

Welcome

TO MEET THE STARS

People, Plants and Productivity- Workplaces of the future

Hosted by

Andrew Aitken

Director- Green Star



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Today's Speakers



**Prof Margaret Burchett- University of
Technology Sydney.**



Prof Neil Holt- Wesley Corporate Health



Digby Hall- Synergy Green



UTS:SCIENCE THINK.CHANGE.DO

*People, Plants, Productivity – Workplaces of the Future -
Indoor Plants as Installations for
Sustainable Building Ecology*

Margaret Burchett, Fraser Torpy & Jason Brennan
Plants and Indoor Environmental Quality Group
Centre for Environmental Sustainability (CEnS)
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Acknowledgements

Our thanks to –

- **Ambius**
- **National Interior Plantscape Association (NIPA)**
- **Nursery Industry**
- **Horticulture Australia Ltd (HAL)**

- **Numerous UTS colleagues**
- **Prof Ashley Craig (Univ Syd)**

Outline

- Overview of indoor air pollution issues
- Role of plants in reducing indoor air pollution – what is research showing?
- Directly measurable benefits to health, wellbeing, productivity & performance
- Some strategies for sustainable workplaces of the future, what's next for indoor plants?

Health issues of urban air pollution (UAP)

~90% caused by fossil fuel emissions

- Mixture of:
- Oxides: CO₂, CO, NO_x, SO_x,
- Air toxics:
 - Volatiles organic compounds (VOCs) eg. BTEX, PAHs
 - Metallics
- Fine Particulate Matter (PM_{10/2.5})
- Ozone (photochemical 2ndary)
-
- Worldwide, causes ≥ 3M p.a. (WHO, 2000)



www.smh.com.au www.neversets.com/images/coalpower.jpg

Health issues of indoor air pollution

Australia - the way we live now -

- >80% of us live in urban areas
- Spend 90% of our time indoors,
So-
- This is where we breathe most UAP

- *And-*
- UAP health costs ~ \$12M p.a. (CSIRO, 2000)
- In Sydney - causes 1,400 deaths &
- 2000 hospital admissions p.a. (NSW EPA, 2006)



Indoor air is more polluted than outdoors

- Staler
- More VOCs-
from synthetic (ie fossil-fuel) materials
- More CO₂ – us breathing



www.deyoungs.com.au <http://www.mainetoday.com/blogs/inasnap/GD0209crowd2.JPG>

Indoor plants can reduce all types of UAP

Overseas research shows-

Reductions in:

- NO_x , SO_x , O_3
- Particulates



UTS research-

Laboratory & office studies-

Shows reductions in:

- VOCs
- CO_2
- CO

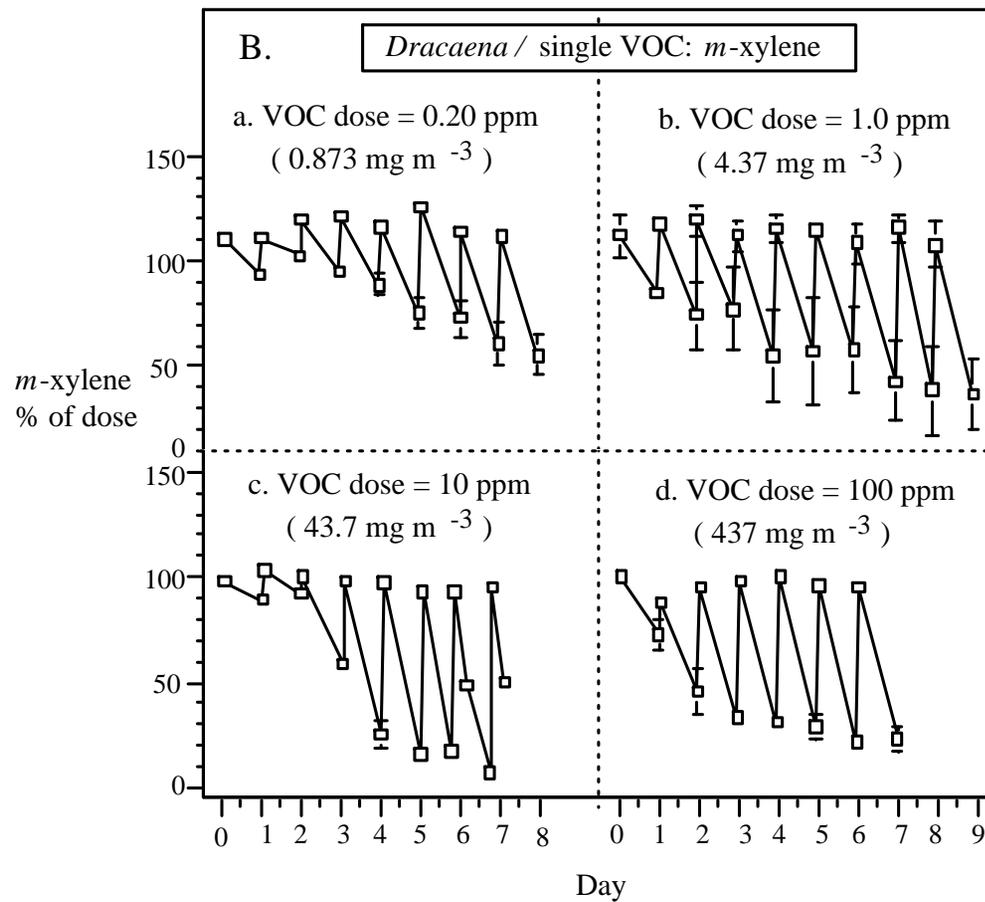


Kingfung.com

UTS Laboratory trials – VOC removal



UTS Lab. trials – VOCs - Results



UTS Laboratory findings – VOCs

- All species ~ equally effective
- Removal rates stimulated by first dose
- Then remove repeated doses in 24 h
- Equally effective in light or dark
- Root-zone bacteria main removal agents

