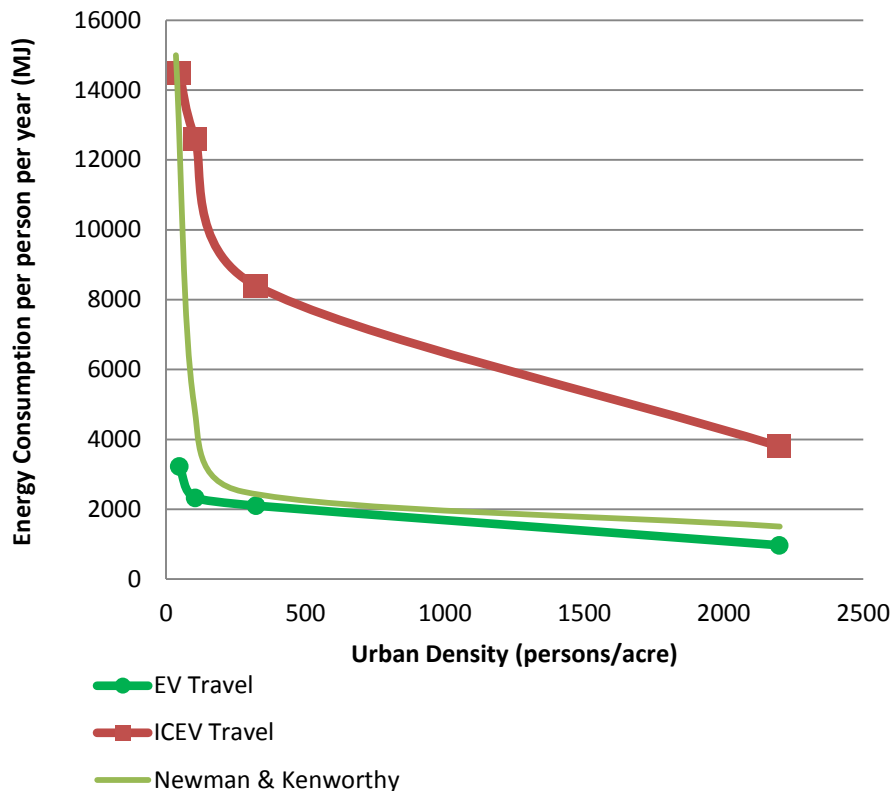


- Residential suburbia has high net-metering potential while industrial buildings can benefit directly from its generation.



