Many, Many Stages

- EOI
- Pre-RFT
- RFT
- Concept Design
- Construction Begins!
- Design Stage 1
- Financial Close
- Submission to the State
- Design Stage 2
- 100% Documentation
- Green Star Design Submission
- Practical Completion
- Green Star As-Built
- Forever.....
- Operation
- Building Tuning
Pre - RFT

The Crystal Ball

- Indoor Environmental Quality
  - Air Quality
  - Thermal Comfort
  - Natural Light
  - Air-conditioning
  - Control Contaminants

- Energy / Carbon Emissions

- Water

- Flexibility / Churn

- Connectivity (Physical / Environmental)

Increase alertness, reduce error rates, maintain quality of experiments

Pre - RFT

The Crystal Ball Gazing Continues

<table>
<thead>
<tr>
<th>Option</th>
<th>CapEx</th>
<th>OpEx</th>
<th>Ability to Achieve 5 Star Green Star</th>
<th>Client Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled beams</td>
<td>$375</td>
<td>✓✓✓</td>
<td>✓✓✓</td>
<td></td>
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<td></td>
<td>Future Proof</td>
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<td>Stable / Secure Indoor Environment</td>
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<td>Corporate Feel</td>
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<td></td>
<td>Fixed / Inflexible</td>
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<td></td>
<td></td>
<td>Water use Perception</td>
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<td></td>
<td></td>
<td>Relatively new technology</td>
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<td></td>
<td>User equity (every occupant receives benefit)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Approx 30% smaller plant space</td>
</tr>
<tr>
<td>Mixed mode ventilation</td>
<td>$375</td>
<td>✓✓✓✓✓(✓)</td>
<td>✓✓✓</td>
<td></td>
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<td></td>
<td>Complex to manage</td>
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<td></td>
<td>Increased maintenance</td>
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<td></td>
<td>Provides user control</td>
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<td></td>
<td>Suitable for smaller office environment where single occupant has control over their environment</td>
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<td>Potential for Natural ventilation not be used and thus heavy reliance on Mechanical Cooling (Increase running cost)</td>
</tr>
</tbody>
</table>

* Note: Very good operational energy assumes natural ventilation mode in operation for approx 40-50% of year, if this is not utilised then [✓]
The Brief

• “to achieve an innovative and ecologically sustainable development, which provides a healthy workplace and laboratory environments and reduces the ecological impact and operating costs of the development

• to maximise the advantages of the site and aspect ensuring access to natural daylight and external views of the Facility Users; and

• to address sustainability objectives into the design at the project from the outset then measure, track and improve throughout the Term to continue to meet the requirements set out in the Project Agreement.”

The Brief

• Commitment to achieve Green Star Education rating (PILOT at the time)
  5 stars

  IEQ points requirement – 18/25

  Daylight factor of 2.5% must be achieved for 60% of occupied functional area

The proposed building must also ensure that facility users within the office zones are able to control the thermal comfort within their workspace environment.
A Culture of Sustainability
- Every aspect of the development is embeds sustainable design
- Priority is given to user interaction
- Science has informed the design

Every Occupant shares ownership in the sustainable performance of the facility
A focal point for collaboration and innovation
- Sustainable planning that promotes connectivity
- Productive workspaces with views, natural light and fresh air
- Thinking green at work

Internationally recognised as a world leading sustainable research facility

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Healthy
- Direct access to outside
- Reduce and Eliminate Pollutant Sources
- A living internal environment promotes normal circadian rhythms
- The new facility actively promotes the wellness of its occupants
Green/Work/Life - Culture

Visibly Green
User tools
Experience

Mixed mode system (Offices):
• Reduced energy consumption
• Improved thermal comfort
• User control

External Shading:
• Reduce summer solar load
• Utilise solar load in winter
• Allow natural light penetration to space

Floorplate (Perimeter Office Spaces):
• Maximise external views and daylight penetration
• Provide good connection with outdoors for occupants

Internal Atriums:
• Exhaust path for natural ventilation
• Maximise natural light penetration
• Provide a connection to the outdoors

Night Purge (Offices):
• Reduced energy consumption
• Improved thermal comfort
• Automatic control

