

Environmentally-Friendly Policies & Initiatives – Experiences at Khoo Teck Puat Hospital, Singapore

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Chief Dietitian / Senior Manager
Khoo Teck Puat Hospital
Singapore
22 Oct 2010



2010 International Conference on
Health Hospitals & Healthy Environment, Taipei
– Health Care in the Climate Change Era

Environmentally Friendly Hospital

- **Where we come from – Alexandra Hospital**
- Building Design – Khoo Teck Puat Hospital
- Healing Environment
- Sustenance & Initiatives
 - Green Committee







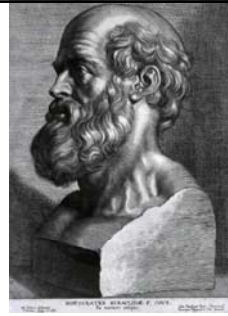
A Brief History of Alexandra Hospital

- British Military Hospital
- Thriving hospital in 70s
- Declining fortunes from 80s
- One-star hospital, historical site in 90s



“Primum non nocere”

- First, do no harm
- Hippocratic oath
 - To abstain from doing harm



Our Belief → Healing with Nature

- A Hospital for Our Patients
- Patients in a World of Nature



Alexandra Hospital

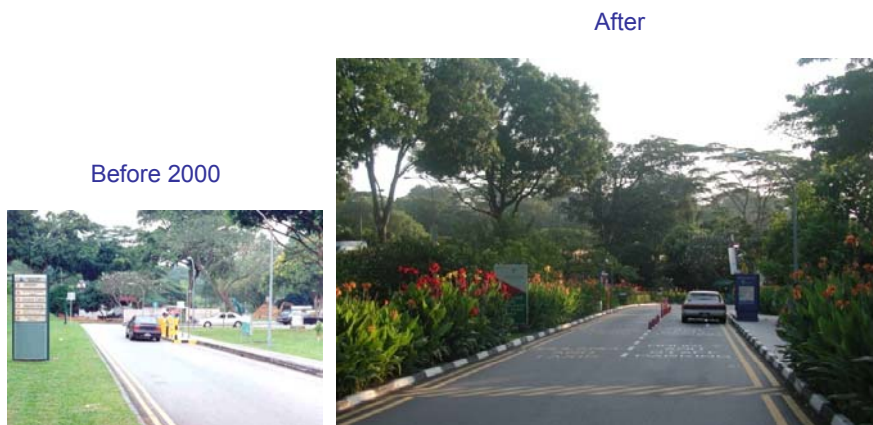
Hospital within a Garden
Garden within a Hospital



Before Restructuring (2000)



Entrance Driveway



New Foot Path 2000

After

Before 2000



11

Shading From Sun

After

Before 2000



12

Hiding Ugly Structures

After

Before 2000



13

The Palm Court

After

Before 2000



14

Zoo Toilet

After

Before 2000



15

Khoo Teck Puat
Hospital
Alexandra Health

Alexandra Hospital After Restructuring



Before Restructuring (2000)



Tuesday, December 25, 2001 THE STRAITS TIMES HOME 117

Hospital gardens proving a big draw

Alexandra opened its grounds, including a soccer field, a year ago: response has been overwhelming

TWICE a month, 18-year-old student Lai Bee Sin takes a bus to take a bus ride from Choo Choo Kang to Alexandra Hospital.

It is not because he is ill or visiting patients there. He is just a footballer in love with the hospital's soccer field.

"It's in great condition, and I get to use it for free," he said happily.

Every week, youths like him come from all over the island to play on the hospital's field.

The hospital, nestled in Queenstown housing estate, opened its grounds to the public a year ago and response has been overwhelming.

On most days, residents can be seen taking a morning stroll through the hospital's sprawling gardens.

The landscaped park with a fountain and exercise corner was refurbished last year.

Visiting residents are mostly retirees who sit and chat, or read the newspapers on the benches provided, a hospital spokesman said.

One nearby resident and self-professed "nature lover," who declined to be named, said that she walks through the garden several times a month just to appreciate the scenery and the peaceful surroundings.

The 65-year-old housewife added: "There are not many nature spots in Singapore. I'm very glad that the hospital has opened up its lovely grounds to the public."

There is no charge for using the 4,000-sq-m soccer field but bookings have to be made in advance.