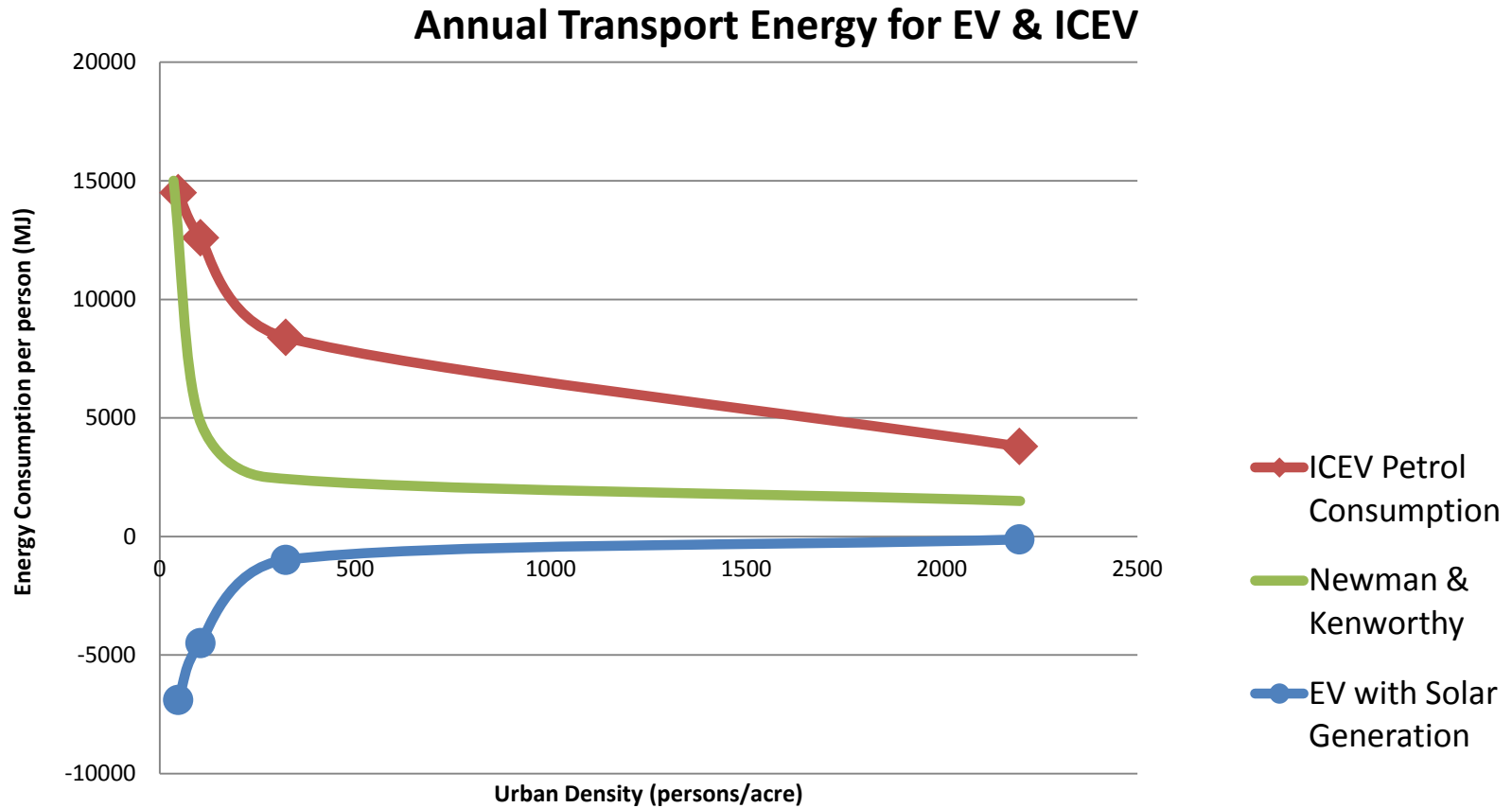
The Impact of Electric Vehicles

EV & ICEV Travel Energy Comparison



| Daily Average Travel Distance per Vehicle Drivers (km) | | | | | |
|--|-------------------|-------------------|---------------------------|---------------------------|------------------|
| | Major Urban Areas | High Density Site | Upper-medium Density Site | Lower-medium Density Site | Low Density Site |
| Home | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |
| Work - main job | 4.3 | 2.5 | 2.5 | 5.0 | 8.0 |
| Work - other job | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Work - employer's business | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Education | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Shopping | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Personal business/ services | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Medical/ dental | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Social visits | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| Recreational | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Change mode | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Accompany someone else | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Total | 19.4 | 17.8 | 17.8 | 20.3 | 23.3 |

