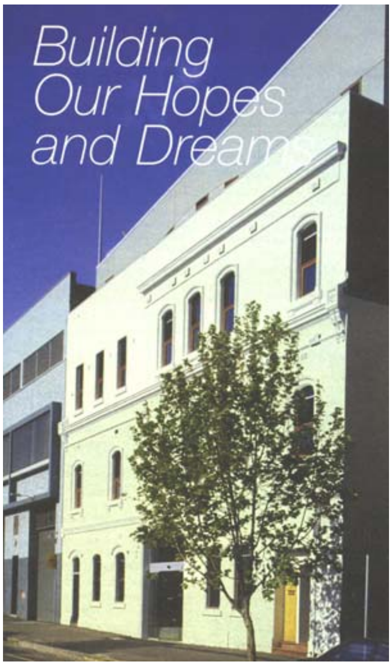

Learning from the 60L Green Building: good intentions, tough action and their outcomes

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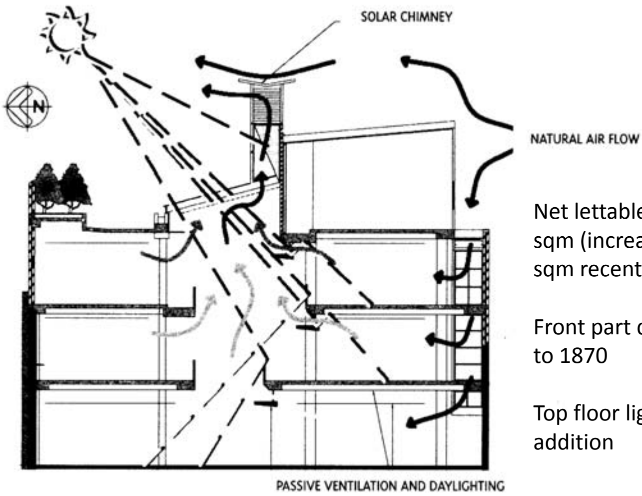
Director Sustainable Solutions
Adjunct Professor RMIT University

Melbourne Forum March 28 2012
State Theatre

Photo from *Habitat* ACF magazine

60L solar and ventilation



Net lettable area: 3216 sqm (increased to 3225 sqm recently), 4 floors

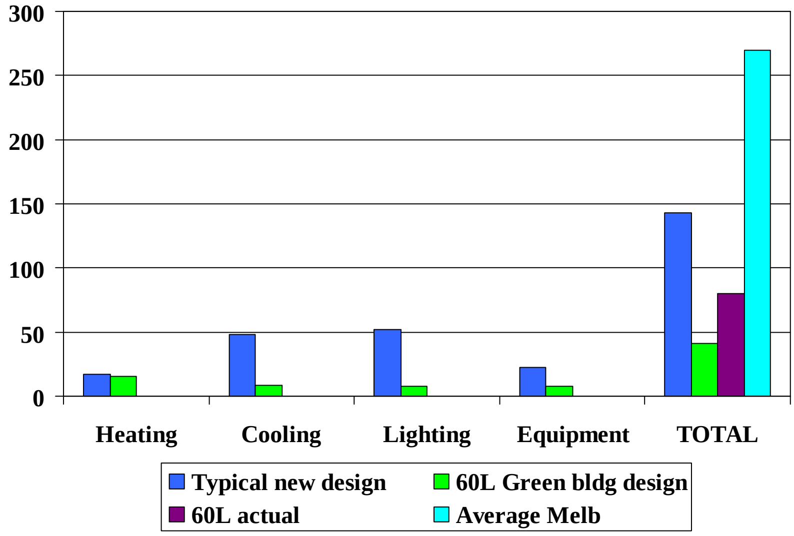
Front part dates back to 1870

Top floor lightweight addition

Daylight is an energy saver and creates a high level of amenity at 60L – and installed lighting power density only 5.5 watts/sqm

High visibility stairs (now carpeted) and lift hidden round corner towards rear means lower lift energy usage

Annual office building energy consumption, Melbourne (kWh/square metre/year)



Why differences between design modelling and reality?

- Modelling pre-dates NABERS modelling protocol
- Not all activities included in modelling
- Construction did not match design, eg:
  - Building much leakier than designed
  - Sewage treatment plant issues
  - Internal heat loads?
- Management and occupant behaviour different from design assumptions, eg variable hours, varying comfort
- Real climate differed from modelled climate
- Accuracy of model and assumptions?
- ??