SO -

- Removal by plant/pot-mix symbiotic microcosm

Conclusions

- *Any species likely to work just as well*
- *Pot-size does not matter too much! -*
- *A 200 mm pot is as effective as a 300 mm pot*



UTS office-plant /air quality studies



300 mm
Dracaena 'Janet Craig'
(1,2,3 or 6 plants)

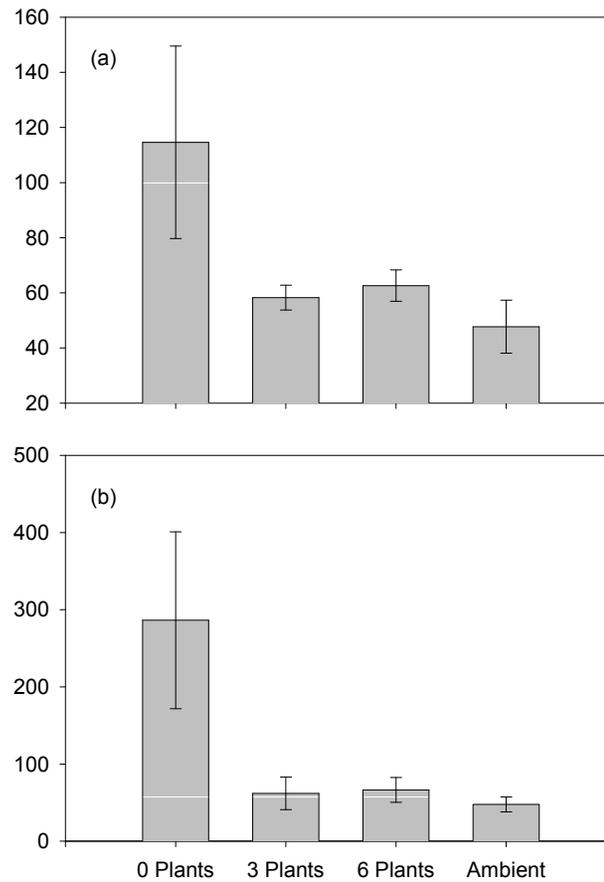


200 mm
Spathiphyllum 'Petite'
(1,3 or 6 plants)



& 0-plant
Controls

UTS office studies – TVOCs



UTS office-plant studies –Summary

Reductions with plants of -

- TVOCs: >75% to <100 ppb
- CO₂: 10-25%
- CO: 90%



But

- **Effects can be masked with modern AC systems**

http://www.indoorplanthire.net.au/images/plants/plants_clip_image002_0000.jpg

UTS office-plant findings – Implications

Plants can be deployed:

- To bring significant reductions in TVOCs & CO₂

&

- Help reduce building AC energy costs

so

- Reducing C-footprint of city

Cleaner air means clearer thought -

Promotes health, productivity and performance



Google images

World research shows -
Stress reduces productivity, and leads to illness

**So- can
office plants
lower stress
& hence
increase
productivity?**

Direct plant benefits to health & wellbeing

Overseas studies -

Reductions in illness symptoms:

- Sick-leave absences > 60%
- Primary school absences - 23%
-
- Coughing, wheezing - 35%
- Dry eyes, nose, throat
- Perceptions of pain
- Blood pressure



Plants promote health, productivity and performance

Plants improve productivity/performance scores

Overseas findings -

Increased scores on :

- Computer tests
- Item-sorting tests
- Creative thinking exercises
- Examination scores
- **Task productivity (items completed) by 12%**
- **Job satisfaction -**
(desk plants preferred to planted window views)



Plants do promote productivity and performance

UTS study - *Does plant presence lower stress?*

UTS Studies: Findings

* Plant treatments -

Reductions in negative-feeling scores:

- Anxiety -37%
- Anger -44%
- Depression -58%
- Fatigue -38%
- Confusion -30%
- **Total negativity -65%**
- **Overall stress -50%**

*No-Plant (Control) group-

- **Negative scores increased: +20-40%**

***Plants directly reduce stress scores -
Promote productivity and performance***

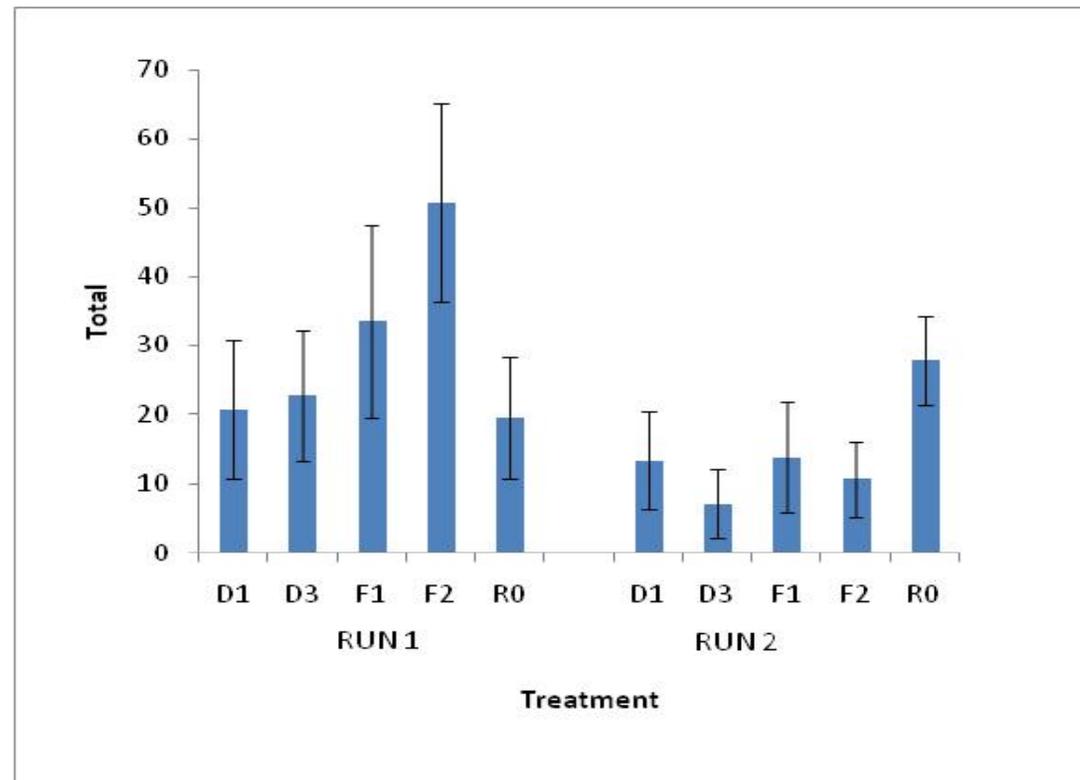
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Google images