Hospital operations executive Henry Sene said: "We don't keep track of the number of 'neighbours' popping in now and then, but the field is occupied almost every day."

"This is not surprising, since somewhere on the island can you get a free field to play on?"

Bee Sin, who plays soccer with 30 friends on the hospital field, said: "Soccer fields at schools are not as easily accessible. And some are not of such good quality, either."

Even if you are not from the Queenstown neighbourhood, you can still see the hospital's soccer field.

With so many people using the field, parts of it have become bare and the hospital has just re-turfed it for \$100,000.

Mr Sene said: "We've increasing maintenance costs, but we haven't decided whether to charge for the field yet."

Patients and visitors do not mind the open-door policy.

Hennette K.K. Giam, who was visiting her sister at the hospital, said: "So long as the patients aren't bothered, and they get the peace and quiet they need, why not?"

PICTURES: GEORGE GAMON

Alexandra Hospital

Hospital within a Garden Garden within a Hospital

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Rosalind and Wee Lee



First Gardening Day 2000



3 S of a Garden

- Sight
- Scent
- Sound



Sight



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Khoo Teck Puat
Hospital
Alexandra Health

Scent



Fragrance Garden



Ms Aileen Lau



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Khoo Teck Puat
Hospital
Alexandra Health

Sound



Soothing sound of water

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More Sights

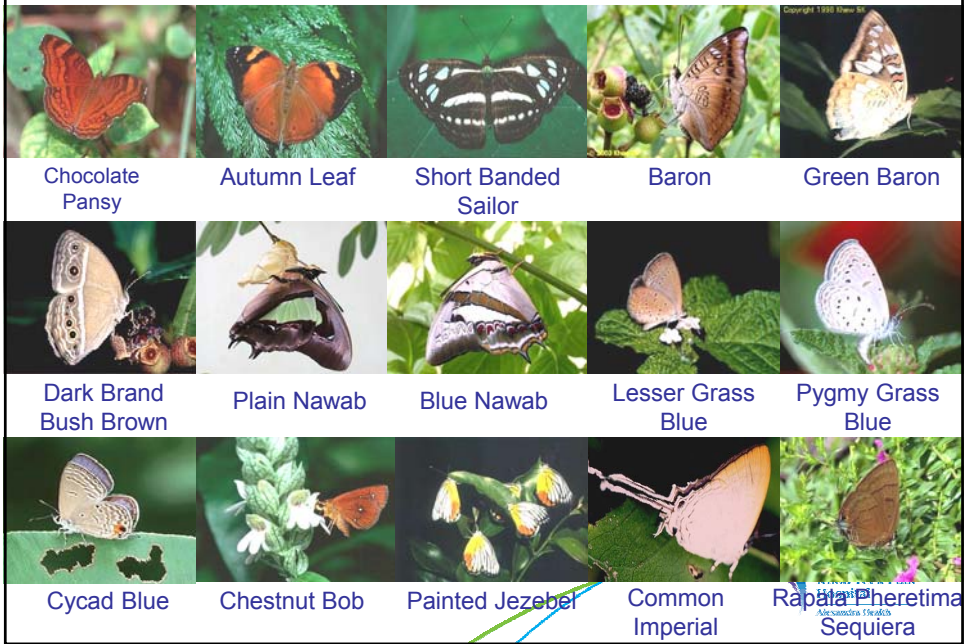
Butterfly Trail



24



Butterflies @ Alexandra Hospital



Eco Pond



Medicinal Garden



Dr Wee Yeow Chin

Banana Plantation



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More Sounds

Birds



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Khoo Teck Puat
Hospital
Alexandra Health