How we tried to ensure performance: construction project

- Extensive design process involving client and independent expertise (eg modelled options, challenged assumptions)
- Client appointed separate project manager and environmental consultants who:
  - reviewed project team's work,
  - represented client at meetings,
  - approved any changes to specifications,
  - Inspected and recorded on-site work
  - helped project team find products and solve problems and educated many contractors and consultants
- Very thorough documentation of environmental requirements in briefs/specifications
- On-site environmental officer

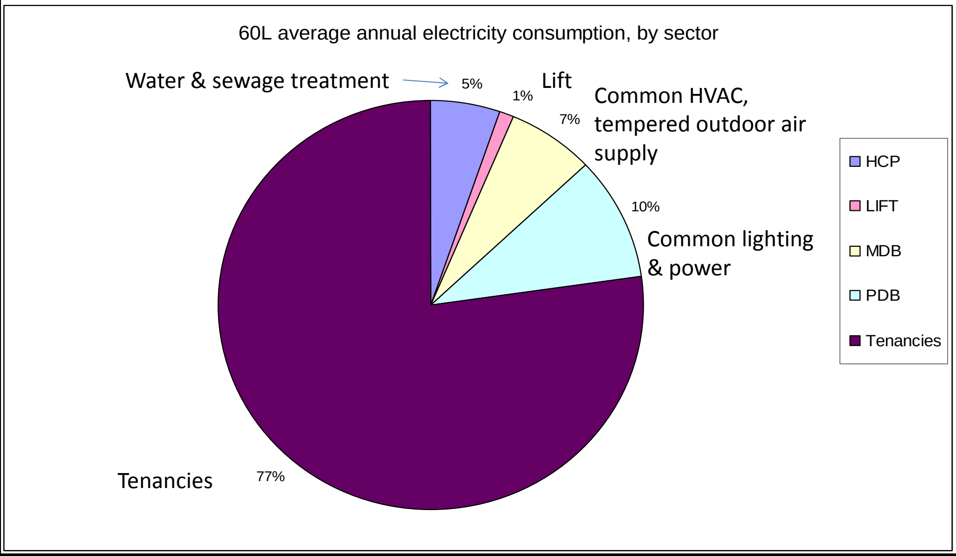
Other Factors to Ensure Performance

- Thorough green fitout and equipment purchase guidelines for tenants (+ specialist advice)
- Separate metering of tenant lights, power and heating/cooling
- Each tenant manages and pays for its own heating & cooling, power and lighting - 77% of total building energy
- Liaison with tenants on environmental performance
- Enthusiastic building manager, strong green culture
- Many energy saving features: lighting, hot water, PV etc

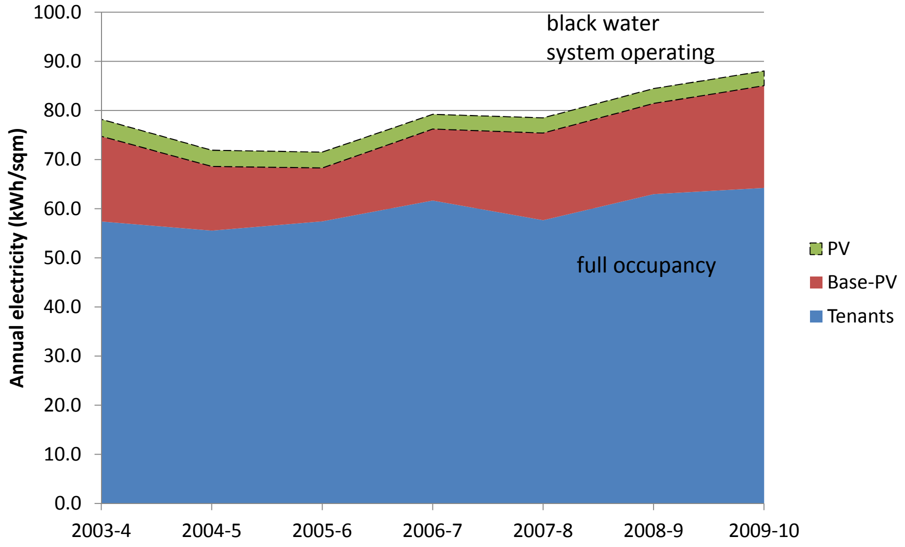
Missed opportunities and issues (personal opinion):

- We didn't get 'domestic' split systems – 'commercial' units less efficient, noisier, didn't have inverter control (+more expensive)
- Ground floor tenancies/existing building not well insulated
- Potential warm air in atrium to heat ground floor not utilised
- Sewage treatment plant issues

Net energy consumption July 2003-July 2010 247,820 kWh/y, 77.1 kWh/m^2/y(PV supplied extra 3.2 kWh/sqm/y)
NOTE: most energy data from Nathan Chapman study as part of his Masters of Sustainable Energy Engineering at RMIT