Internal Blinds:
• Improve thermal comfort
• User control

Green/Work/Life - Planning

Winter Sun
Summer Shade

Building Orientation:
• Minimise extent of West facing façade to reduce summer heat loads

Building Orientation:
• Consider direction of prevailing winds for optimum design of natural ventilation and night purge systems

External Shading:
• Design fixed shading elements to block direct solar penetration in summer but allow solar load in winter
• Maintain good levels of daylight penetration to the space year round
Green/Work/Life - Air

Natural Ventilation and Mixed Mode

Natural Ventilation: Air is exhausted through stair wells

Natural Ventilation: Fresh air enters office spaces through windows in the façade

Natural Ventilation: Air is exhausted through atrium

Natural Ventilation: Air passes through plenum above labs and is exhausted into the atrium space

Green/Work/Life - Light

Daylight
Views
Artificial lighting

Daylight: Floor plate designed to maximise natural light penetration to office spaces
Good daylight penetration to atrium spaces

External Views: Floor plate designed to maximise access to external views
Good daylight penetration to atrium spaces
Green/Work/Life – User Interface

**Controls**

**Information**

**Touch points**

- Mixed mode system (Offices): Red light/green light system for control of windows for mixed mode system.
- Internal Blinds: User control of blinds for control of thermal comfort and daylight penetration.
- Lighting Controls: Lighting control systems control artificial lighting for energy efficiency.

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**Filling in the Gaps**

- Atrium
- Offices
- Green Star
- Water Strategy
- Energy Cycle
- Risk Mitigation
Atrium

Direct Sun Penetration
Quadrant 1 and Quadrant 2
Daylight Penetration
Daylight factor of 2.5% achieved on ground floor of atrium

A daylight factor of 2.5% is achieved across the entire ground floor area of the atriums which means that the atrium qualifies as providing external views under Green Star (based on min 50% VLT)

Office and Administration

Originally preferred to be mixed mode by architect

Final system is VAV providing 150% increase in OA levels

Seasonal adjustment of set points is undertaken

<table>
<thead>
<tr>
<th>Outside Air Temperature (°C)</th>
<th>Set-point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15</td>
<td>22.5</td>
</tr>
<tr>
<td>16 to 20</td>
<td>23.0</td>
</tr>
<tr>
<td>21 to 25</td>
<td>23.5</td>
</tr>
<tr>
<td>26 to 30</td>
<td>24.0</td>
</tr>
<tr>
<td>31 to 35</td>
<td>24.5</td>
</tr>
<tr>
<td>&gt;36</td>
<td>25.0</td>
</tr>
</tbody>
</table>

Control band of ±1.5°C for all conditions
Lab and Special Function Spaces

Initially give consideration for innovative systems during bid stage

Final brief was very prescriptive, did not allow much room for movement

Still targeted most Green Star within rating in all spaces (eg, Increased OA, Materials, Water consumption

Water Strategy

200kL Rainwater Tank

- 60% of Cooling Tower Water
- 75% of Toilet Flushing

Artificial Lake

Landscaping Irrigation
Energy Modelling

Tri-Generation

Mains Electricity

Generated Electricity

Electric Chiller

Mains Gas

Generator Flue Heat Absorption Chiller Water Jacket Heat

Gas Boiler

Building (Load)

Green Star Assessment

- Brief required submission under Education tool
- BRC does not strictly fit into Education but would have similar issues in any tool
- Definition of areas was a problem from the start
  - Large area will not be fitted out (Opportunity Space)
  - Many areas have functional requirements which preclude achievement of certain credits (darkroom cannot achieve daylight, external views)
  - Some spaces do not have appropriate benchmarks under Ene-1 (Controlled Environment Rooms)
- Long process of clarifying areas with the GBCA
  - Opportunity Space has been excluded from rating
  - CERS have been excluded from Ene-1
  - Some areas excluded from individual credits depending on functional requirements
Green Star – Risk Mitigation

Process

1. Project Control 1: Conditions of Tendering
2. Project Control 2: Tender Schedule 16 - ESD Commitment
3. Project Control 3: Post Tender Questionnaire
4. Project Control 4: Pre-Award Commitment to ESD Management Plan
5. Project Control 5: ESD Briefing
6. Project Control 6: As-Built Tracking