They Visited Us



Khoo Teck Puat
Hospital
Alexandra Health

We Visited Them



Teck Puat Hospital
Alexandra Health



Happy Environment

- ➔ Happy Staff
- ➔ Happy Patients
- ➔ Happy Rating



*President's Award
for the Environment*

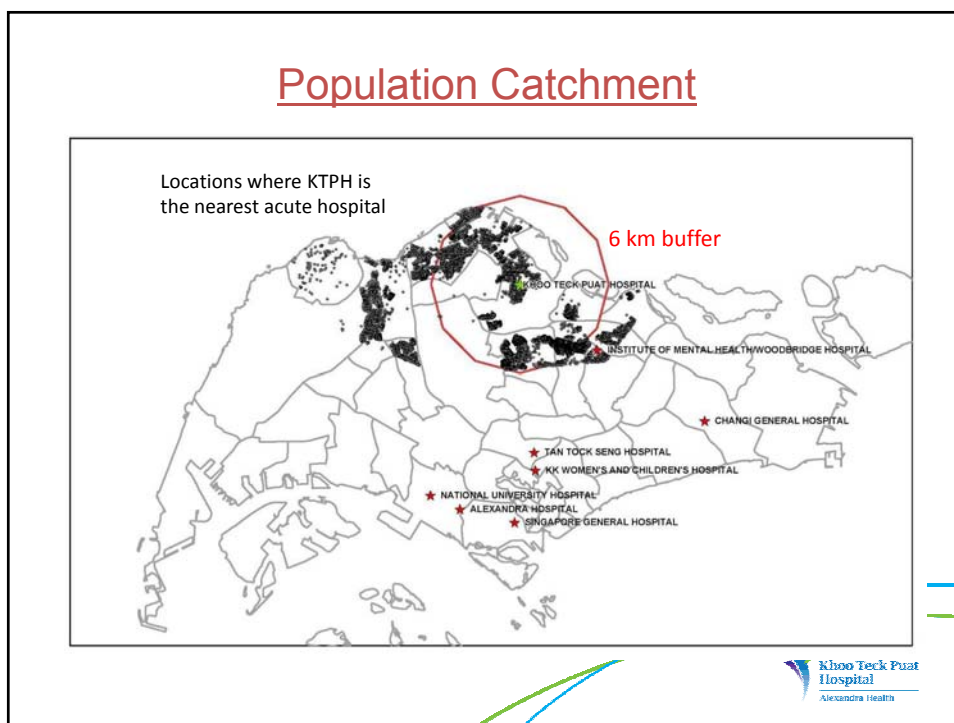
Recognising Outstanding Contributions towards Singapore's Environment Sustainability



Platinum Singapore Health Award
HEALTH Leader Excellence Award
HEALTH Promoter Award

*Watermark
AWARD*





Trailblazing Hospital of The Future

Touching Lives, Pioneering Care, Making A Difference

- Dr James Low, Head, Geriatric Medicine



KHOO TECK PUAT HOSPITAL

Vision

Help our people live a long healthy life
and support them with thoughtful,
dignified care to the end.

Mission

Provide good quality, affordable and
hassle-free healthcare
with science, love and wisdom



Hassle Free Hospital

“I posed the challenge to the AH rebuilding team: build a hospital... designed with **patients** unambiguously at the **centre of the focus**, with technology fully exploited for the benefit and convenience of patients.... It will be a hospital which is well linked... and to which the patients can be transferred seamlessly. It will be a ***hassle-free hospital.***”