Effects of plant treatments on total negative 'Mood State' scores

For lifting spirits -----
----- >

*Just 1 plant
makes the difference!*



Overall - Indoor plants contribute to most IEQ criteria

IEQ criterion	Indoor plants
* <i>Air pollution mitigation</i>	Reduce all types of UAP ⁺⁺
* <i>Low Emitting Materials</i>	Absorb toxic emissions - VOCs etc. ⁺⁺
* <i>Ventilation effectiveness</i>	Increase effectiveness - remove CO ₂ /add O ₂ ⁺⁺
* <i>Lighting</i>	OK for Plants? - OK for staff also? ⁺⁺
* <i>Noise</i>	Absorb & buffer noise ⁺
* <i>Views</i>	Adds aesthetics & calming greenery; lowers stress ⁺⁺
* <i>Thermal comfort</i>	<i>Not influenced</i> – but plants tend to stabilise humidity in human comfort zone ⁺
* <i>Systems controllability</i>	<i>Not influenced</i>

*Criteria list:
studies

NSW Government,
Workplace Guidelines, 2010

⁺O/S studies ⁺⁺O/S & UTS

- Indoor plants positively influence at least 75% of IEQ criteria
- GBC - up to 2 points for plants in Green Star rated buildings

Strategies for sustainable workplaces of the future?

- **Make interior plantings normal building installations - to improve:**
 - Productivity and performance
 - Staff spirits/morale
- **Productivity increases of < 1% would more than cover costs of plants**
- &
- **Assist in achieving the goal of sustainable workplaces and cities in Australia -**
- **Triple-bottom-line: 'planet-people-profit'**



Google images

What's next for indoor plants?

R&D to:

Maximise CO₂ reduction capacity, via-

- Horticultural technology development
- Collaboration with engineers on lighting needs
- **Integration of plant capacity to reduce AC energy costs**



Compare plant air-cleansing efficiency-

- In different growth media -
eg hydroculture, waste materials, etc
- **To optimise total plant contribution to IEQ**



Google images

Species UTS-laboratory tested for VOC removal

- *Aglaonema modestum*
- *Chamaedorea elegans* (Parlour Palm)
- *Dracaena deremensis* ‘Janet Craig’
- *Dracaena marginata*
- *Epipremnum aureum* (Pothos; Devil’s Ivy)
- *Howea forsteriana* (Kentia Palm)
- *Philodendron* ‘Congo’
- *Sansevieria trifasciata* (Mother-in-law’s tongue)
- *Schefflera* ‘Amate’ (Qld. Umbrella Tree)
- *Spathiphyllum* ‘Petite’ (& ‘Sweet Chico’)
- *Spathiphyllum* ‘Sensation’
- *Zamioculcas zamiifolia* (Zanzibar; ZZ)

