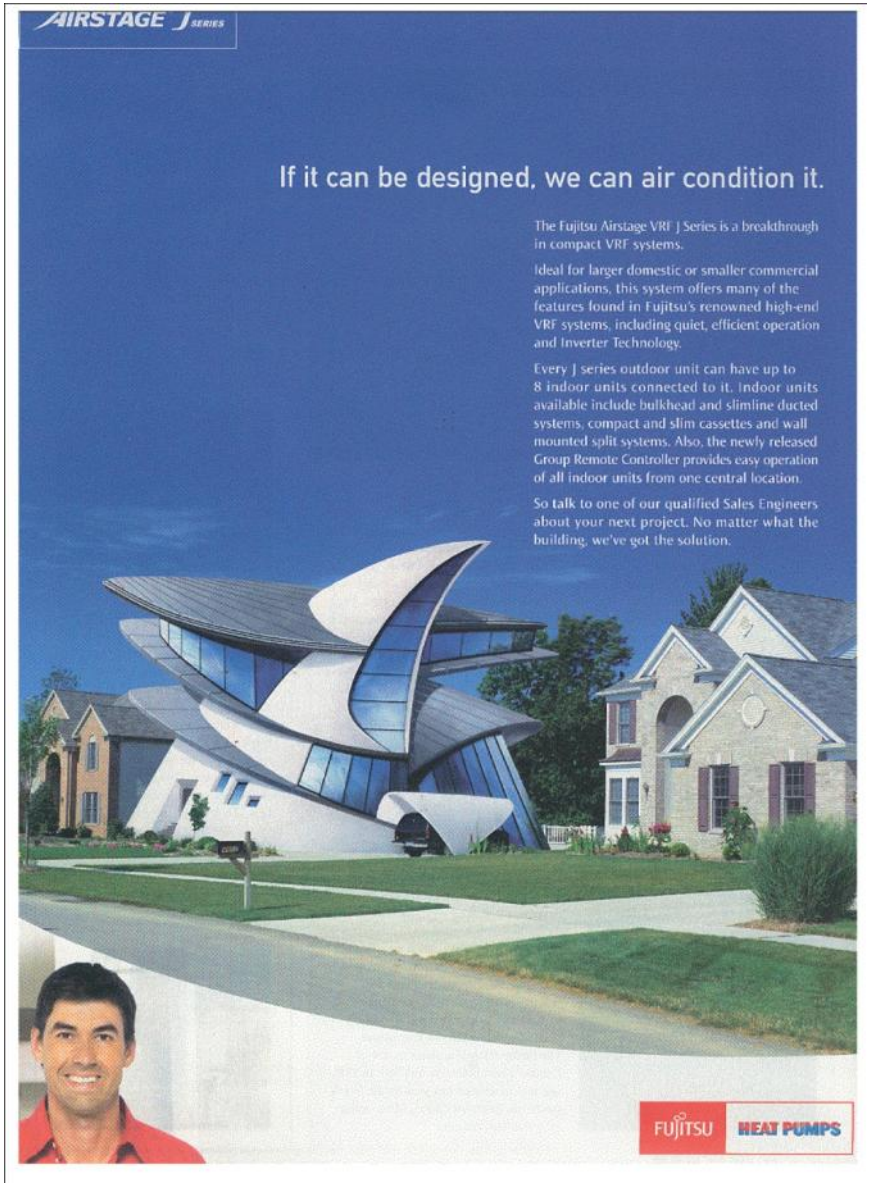
Changing Architecture for a Changing Climate; Unsustainable Trends in New Zealand

Byrd, Dr. Hugh*
Rehm, Dr. Michael**
The University of Auckland
*School of Architecture & Planning
**The Business School

Energy and Building Design



Fuel and electricity allows buildings to ignore the natural environment by creating an artificial internal environment through heating, cooling and lighting.

This allows designers to ignore the environmental performance of the building envelope since poor performance can be remedied by more heating, more cooling, more lighting....**more energy**.

"*If it can be designed, we can air-condition it*" is a license for designers to ignore the performance of a building envelope.

