Top Tricks for Upgrading Buildings

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Overview

- Why fix existing buildings?
- Controls
- Commissioning
- Plant upgrades
- Conclusions

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Why fix existing buildings?

- Cost: It's a lot cheaper than new build
- Speed: It's a lot faster then new build
- Environment: It's a lot better for the environment than new build
  - But oh so much less sexy!!

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What's wrong that needs fixing?

- Post 1990 buildings: Dying controls, aging plant and years of accumulated bad commissioning, and some design problems
- Pre 1990 buildings: As above plus a greater share of overriding design problems

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Priorities

- Priority 1: Control.
  - Bad control beats good plant
  - Well designed control can fix some commissioning errors
- Priority 2: Commissioning
  - Bad commissioning beats good plant
- Priority 3: Plant
  - Only worthwhile once it's controlled and commissioned properly

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Control

- The key aims of efficient control are to achieve comfort control at the same time as:
  - Minimising the chiller/boiler run hours
  - Minimising simultaneous heating and cooling
  - Dropping fan speeds as far as possible
  - Dropping pump speeds as far as possible
  - Making best use of available free resource (e.g. economy cycle)

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Key control tricks - chillers

- Maximise chilled water temperature
- Minimise condenser water temperature
- Stage for maximum efficiency (but don’t forget the pumps)
- Don’t turn on until you absolutely have to

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Key control tricks - boilers

- TURN THEM OFF!!!!!!

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Key control tricks – fan and pumps

- Variable pressure control
  - Maximise valve/VAV damper positions
  - Compensates for shoddy commissioning AND doubtful sensors

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Key control tricks – AHUs

- Variable volume, always
- Reduce maximum flows
  - Get rid of overdesign
  - Especially important for full outside air systems
- Beware high-select
  - Whatever is extreme is probably broken
- Economy cycle
  - Enthalpy control
  - Don’t over-conservatise

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Key control tricks – VAVs

- Reduce minimum flows
  - Down to 20% often feasible
- Increase VAV deadbands
- Use proportional control
- Coordinate VAV settings and AHU supply air temperature control
  - Generally aim for low flow, low temp
- Disable reheat except when needed for space heating

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Commissioning

- Get the pressure set-points as low as possible
- Locate pressure sensors at the end of the main run
- Actually test the air and water flows
- Make sure that the valve/damper actuators are actually working
- Test and fix the VAVs
  - 15-20% failure rate common
- Test the lighting controls, if you have any……

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Plant upgrades

- Chillers
  - Savings of 50% on older chillers are feasible
  - Select the chiller to match your needs
  - Great (IPLV>9) may be expensive
    - but good (IPLV>8) isn't
- Remember: the best water conservation is energy conservation
  - So don't rush to air-cooled

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Plant upgrades

- AHUs
  - An expensive option but worth consideration for older buildings
  - Aim for one AHU per façade
  - Try to eliminate reheat
  - Upgrade to swirl diffusers
  - Get rid of fan assisted boxes

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Plant upgrades

- Tenant condenser water loop
  - VSD on pump
  - Static pressure sensor at the end of the main run
  - Automatic shut-off valves on every tenant unit

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Plant upgrades

- Base building lighting
  - Occupancy sensor common area lights off
  - Consider stairwell lighting controls
  - Eliminate dichroics
  - Remove/delamp valence lighting
  - Occupancy sensors for car parks

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Plant upgrades

- Tenancy lighting
  - Upgrade to better than 7W/m²
  - Preferably single lamp fittings
  - Provide control infrastructure, and make the tenants use it

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Plant upgrades

- Lifts
  - Lift companies in Australia have not yet caught up with energy efficiency
  - Reduce unnecessary speed, acceleration
  - Consider variable frequency, variable voltage with regenerative braking
  - Push for low stand-by loads

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Plant upgrades

- Cogeneration
  - Last refuge of the desperate
  - Consider fixing the lifts first!!!
  - Only 0.5 star benefit in temperate climates
  - Absorption chillers may not be net benefit
  - Doubts about longevity and maintainability