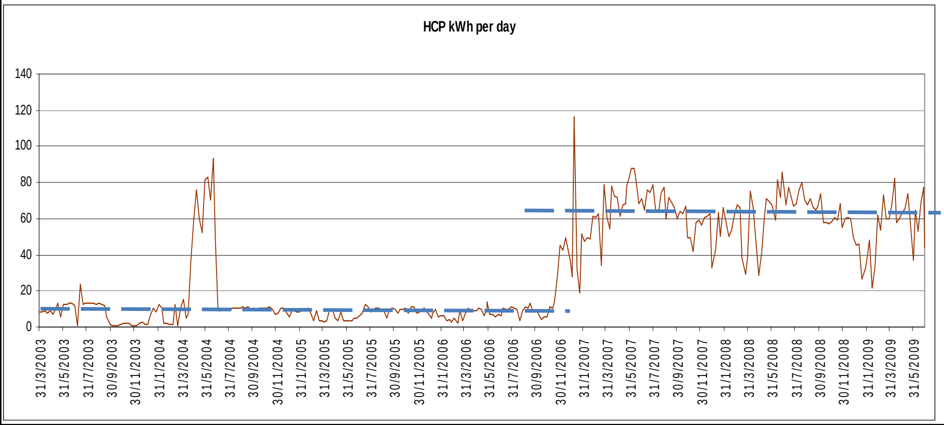


Annual electricity consumption per square metre (kWh). PV provided 3.2 kWh/sqm. Average net annual usage 77 kWh/sqm (NABERS normalised Vic 5 star is 127 kWh/sqm)

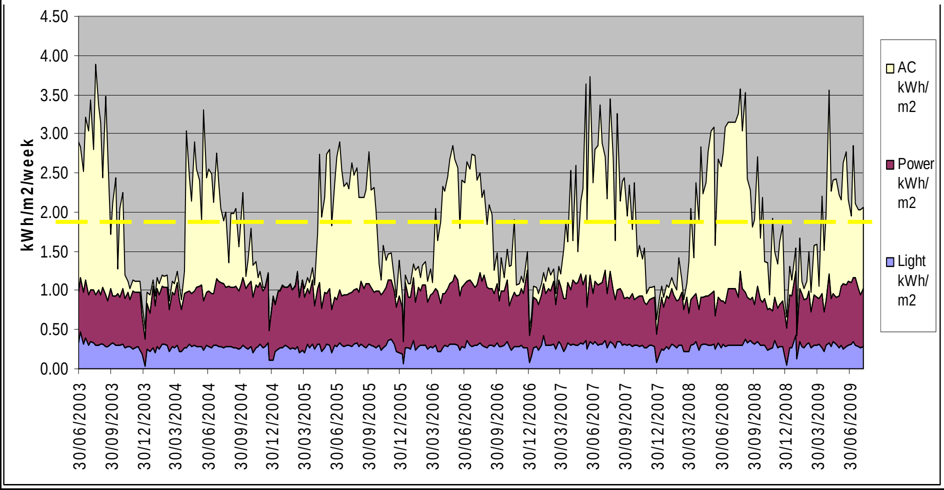


HCP (Hydraulic Control Panel) 2003-2009. When sewage treatment system operating, daily consumption over 60 kWh/day (7 kWh/sqm/y, ~20 kWh/kl) compared with under 10 kWh/day (1 kWh/sqm/y) when rainwater treatment only operating.

Sewage treatment plant now decommissioned: very energy-intensive, high maintenance and treated water dumped to sewer as excess



A ground floor tenancy: 95 kWh/sqm/year (1.83 kWh/sqm/week), dominated by power (47%) winter heating (37% over year)
Average electricity/sqm ~60% above tenant average, with heating much above average but still cool in winter