Mr Khaw Boon Wan, Minister of Health
Debate, 17 March 2004

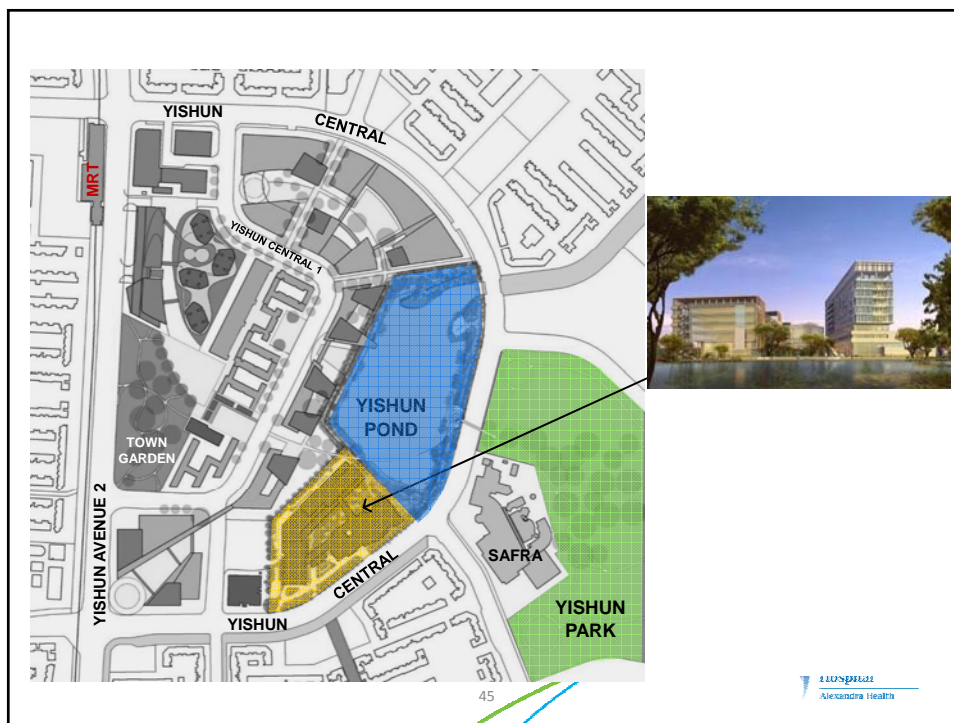


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Environmentally Friendly Hospital

- Where we come from – Alexandra Hospital
 - how we developed our culture
- **Building Design – Khoo Teck Puat Hospital**
- Healing Environment
- Sustenance & Initiatives
 - Green Committee





Challenges To Architects (2004)

- Award winning reference site
- WOW for patients, visitors and staff
- Criticized by small-minded critics
- Reasonable cost

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Energy Efficient Challenge (2004)



- 50% more energy efficient than present hospitals
- Tropical building
- Natural ventilation
- Overhangs
- High ceilings
- Use of solar & wind power

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Green Mark Platinum Award 2009



KEY GREEN DELIVERABLES

- Healing Environment to patients through appropriate comfort conditions
- A tropically responsive Facade Design
- Renewable energy to offset Carbon Foot Print
- Energy efficient systems design
- Operational efficiency & ease



KEY GREEN DELIVERABLES

- Bright & Cheerful
- Environment

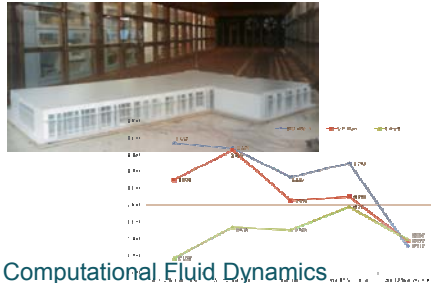
- Day Lighting
- Glare Control
- Soothing Pastel Colours
- Green Views

Seamless and Accessible

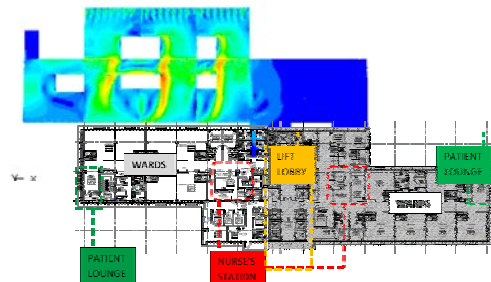


KEY GREEN DELIVERABLES

Wind Tunnel Tests



Computational Fluid Dynamics



The lower block legend showing the position of the nurse's station, wards, lift lobbies and the patient lounges that aim at achieving visual comfort.

Superior Thermal Comfort

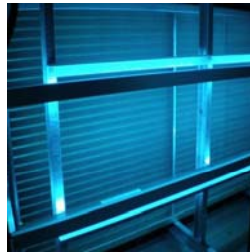
- Customised Shading Devices
- Tropically Acclimatised Façade
- Active/Passive Climate Control
- Computational Fluid Dynamics
- Wind Tunnel Tests
- Wing Wall
- Individual Temperature Controls

KEY GREEN DELIVERABLES



CO2 Sensor

UVC Light in AHU & FCU



Superior Indoor Air Quality

Indoor Air Pollutant Control

UVC Treatment

Superior Filtration

Pneumatic Waste Disposal

CO² Monitoring



GREEN COST ANALYSIS

Ref	Description	Value	Remarks
A	Construction Cost S\$ (exclude GST)	S\$ 520,779,000.00	
B	Constructed Floor Area (m2)	132,339 m2	include all covered area Eg. Car park
C	Unit construction Cost (S\$/m2)	3,933.00 S\$/m2	A/B
D	Cost increase due to better glass facade to achieve better ETTV/RETV (S\$)	S\$ 1,680,000.00	Eg. Double glazed facade system
E	% increase in construction Cost due to use of better Glass (%)	0.3%	
F	Over all % increase in construction Cost due to green features (%)	4.88%	
G	Payback period (years)	6.23 Years	incremental cost/ Potential saving /year