Using PVs to charge Electric Vehicles

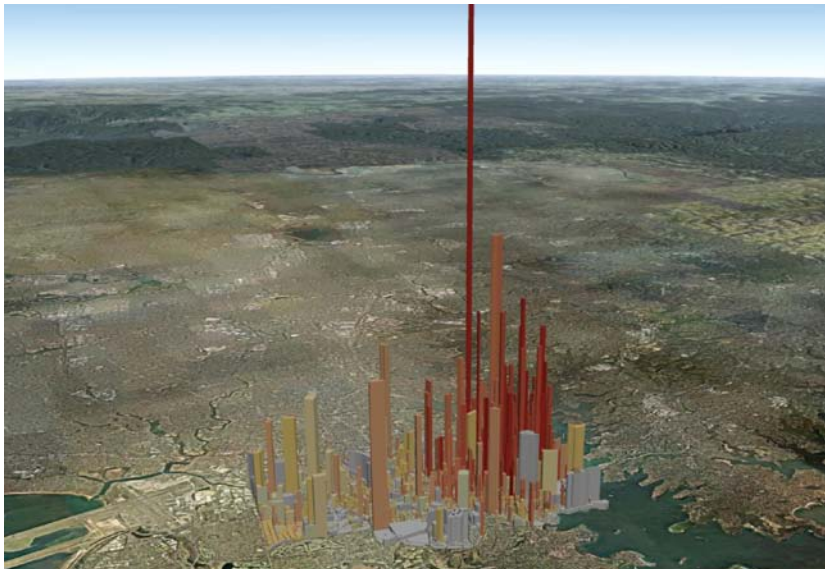


Evidence based research

Novel methods of mapping cities

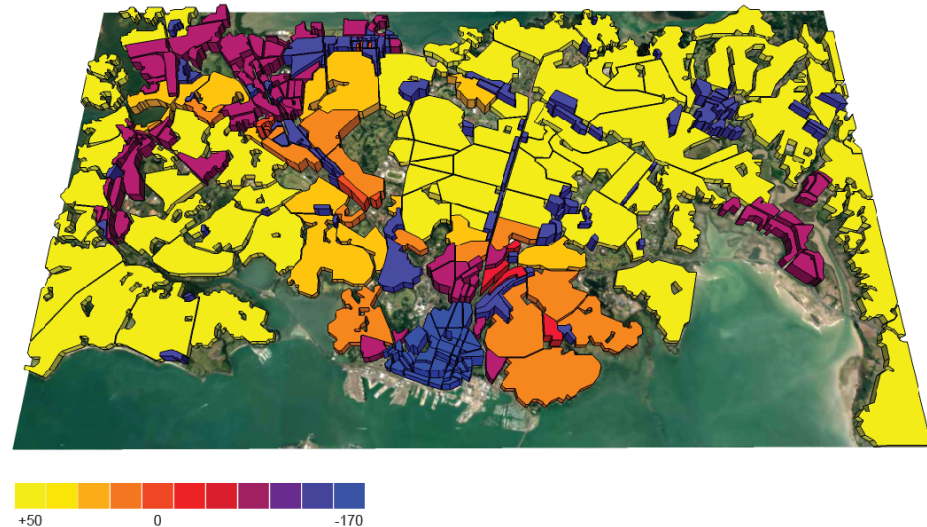
Sydney

Measuring electricity use to
Map carbon emissions to
Inform policy about urban
infrastructure



Auckland

Measuring electricity available
from PVs to
Map 'net-metering' to
Inform policy on urban transport