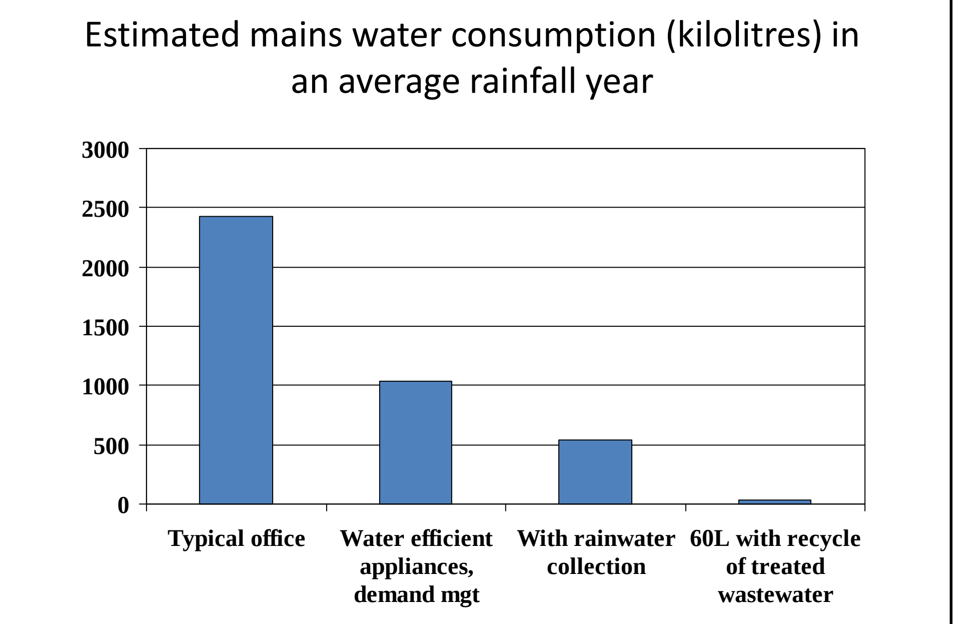


AAA 3/6 litre toilets using reclaimed water

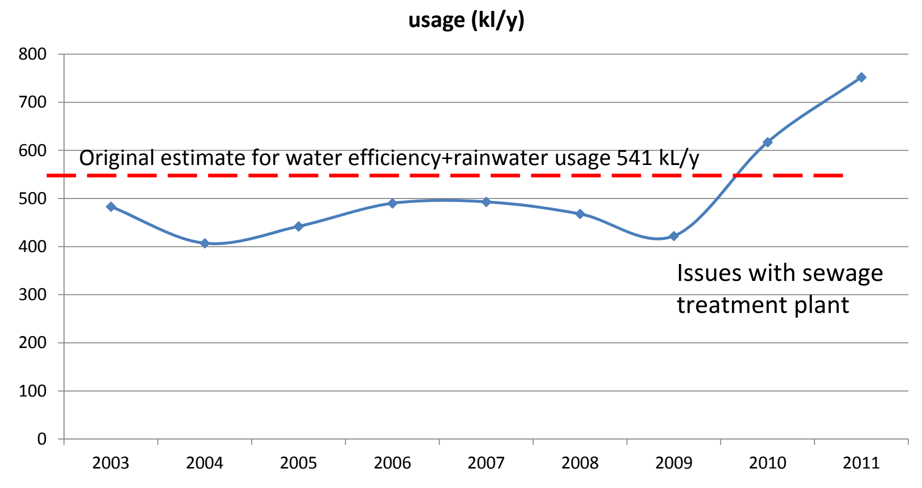
Waterless urinals

Two 10,000 L tanks fed by approx 1,000 sqm of roof. Water is filtered, sterilised and pumped to points of use.
Daily energy approx 10 kWh – much lower than original design:
•Low pressure drop filters and sensor controlled circulation pumps

Unfortunately, we didn't catch the pipe installation: right-angle bends waste energy!!!



Mains water usage consistently below predicted (ave 460 kL/y c/f 541 kL/y) except sewage treatment plant. Ave usage approx 0.4 litres/m2/day during extended drought (ave rainfall 500 mm c/f long term average of 650 mm for Melbourne). Close to self-sufficiency possible without sewage treatment, but possibly more storage needed



Post Occupancy Evaluation: international comparison of 30 Green buildings by George Baird (2010) *Sustainable Buildings in Practice what the users think*

- Overall rated high: "...building was rated 'Exceptional' on the seven point scale, ...96%. .....All-Factors 83% ... Upper end of the 'Good Practice' band." (p.220)
- Ratings (relative to benchmarks of sample):
  - Lighting 5/5 better, Satisfaction factors 5/5 better
  - Operational 6/8 better 2/8 similar
  - Control 3/5 better, 2/5 similar
  - Environmental: winter 5/8 better, 2/8 similar 1/8 worse
  - Environmental: summer 5/8 better, 1/8 similar 2/8 worse
  - Noise 5/6 similar, 1/6 better (stairs now carpeted)

To conclude: Lessons

- Design and construction:
  - Thorough documentation and strong leadership
  - Independent monitoring and reporting to client
  - Demand accountability and challenge assumptions – maybe also offer incentives for excellent performance
  - Drive extreme energy efficiency including standby and distribution losses - don't assume ANYTHING: check!
- Ensure tenants install efficient equipment, educate them on behaviour, provide feedback, ongoing engagement
- Monitor, report, manage and improve performance
- Empower building managers, contractors and occupants