THE FUTURE@WORK HEALTH REPORT

Employees and their Workplace



Neil Holt

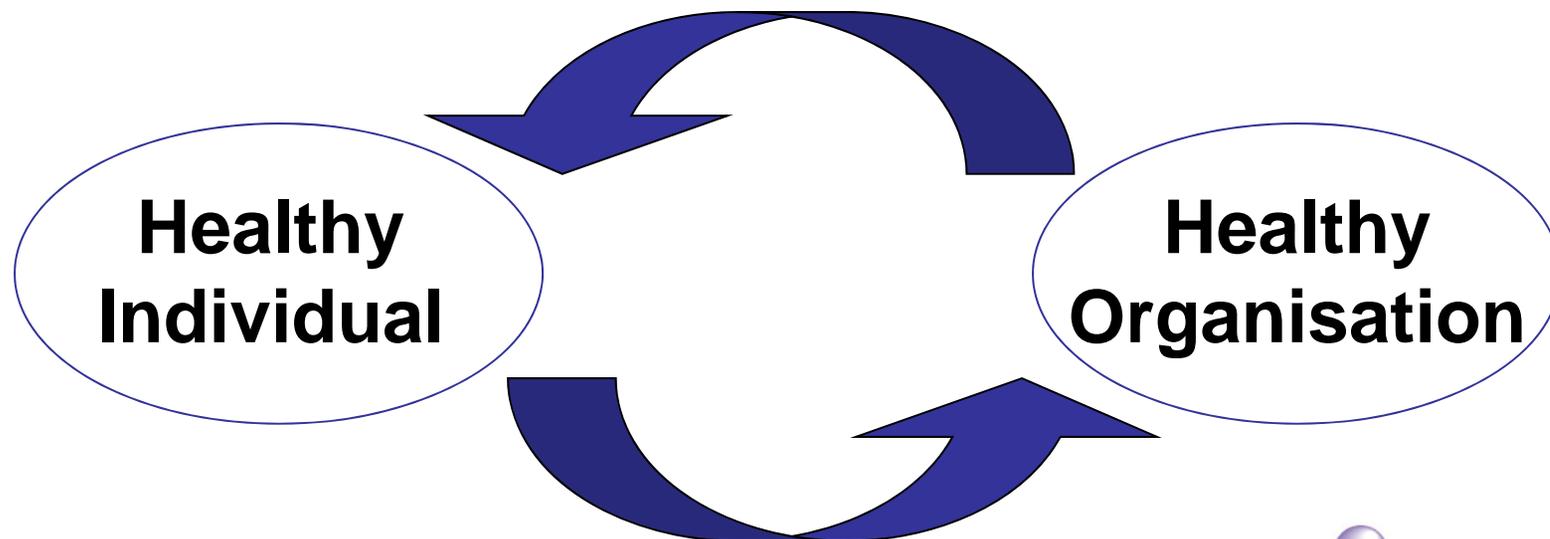
CEO

Wesley Corporate Health



Why Health in the Workplace?

Workplace health focuses on discretionary programs and strategies to improve staff health and wellbeing, productivity and profitability. Healthy people spend more time at work and are more productive than unhealthy people



Australia's Best Employers

(AGSM, Hewitt & Assoc, AFR)

*provide leadership, communication, respect
and responsibility*

One piece of evidence linking people practices and performance

Average revenue growth	-	48% vs 25%
Profit growth	-	62% vs 18%
Staff turnover	-	15% vs 20%
Job applications	-	5 vs 2.8

For every \$1 spent on employee health – there is a \$3.27 return in reduced absenteeism and improved productivity

What about the link between the workplace environment, health, people practices and performance



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Absenteeism

Direct and Hidden Costs

- Absenteeism – direct costs
 - Incidence of 2.5% (6.7% of payroll)
 - Costs employers 2% of GDP (\$20 billion)
- Administrative costs – indirect costs
 - Double the direct salary costs
- Presenteeism – hidden costs
 - Present but not productive
 - Doubles the direct salary costs

Total cost of absenteeism is estimated at 3 to 5 times the initial salary cost

Health Risks – the Hidden Costs

Its all about productivity

Bank One (28,375 employees)

Health Risks Studied:

- Smoking
- Inactivity
- Excess Alcohol
- Relaxation Medication
- Elevated BP
- High Cholesterol
- BMI>30
- Life Dissatisfaction
- Job Dissatisfaction
- Poor Physical Health
- High Stress

- 10 risk factors were found to each decrease productivity by 2.4%
- Collectively these risk factors had a larger impact
- Greater than 5 risk factors reduced productivity by 13.5%

JOEM, August 2005



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The Workplace Environment's Effect on Health

Internal Environment Quality (IEQ) includes

- Air quality & Ventilation
- Temperature & Lighting
- View & Noise

Poor IEQ is linked to respiratory disease, Sick Building Syndrome and employee stress

- It costs the Australian economy \$12 billion per annum (CSIRO)
- Improved IEQ can lead to productivity increases of 15% (ranging up to 30%)



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The Workplace Environment's Effect on Health

Indoor air quality (IAQ) is a major part of IEQ

- Over 350 VOCs have been identified in indoor air
- Air pollution is a major risk factor for respiratory disease
- Respiratory disease is the number one cause of workplace absence
- Asthma is Australia's most widespread chronic disease affecting 2.2 million Australians
- Asthma begins with an allergen – VOCs, airborne particles



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What is Sick Building Syndrome

- Acute symptoms of eye, skin and nose irritation, headache, fatigue and breathing difficulties associated with occupancy but not a specific disease
- NSW Dept of Works estimated SBS related absenteeism cost \$125 million annually and 40% + of offices qualified
- Between 5% and 40% of all office workers experience symptoms
- Risk factors included lower ventilation rates, presence of AC, higher indoor air temperatures, debris or moisture in AC, increased chemical and organic pollutants, more carpets and fabrics, less cleaning
- One study showed increasing ventilation rates to 10 cubic feet per person per minute decreased the prevalence of common SBS symptoms by 33%



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The Ideal Workplace Environment

- Facilities that promote physical activity
- Green star rated building
- Good IEQ
- Good furniture and equipment layout
- Facilities that promote healthy eating
- Facilities that enable work/life balance
- Onsite child care

Ideal Workplace Environment

Green Star Ratings - Best Practice for IEQ factors

- Reduced greenhouse gas emissions
- Energy efficient
- Waste reduction – recycling
- Improved IEQ
- Reduced lifecycle costs
- Improve health
- Higher morale and motivation
- Increase productivity



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Ideal Workplace Environment

Good IEQ

- Improved air quality
- Reduced VOCs in fitout materials
- Occupant control of temperature and air flow
- Minimise noise levels – partitions & meeting areas
- Healthy lighting - daylight and artificial light mix
- Green space and view – indoor plants

Studies of productivity increases from good IEQ average 15%
(range up to 30%)

CH2 Melbourne

12 months post occupancy study to evaluate IEQ and occupant health, wellbeing and productivity

Key conclusions

- High satisfaction rate compared to previous spaces
- Thermal comfort measurements good; perceived thermal comfort good
- Air quality measurements excellent; perceived quality good
- Ambient noise levels measurements ideal; staff rating average to poor
- Lighting measurements satisfactory; staff rating average to poor
- 10% perceived productivity enhancement; 75% rated it +ve
- Absenteeism and staff turnover; no change at 12 months