Christchurch

An opportunity to rebuild a resilient city

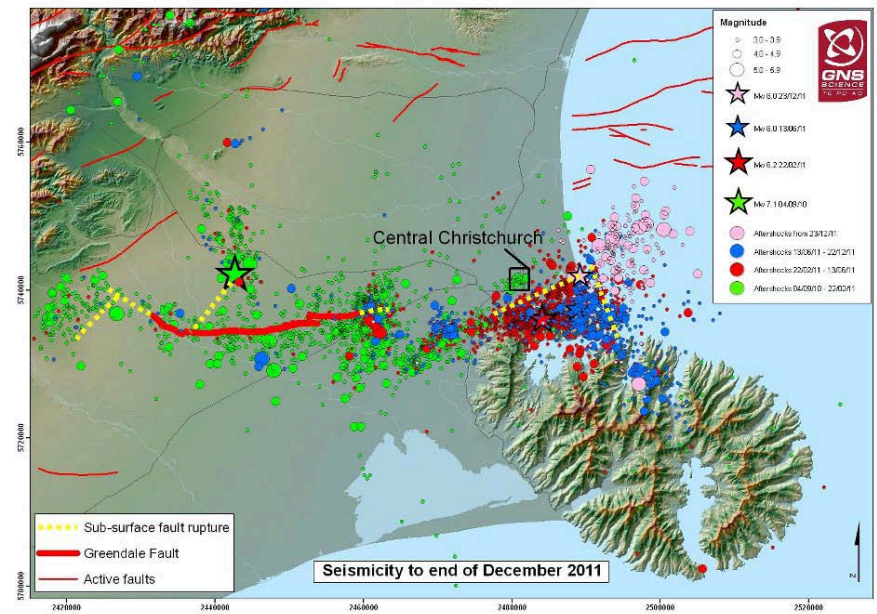
Electricity: 75% renewable

Buildings: Mainly heating

Transport: public and private

Renewables: solar

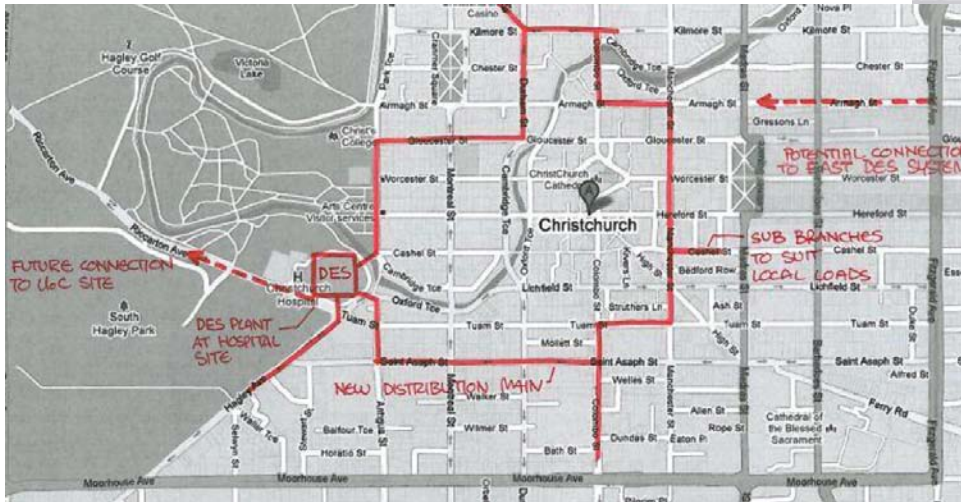
Earthquake risk





District Energy Scheme

Heating and cooling pipes buried in the ground



KPMG
cutting through complexity

Christchurch District Energy System

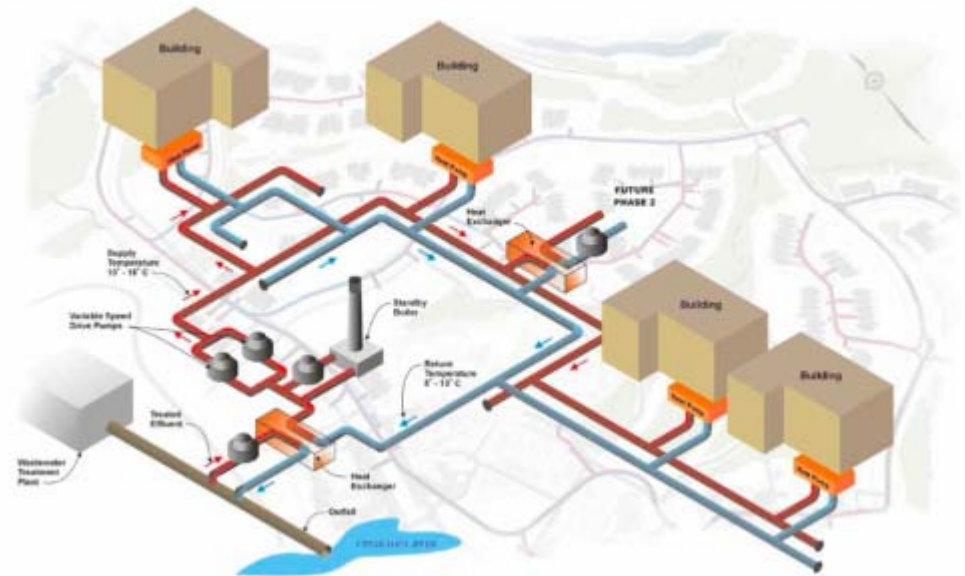
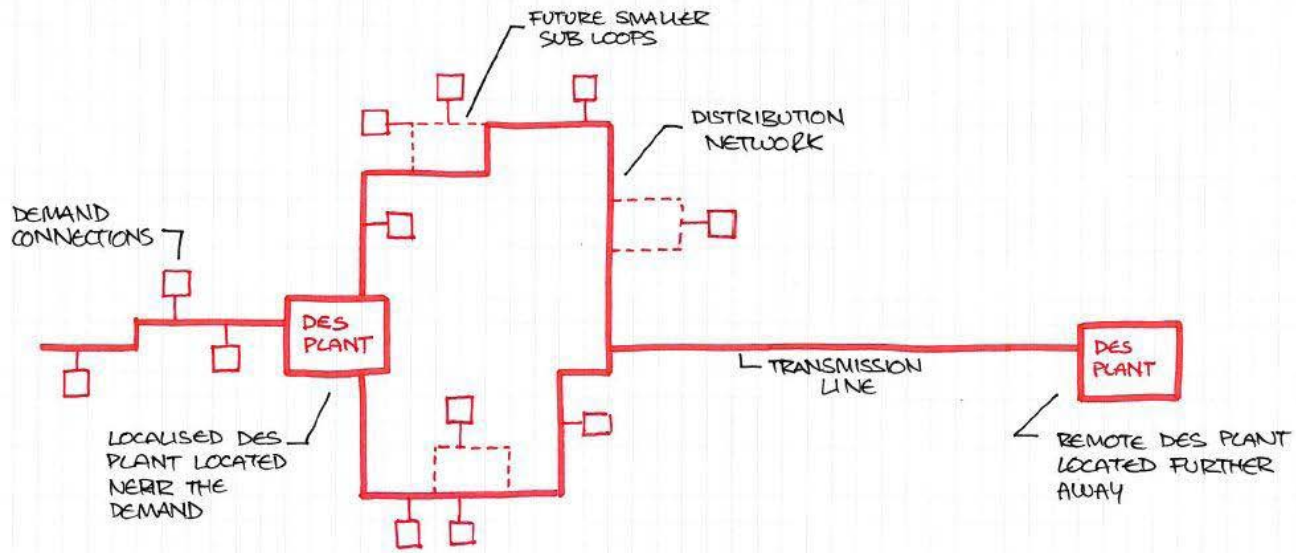
A summary of feasibility study findings

May 2012



Christchurch DES proposal

- No attempt to measure needs
- Centralizing generation
- Poor use of resources
- Fragile infrastructure
- No effort to reduce demand
- Minimal incentive to 'feed-in'
- High 'standing losses'
- No need for cooling buildings



Summary

Resilient cities:

~~Business as usual~~

- 1. Each city is individual:** climate, resources, infrastructure
- 2. Evidence based:** measure needs, resources and externalities.
- 3. Minimise carbon and maximise renewable energy**
- 4. Decentralize generation of energy:** distributed generation (DG)
- 5. Democratise the infrastructure :** smart grids with feed-in
- 6. Adopt emerging technologies:** PVs, tri-generation, EVs, smart grids