GREEN COST ANALYSIS

Key KPIs	Estimated saving	Remarks
Energy saving	35.9%	% saving compared to code compliance building
	20,408,947 kWh/yr	kWh energy saving per year (kWh/Yr)
	4.08 million	S\$ saving per year (assume \$0.20 per kWh)
CO2 emission reduction per year	10,204.47 tonne	Express in tonne of CO2 (assume 500g of CO2 produced for every kWh electricity consumed. 1 tonne of CO2 is equivalent to 1000Kg of CO2)
Renewable Energy	435,547	kWh harvested per Year
Water saving	39.80%	% saving compared to code compliance building (Operational Phase)
	64349.5 m3	Cubic metre saving per year (m3/Yr) (operational phase)
	\$75,290.20	S\$ Saving per year (S\$ 1.17/m3 + 30% water conservation Tax)
Expected overall Annual cost Savings (S\$)	S\$ 4,155,290.20	Energy + Water savings

Resource Efficient Operations

Alexandria Sheekh

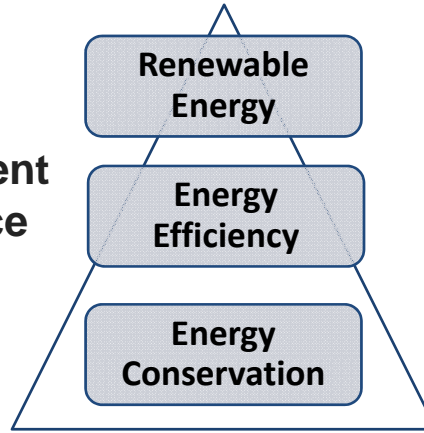
ENVELOPE THERMAL TRANSMISSION VALUE: 38.7 W/m²

	Type	Shading Co-efficient (SC)	Thermal transmittance (U) in W/m2
24 mm Thick Glass	A	0.21	1.42
24 mm Thick Glass	B	0.24	1.6
10 mm Thick Glass (grey tinted Glass door)		0.53	5.6

Khoo Teck Puat Hospital
Alexandria Health

ENERGY EFFICIENT OPERATIONS

**35.9% more
energy efficient
over reference
standards.**



ENERGY EFFICIENT OPERATIONS

Air-conditioning System



Efficient equipment & system design

900Ton Chillers	- 0.49 kW/To
Chilled Water Pumps	- 0.098824 kW/To
Condenser Water Pump	- 0.058003 kW/Ton
Plant room efficiency	- 0.647 kW/Ton
Cooling Tower	- (0.042kW/Ton)
System efficiency	- 0.689 kW/Ton
Air Conditioning Plant	- 29.9%
Air System Fans	- 25.7%

ENERGY EFFICIENT OPERATIONS

Energy Recovery Systems

Heat Pipes system – Passive method to recover waste heat from AHUs serving day surgery operating theatres.



ENERCOV system – Active method to recover waste heat from AHUs in the operating theatres.



ENERGY EFFICIENT OPERATIONS

Solar Photovoltaic System: CERT Programme

137 kWp of photovoltaic cells installed on the roof top of KTPH.

Producing 150,000 kWh of power per year.



ENERGY EFFICIENT OPERATIONS

Solar Thermal – Hot Water

Solar thermal system to provide for 100% of hot water requirements in Khoo Teck Puat hospital.

The system replaces 285,532 kWh of energy per year compared to a conventional hot water boiler.



WATER EFFICIENT OPERATIONS

Efficient Water Fixtures & Fittings

Selection of WELS rated “Very Good” and “Excellent” fixtures & fittings.