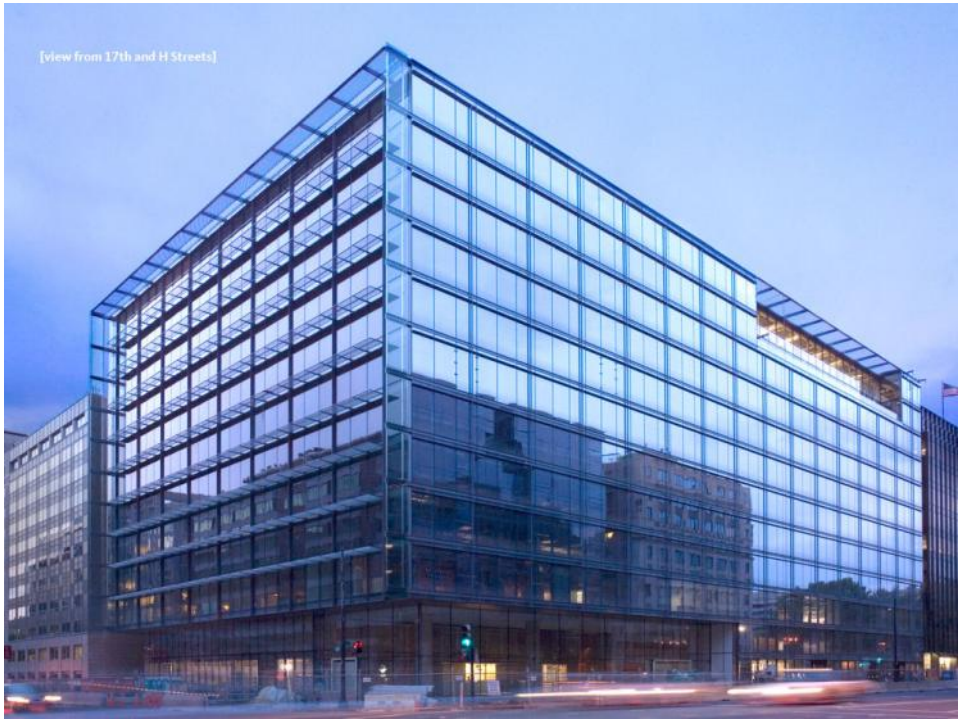
"less is more"; a bad joke for energy

This has led to an architecture that is characterised by being highly-glazed, lightweight, air-conditioned and poorly insulated.

Also characterised by 'sick building syndrome', overheating, glare and excessive energy consumption.

However, the powerful brand image that this building type portrays drives its continued production.

Energy consumption has little value when fuel and electricity is cheap and plentiful



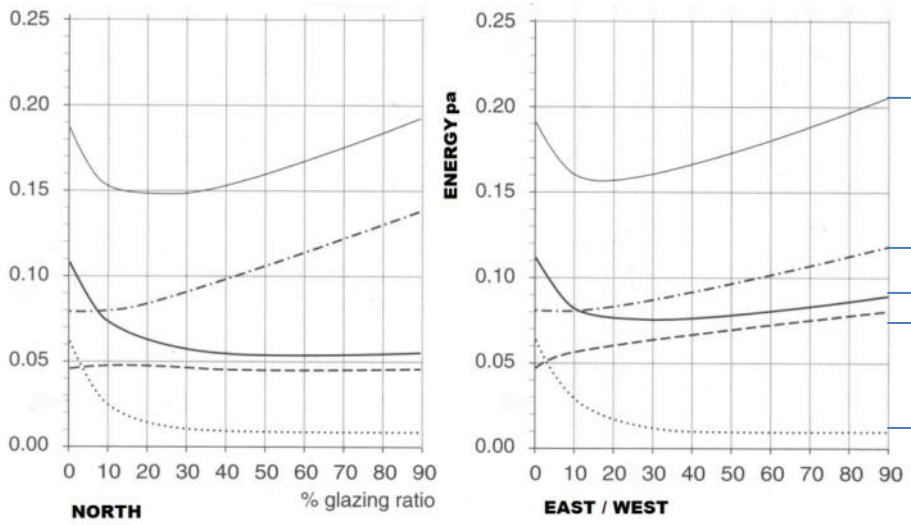
17th and H Streets, Washington DC. LEED accredited

But what happens when energy supplies are scarce and insecure?

Glass-box buildings have no resilience to an interrupted or inadequate supply of energy.