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IEQ and Productivity Gains

- Study by US EPA – 90% of 30 year building costs are employee salaries
- Reducing absenteeism and presenteeism by 1% would pay for upgrading to a green status
- 80% of productivity gains are from improved IEQ
- This is the largest economic benefit of high rating green buildings
- CH2 predicts productivity benefits higher than savings from energy and water



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Ideal Workplace Environment

Physical Activity

- Internal stairwells and signage
- Onsite gymnasium or close access
- Bicycle racks
- Adequate lockers and showers
- Proximity to bicycle paths and walkways
- Proximity to parklands
- Proximity to public transport

Ideal Workplace Environment

- Good Ergonomic Design for Furniture and Equipment Layout
 - Reduces accidents and injury
 - Productivity gains of 18% have been reported
- Facilities that Promote Healthy Eating
 - Onsite cafeteria with healthy food options
 - Onsite food courts with variety of food outlets
 - Vending machines with healthy food options

F@W Health Report

Conclusions

- ❖ Employers need workplace and workforce strategies to attract and retain employees
- ❖ Workplace health strategies reduce absence, improve health and increase productivity
- ❖ The workplace environment has a direct effect on employee health and productivity
- ❖ The ideal workplace environment is green, has good IEQ and smart features that enable work/life balance and promote activity, health and wellbeing



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People, Plants and Productivity - Workplaces of the Future

Green Star – IEQ

Digby Hall



greenstar IEQ – Agenda

- IEQ - What Green Star is trying to achieve
- Design Requirements
- Who contributes?
- Key strategies and success factors
 - Early adoption & commitment
 - Collaboration & Holistic design

greenstar IEQ – Green Star Aims

- Balance with other categories
- Response to Sick Building Syndrome
- Giving us a way to measure & manage

greenstar IEQ - Green Star Aims

IEQ is in ALL
Green Star
tools...

 green star™ environmental rating system for buildings	Office v3	 green star™ environmental rating system for buildings	Office Existing Building EXTENDED PILOT
 green star™ environmental rating system for buildings	Office Interiors v1.1	 green star™ environmental rating system for buildings	Education v1
 green star™ environmental rating system for buildings	Retail Centre v1	 green star™ environmental rating system for buildings	Industrial PILOT
 green star™ environmental rating system for buildings	Healthcare v1	 green star™ environmental rating system for buildings	Multi Unit Residential v1

™green building council australia

greenstar IEQ – Green Star Aims

Weightings

Office v2/v3		20%
Office Interiors	25%	
Education		20%
Retail	12%	
Healthcare		20%

The number of points available is also a factor, however IEQ is consistently amongst the top 2-3 categories for 'value per point'



IEQ – Design Requirements

Ventilation	Design Requirement	Stakeholder
Ventilation Rates	Increased outside air	Mechanical
Air Change Effectiveness	Improved air circulation, diffuser selection and location	Mechanical
Carbon Dioxide Monitoring & Control	Control of CO ₂ , BMS connection	Mechanical



IEQ – Design Requirements

Comfort	Design Requirement	Stakeholder
Daylight	%NLA with natural light	Architect, Electrical
Glare Control	Prevent direct sun penetration	Architect
HF Ballasts	Electronic control gear	Electrical
Lighting Levels	Max. 400Lux – good lighting design	Electrical
External Views	NLA within 8m of façade/atrium	Architect
Thermal Comfort	Human comfort levels	Architect, Mech / Elec
Comfort Control	Localised control of HVAC/conditions	Mechanical
Noise Levels	Acoustic comfort to 'recommended' levels	Acoustic, Mechanical, Architect
Places of Respite	Quiet places for occupants, indoor or outdoor	Architect



IEQ – Design Requirements

Pollutants	Design Requirement	Stakeholder
Hazardous Materials	Remove asbestos, lead, PCBs	Architect, Client
VOCs	Low VOC emissions in paint, carpet, sealants / adhesives, joinery	Architect, building services included
Formaldehyde	Low emissions in composite timbers	Architect
Mould Prevention	Control Relative Humidity	Mechanical
Tenant Exhaust Riser	Dedicated tenant exhaust	Mechanical
Indoor Plants	Maintained indoor plants	Architect
Air Distribution System	Access to components for cleaning	Mechanical
Outdoor Pollutant Control	ASHRAE compliance	Mechanical

greenstar IEQ – Design Requirements



From master planning to detailed design

New build or refurbishments



IEQ – A Team Effort

Ventilation

- Ventilation Rates
- Air Change Effectiveness
- Carbon Dioxide Monitoring & Control

Architect
Mechanical engineer
Electrical engineer

Comfort

- Daylight
- Glare Control
- High Frequency Ballasts
- Electric Lighting Levels
- External Views
- Thermal Comfort
- Comfort Control
- Internal Noise Levels
- Places of Respite