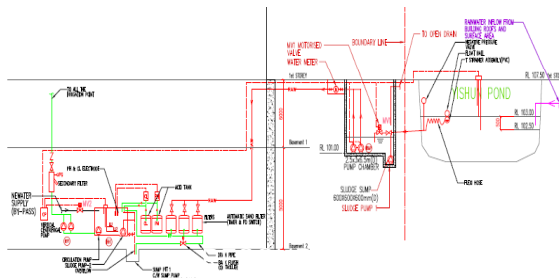
Estimated savings of 39.8% (26.3 m³/day) against non rated fixtures.



WATER EFFICIENT OPERATIONS

Water Efficient Landscaping Irrigation

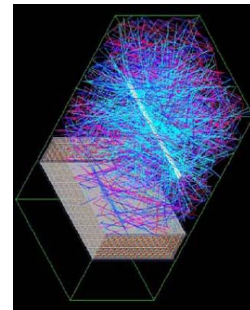
Use of efficient drip irrigation system for landscaping and the use of non-potable water from Yishun pond for irrigation purpose. Rain sensors are utilised to reduce irrigation requirements during rainy seasons.



GREEN FEATURES

UVC Treatment for AHU

UVC treatment for AHUs improves the operational efficiency of AHUs in the long run and improves the air quality by eliminating harmful bacteria & viruses.



GREEN FEATURES

Eco-pond

An ecologically self-sustaining pond that serves as an educational & aesthetical feature.



Total Greening at Eco-pond :

1. Trees: 497 Nos.
2. Palms: 71 Nos.
3. Shrubs: 5900m².
4. Grass: 2315m².

GREEN FEATURES

Composting Equipment

Composting equipment to process food wastes from the kitchen into useful fertilizers for the landscaping in KTPH.



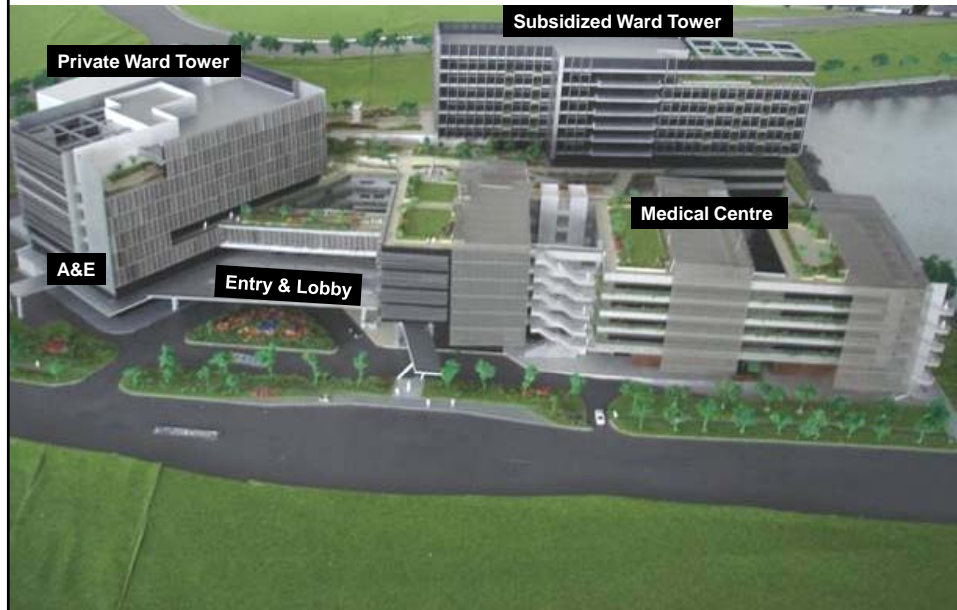
Energy Efficiency Index Calculation (Summary)

	Reference Case (kwh)	Design Case (kwh)	Saving
Lighting (AC)	5,274,888.00	5,079,773.00	3.7%
Lighting (Non AC)	4,184,349.00	3,499,892.00	16.4%
Façade Lighting	472,961.85	428,983.25	9.3%
Exterior Lighting	110,689.00	85,133.00	23.1%
Air Conditioning Plant	13,494,991.00	9,464,321.00	29.9%
Air System Fans	7,012,226.00	5,208,253.00	25.7%
Mechanical Ventilation Fan	11,702,685.00	6,393,404.00	45.4%
Lift	4,536,022.40	4,082,420.16	10.0%
Escalator	1,022,751.22	838,656.00	18.0%
Total Power Consumption (kWh/yr)	56,834,253.47	36,425,306.23	35.90%
Number of Beds	550	550	
EEI (kWh/Bed.mth)	8,611.25	5,518.99	