"the power failures to the Eastern Seaboard of the USA in August 2003 when New Yorkers had to evacuate most of the buildings in the city because they had non-opening windows and air-conditioning systems in which the air for breathing ran out in under an hour and internal temperatures surged within minutes"

How much glazing is energy efficient?



Total energy p.a.

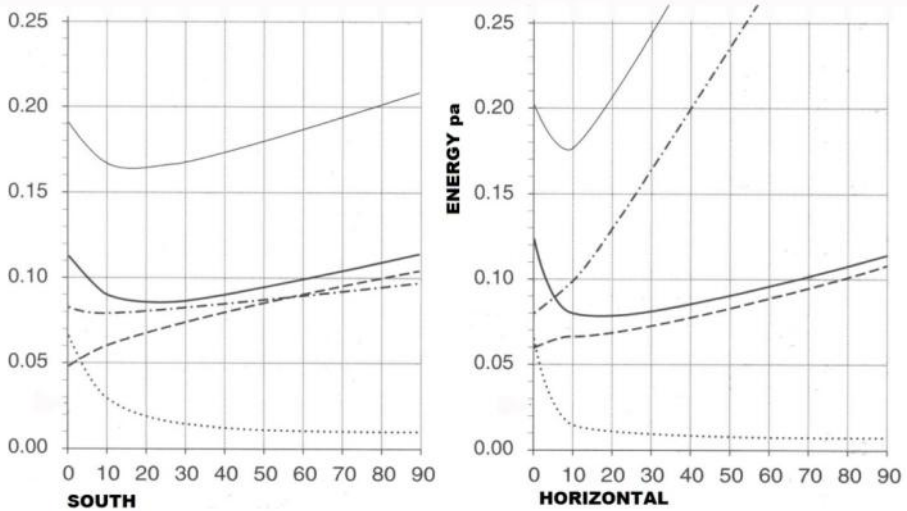
Energy for cooling

Total Heat & Light

Energy for heating

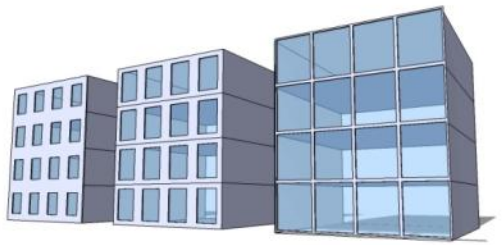
Energy for lighting

% Glazing Related to Energy Use in Temperate Climates



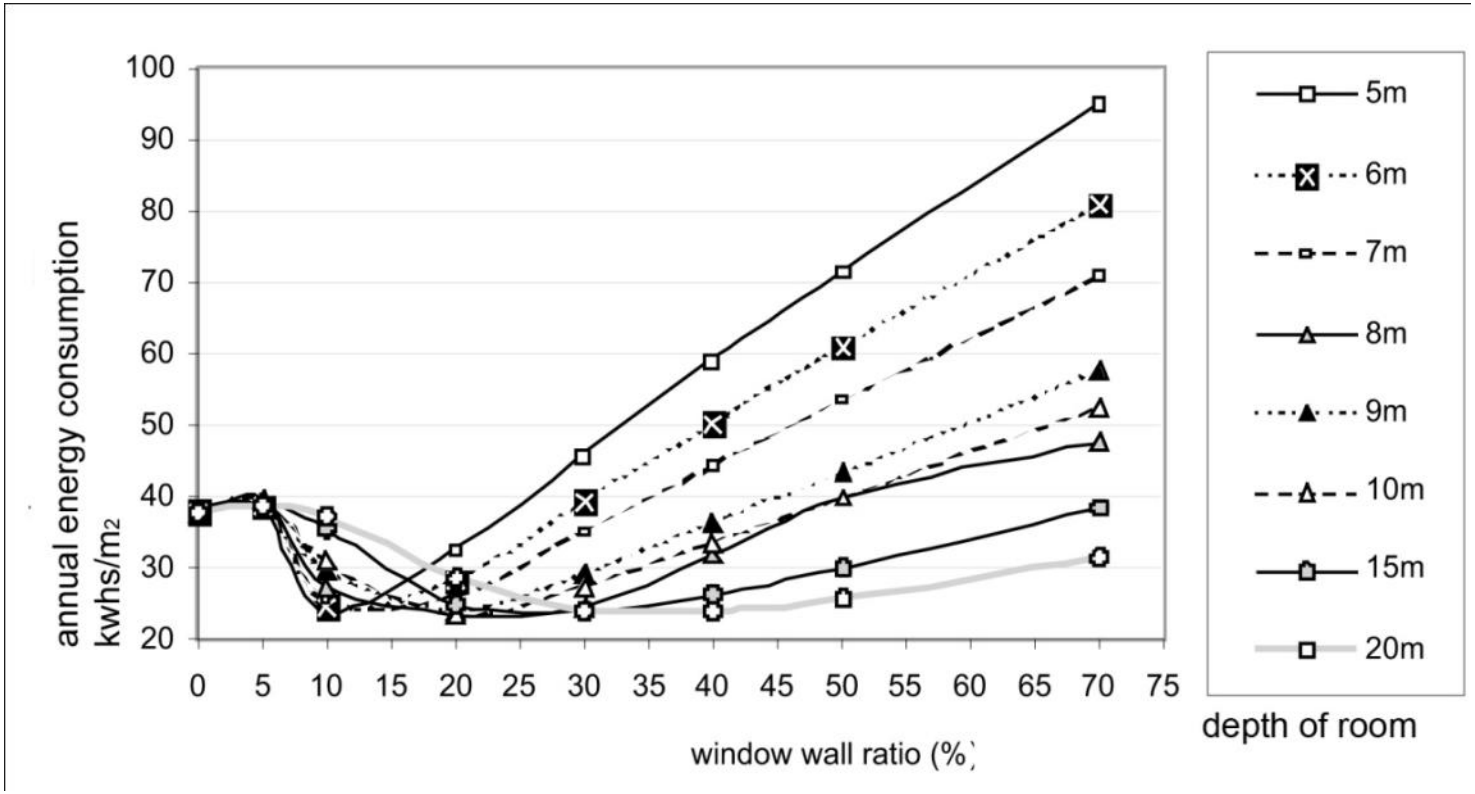
On all orientations and all circumstances the optimum lies somewhere between 20 and 40 %

30% 50% 100%



Baker, N., Steemers, K. (1994) The LT Method v 2.0, The Martin Centre for Architectural & Urban Studies, Cambridge.

Optimum % Glazing in Sub-tropical Climates

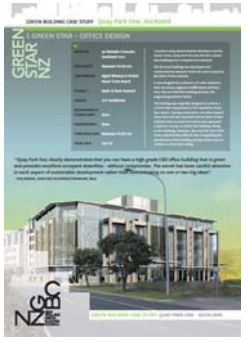


With climate change, Zone 1 (NZS 4218) is moving towards a sub tropical climate. The optimum area of glazing in sub-tropical climates is less than temperate climates.

Hyde, R.A., Pedrini, A. (2002) 'LTV Design Tool', *Proceedings of the Experts Meeting, Department of Building,* NUS Singapore.

‘Green’ rated buildings in NZ






- Air conditioned, ‘green’ office buildings average score for ‘energy’ is only 50% of the available.

- The majority are sealed buildings that are fully air-conditioned and have 80% glazing or more.

- These buildings are dependent on a constant and uninterrupted supply of electricity in order to remain habitable and productive.

NZGBC (2010) web site content http://www.nzgbc.org.nz/main/greenstar/elaboration/casestudies. Accessed June 30 2010

NZGBC Office Design Case Studies

- 25% weighting for ‘energy’ in rating tool

- Only 2/3rds of these points are for building envelope performance

- Case studies of air conditioned offices on NZBBC web site average 50% of total energy score

- Therefore the typical NZ green building values energy in the design of its envelope as :

  25% of %66% of 50% = **8%**

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The next oil shock?