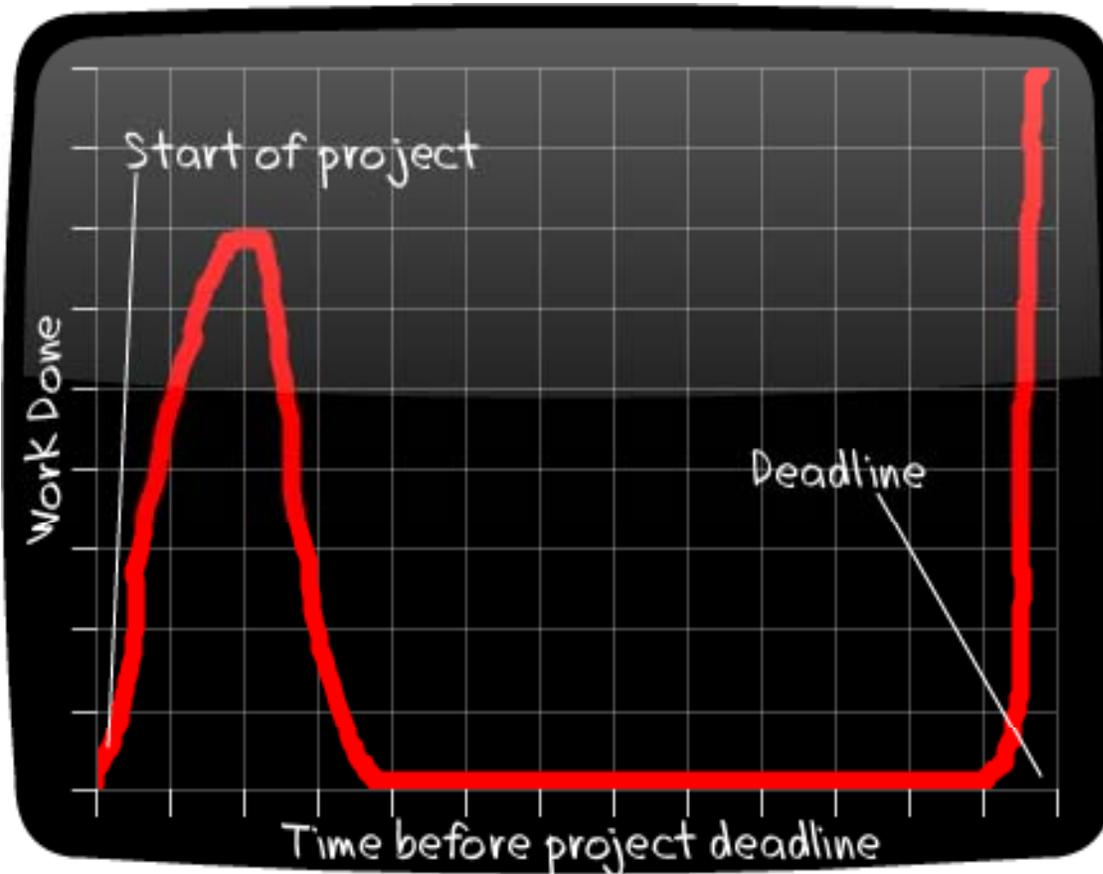
Indoor Pollutants

- Hazardous Materials
- Volatile Organic Compounds
- Formaldehyde Minimisation
- Mould Prevention
- Tenant Exhaust Riser
- Indoor Plants
- Air Distribution System
- Outdoor Pollutant Control