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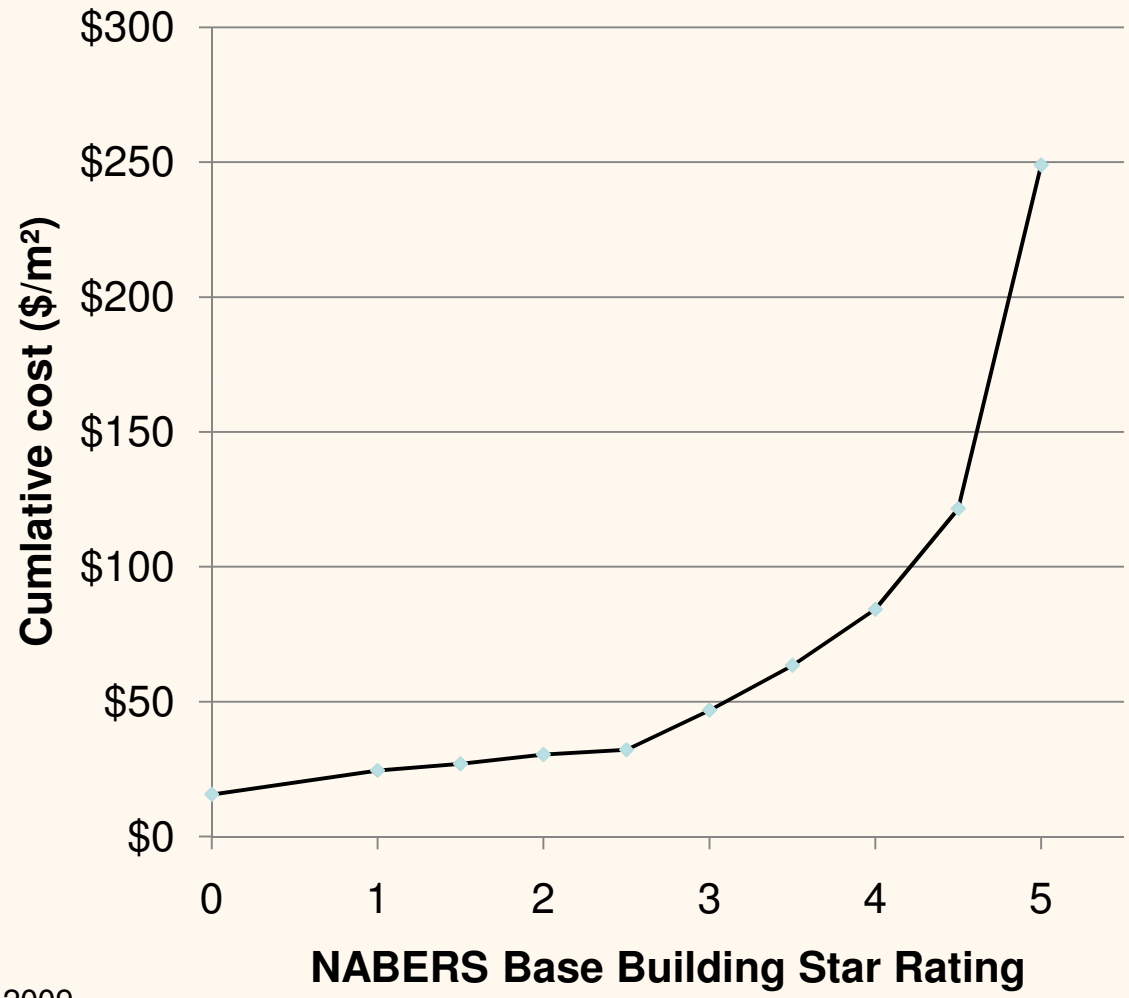
How far does this get me?

- For most buildings an upgrade to 4 stars is feasible
  - 4.5 stars at a more of a stretch
- Upgrade to 5 stars very expensive and experimental
- Our results indicate 30% saving on a 3 year payback as a reasonable expectation


$300
$250
$200
$150
$100
$50
$0
Cumlative cost ($/m²)
0
1
2
3
4
5
NABERS Base Building Star Rating

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Don’t forget to upgrade the staff!!

- Warren Centre Low Energy High rise Project indicate that buildings perform better when:
  - The staff and contractors care about performance
  - The management chain all work positively with efficiency issues
  - Energy efficiency training is provided
  - The NABERS rating is declared to tenants

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Conclusions

- Upgrading existing building is viable, and good business
- Upgrades to 4 stars are generally feasible, higher ratings with more effort
- Controls and commissioning play a central role to achievement of good ratings
- Plenty of options for plant upgrade too – but AFTER control and commissioning
- Cogen is always an option but it's desperation.

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