October 2010

SUMMARY

- Oil is "the lifeblood of modern civilisation". This paper provides an overview of the global oil market. In particular, it examines the outlook for oil supply and demand over the next five years, and the economic consequences.
- Low-cost reserves of oil are being rapidly exhausted, forcing oil companies to turn to more expensive sources of oil. This replacement of low-cost sources of oil with higher-costs sources is driving the price of oil higher.
- While the world will not run out of oil reserves for decades to come, it cannot indefinitely continue to produce oil at an increasing rate from the remaining reserves. Forecasts indicate that world oil production capacity will not grow or fall in the next five years while demand will continue to rise.
- If oil production capacity does not rise as fast as demand, the buffer of spare production capacity disappears. In such a 'supply crunch' the price of oil 'spikes' to high levels. High oil prices can induce global recessions.
- Organisations including the International Energy Agency and the US military have warned that another supply crunch is likely to occur soon after 2012 due to rising demand and insufficient production capacity
- There is a risk that the world economy may be at the start of a cycle of supply crunches leading to price spikes and recessions, followed by recoveries leading to supply crunches.
- New Zealand is heavily dependent on oil imports and will remain so for the foreseeable future. While there is potential to substantially increase domestic production, domestic oil production cannot insulate New Zealand from global oil price shocks because New Zealand pays the world price for goods like oil.
- Key export-generating industries in the New Zealand economy including tourism and timber, dairy, and meat exports are very vulnerable to oil shocks because of their reliance on affordable international transport.

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Introduction

The US Department of Energy (DoE) calls oil "the lifeblood of modern civilisation".[1] Around 86 million barrels (13.7 billion litres) are consumed each day. Oil supplies 37 percent of the world's energy demand,[2] including 40 percent of New Zealand's energy demand.[3] It powers nearly all of the world's transportation, without which production and trade would grind to a halt. Studies have shown that GDP growth is very strongly related to increased use of oil.[4]

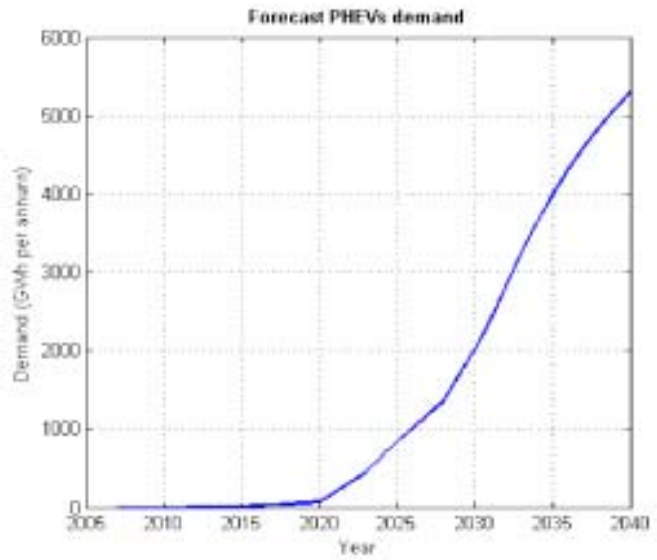
Why is Energy Important?

We are now in an era where there is a general understanding that fossil fuels are depleting and our dependence on an adequate supply of energy cannot be assured.

To be sustainable, buildings should usefully last for many generations.