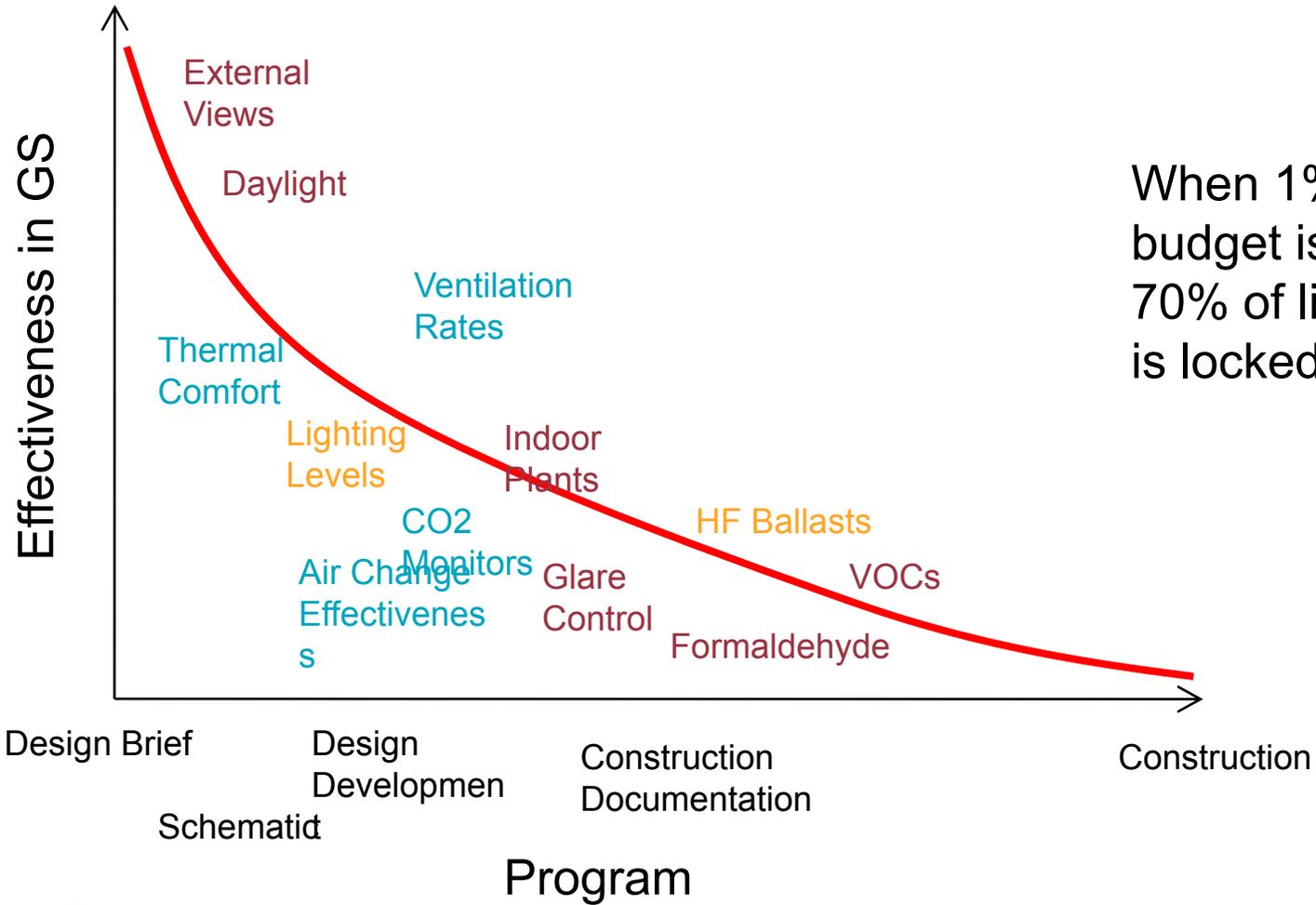
greenstar IEQ – A Team Effort

- Most *collaborative* Category in Green Star
- Intense team work is required
- Regular design team meetings required





Typical design / documentation process...



When 1% of budget is spent, 70% of lifecycle is locked in



IEQ – Success Factors

Collaboration

THERMAL COMFORT

Aim: To encourage and recognise buildings that achieve a high level of thermal comfort.

- Assessments based on PMV (predicted mean vote) levels for 98% of the year when building is occupied.

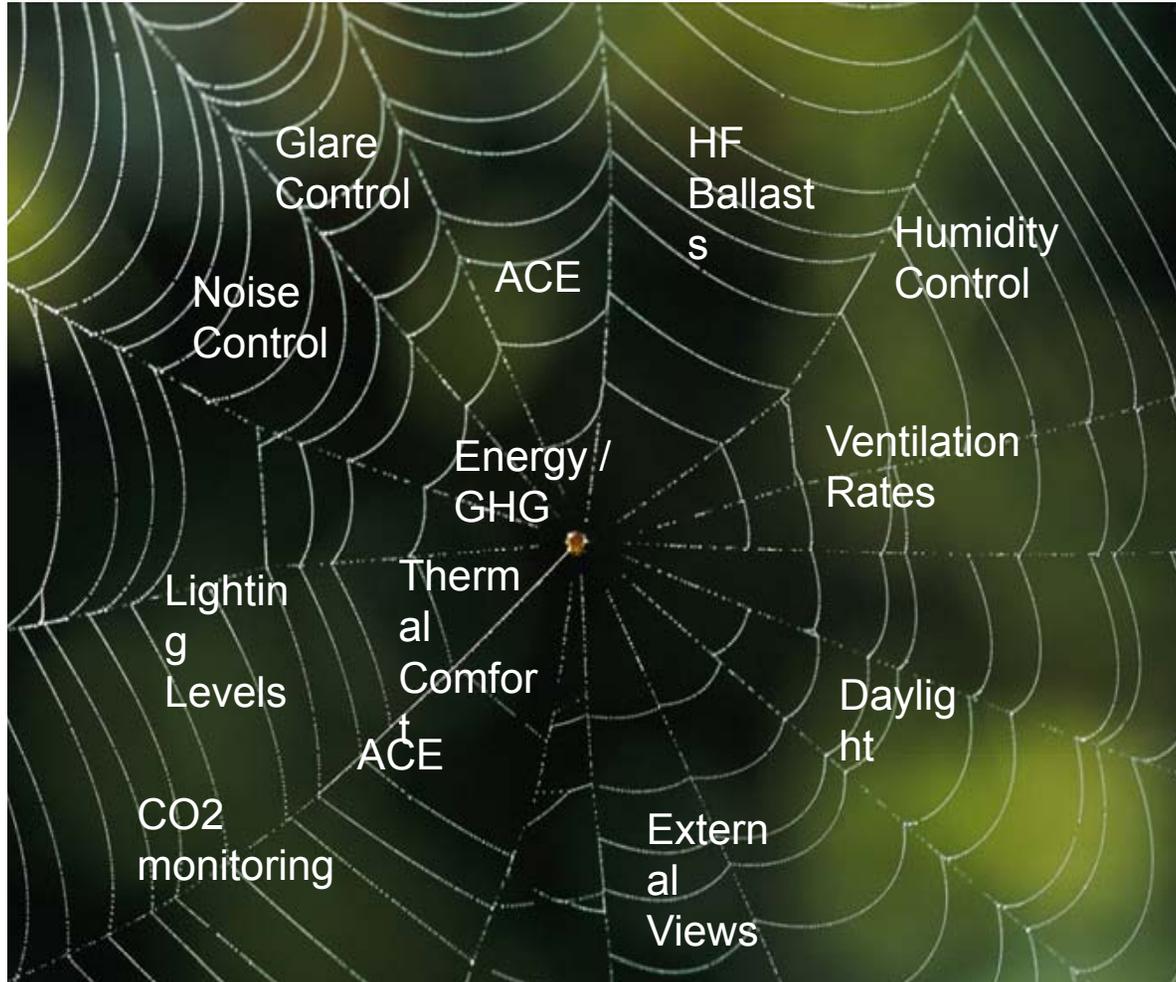
Component	Architect	Mechanica l	Electrical
Glazing	✓	✓	
Wall section	✓	✓	
Insulation	✓	✓	
Air velocity		✓	
Humidity		✓	
Lighting			✓
Equipment	✓		✓