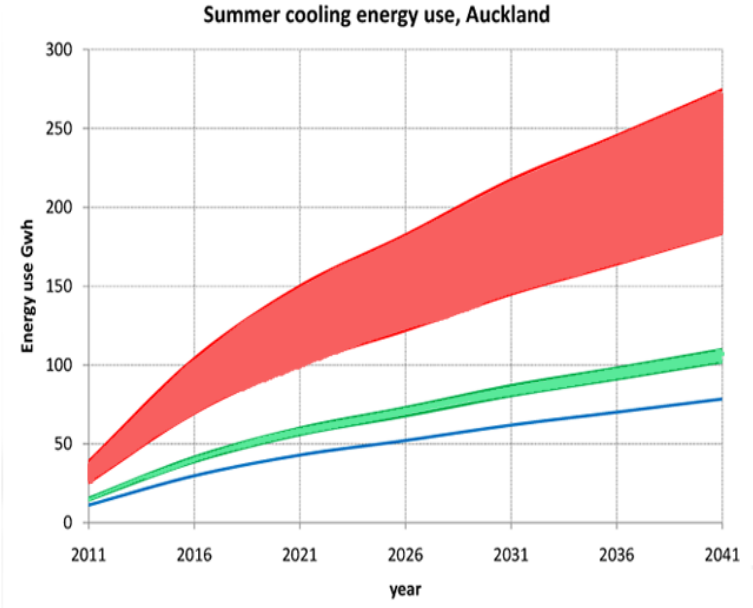
Energy Demand Increasing

PHEVs Electric demand



5000 times greater by 2040

Domestic Air-conditioning cooling demand



100 times greater by 2040

Smith, B (2009) "Electric Vehicles and generation development". NZ Electricity Commission. Conference on :The Impact of Electric Vehicles on the NZ Electricity System. http://www.electricitycommission.govt.nz/pdfs/opdev/modelling/GPAs/presentations-29Feb08/electricvehicles.pdf. Accessed July 2010

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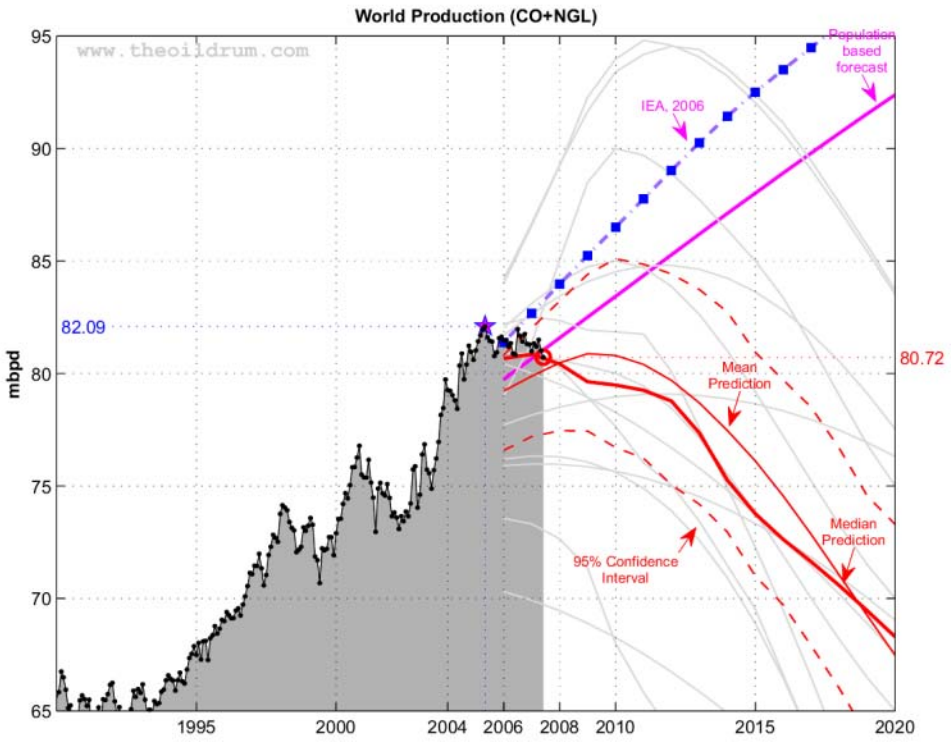
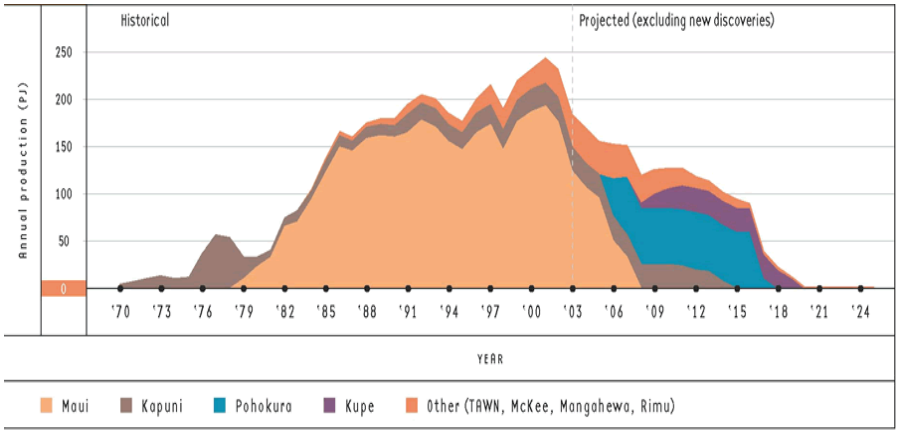
Energy supply reducing



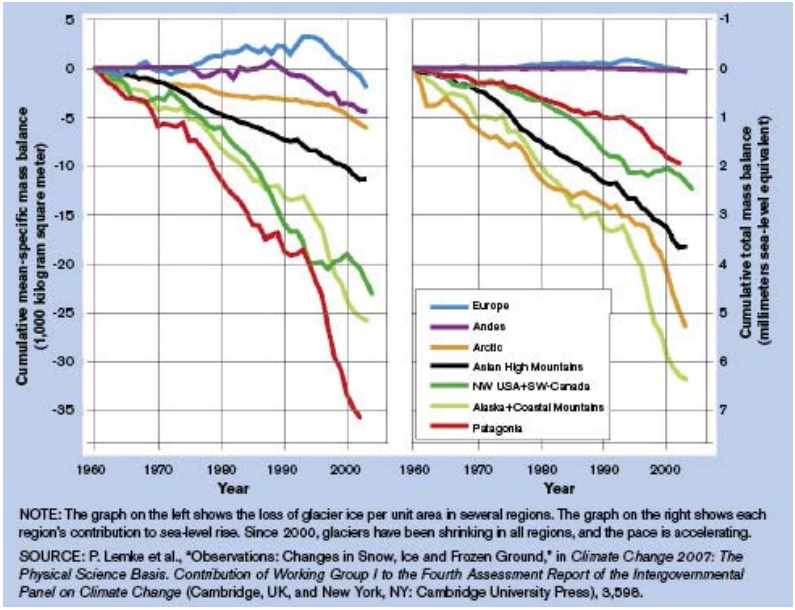
International Peak Oil



NZ Peak Gas?

NZ Peak Hydro

- 50% of hydro electricity generated from melt water[1]
- Glaciers are NZs largest water store for hydro (53 Km^3) [2]
- "Glaciers across the globe are continuing to melt so fast that many will disappear by the middle of this century"[3]
- Melt water increases in the short-term, peak, then declines



NOTE: The graph on the left shows the loss of glacier ice per unit area in several regions. The graph on the right shows each region's contribution to sea-level rise. Since 2000, glaciers have been shrinking in all regions, and the pace is accelerating.

SOURCE: P. Lemke et al., "Observations: Changes in Snow, Ice and Frozen Ground," in *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK, and New York, NY: Cambridge University Press), 3,598.

1. Waterpower (2006) Editorial, International water power and dam construction (2006) "Hydro in the Mix in New Zealand". http://www.waterpowermagazine.com/story.asp?sectionCode=166&storyCode=2039414 accessed July 2010
2. Fitzharris J and Hay J (1989) Glaciers: Can they Weather the Storm of Climate Change? In Proceedings 15th New Zealand Geography Conference, ed R Welch, 284-291, New Zealand Geographical Society.
3. Jowit, J. (2010a) Worlds Glaciers Continue to melt at Historic Rates. http://www.guardian.co.uk/environment/2010/jan/25/world-glacier-monitoring-service-figures. Accessed June 2010

Energy, Climate and Building Performance In NZ

- High proportions of glazing lead to an overall poor energy performance of a building
- As the climate gets hotter the optimum proportion of glazing reduces
- With increased temperatures, the peak demand for electricity will shift towards summer
- Glacial retreat due to climate change and a greater reliance on renewable energy makes electricity supply less secure in the summer
- Highly glazed air-conditioned buildings become less resilient

Changing the Criteria for 'green' rating tools

If the mission of 'green' rating tools is to "accelerate the transformation of the global built environment towards sustainability" [1], then it needs to reconsider the criteria to take account of energy depletion, climate change and the consequent need for adaptation by building occupants.

NZGBC (2010) web site content http://www.nzgbc.org.nz/main/greenstar/elaboration/casestudies. Accessed June 30 2010

Brand Image vs. Resilience

The rental value of commercial property in CBDs is rated (generally A to D) according to its desirability. An essential characteristic for A and B rated buildings is air-conditioning.

While electricity is abundant and cheap, these building types are desirable.

However, this could all change if electricity supplies become insecure.

Naturally ventilated buildings have a greater potential to remain productive than air-conditioned buildings.