Linked to
daylight, Ene-1,
Lighting levels,
LPD etc



IEQ – Success Factors

Holistic Design



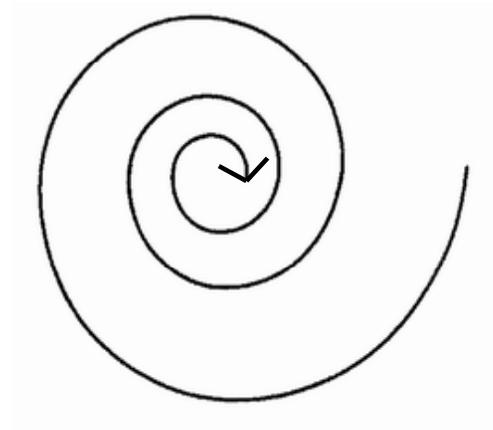


IEQ – Success Factors

Holistic Design



Linear design process



Holistic design process



IEQ – Success Factors

- Allow enough time to resolve the outcome
- Get all disciplines involved early
- Commit to IEQ attributes early



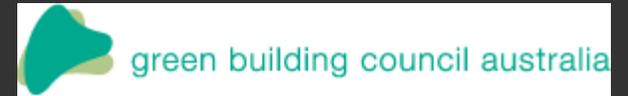
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Ray Borg
Regional Director
Ambius Pacific



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TO OUR SPEAKERS....

**Prof Margaret Burchett- University of
Technology Sydney.**

Prof Neil Holt- Wesley Corporate Health

Digby Hall- Synergy Green

Today's Projects

**Brisbane City
Council Fit Out**

**4 Star Green Star
Office Interiors v1.1**

**Ed Crouch
Brisbane City Council**



Today's Projects

**25 Montpelier Road
Fortitude Valley**

**4 Star Green Star
Office As Built v2**

**Simon Juniper
Watpac Developments**



Today's Projects

**Emerald Lakes
Town Centre**

**4 Star Green Star
Office Design v2**

**Mark Grierson
Nifsan Developments Pty Ltd**

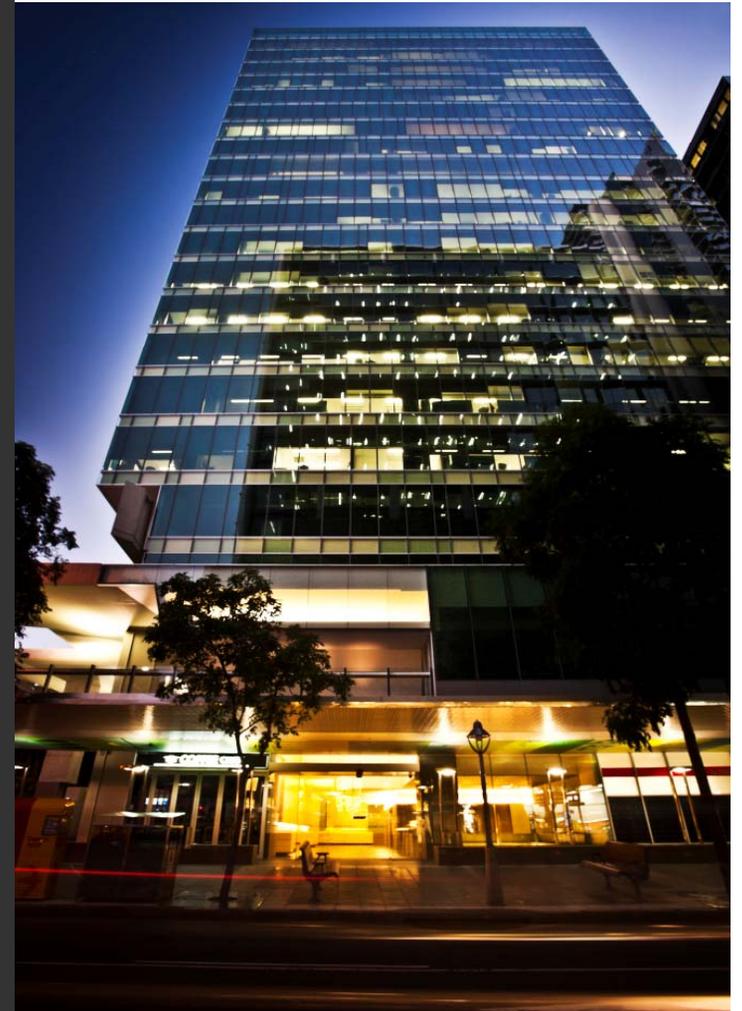


Today's Projects

42 Albert St- AM60

**5 Star Green Star
Office Design v2**

**Amanda Gilson
Trinity Fund Management**



Today's Projects

The New Port Office

**5 Star Green Star
Office Design v3**

**Jeff Coleman- CEO
Port of Brisbane Corporation**



Today's Projects

Joint Contact Centre

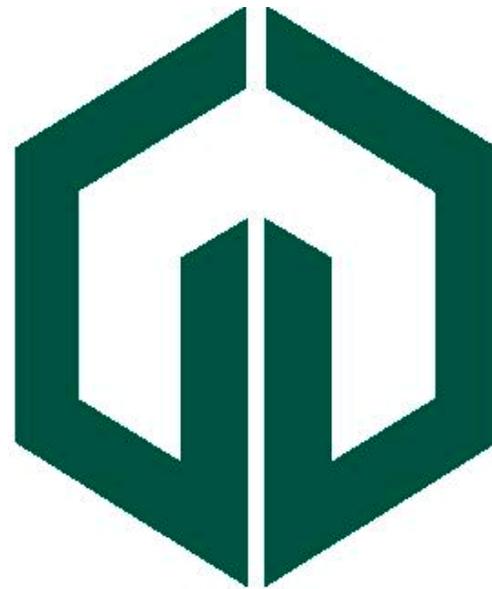
**6 Star Green Star
Office Design v2**

**Graham Messenger
Department of Public Works**



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YOUR GREEN
BUILDING
QUALIFICATIONS
TO A NEW
LEVEL**



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TO THE**

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Details at www.gbca.org.au**



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on GBCA

www.gbca.org.au