Environmentally Friendly Hospital

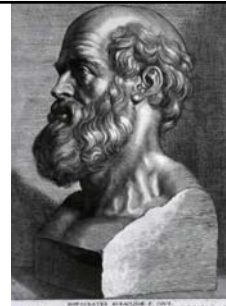
- Where we come from – Alexandra Hospital
- Building Design – Khoo Teck Puat Hospital
- **Healing Environment**
- Sustenance & Initiatives
 - Green Committee
- Future Initiatives

Khoo Teck Puat Hospital



“Primum non nocere”

- First, do no harm
- Hippocratic oath
 - To abstain from doing harm



Our Belief → Healing with Nature

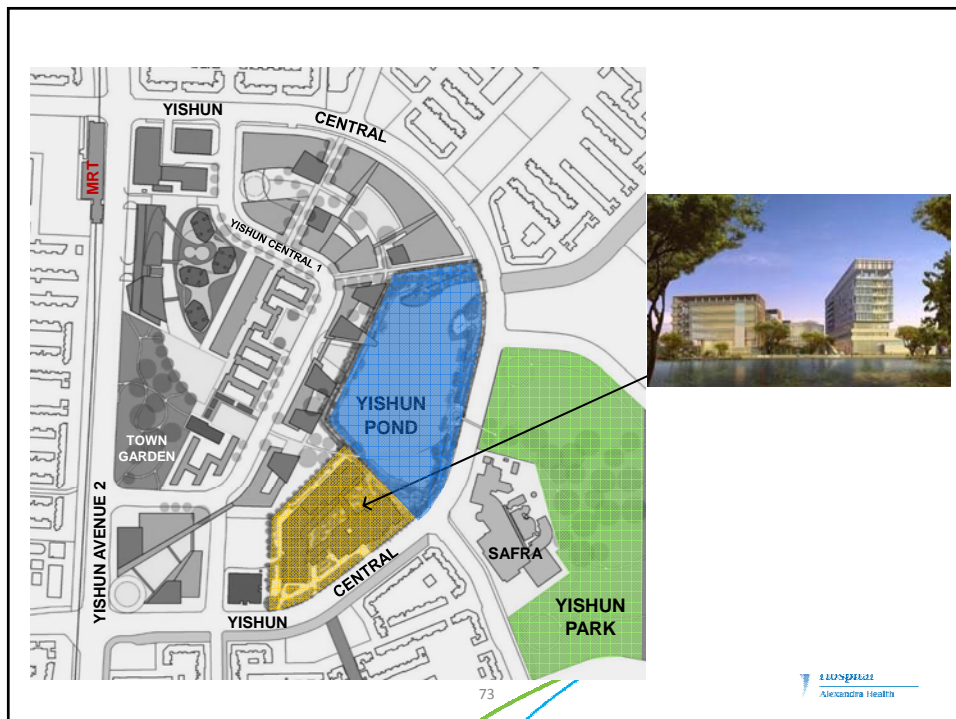
- A Hospital for Our Patients
- Patients in a World of Nature



3 S of a Garden

- Sight
- Scent
- Sound

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Yishun Pond



Engaging URA,
PUB, NParks, LTA
and Sembawang
Town Council in
developing Yishun
Pond and
integrating with
Yishun Park

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Our Partners



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Adoption of Yishun Pond



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Enriching My Yishun

Transforming Yishun Pond into An Urban Oasis

A health-promoting inter-generational garden with lush natural greenery and ecological-friendly features
 Planned Completion: 2015

Children's Garden with play and the parents will also enjoy it

Nature Trail with various trees around the pond

Wetland Wetlands with various birds and plants

Nature Pond with various trees around the pond

Iconic Lookout Tower bridging the Pond with Yishun Park

Located at the flower trail, the Lookout Tower offers visitors a panoramic view of the Town Centre across Yishun Pond and will be seamlessly connected to the lush greenery of Yishun Park by an adjoining overhead bridge.

An elevated walk to be enjoyed by all

A New Landmark for a Rejuvenated Yishun Town Centre

Inspired by nature, the cultural tower will be designed to take the design ideas from the surrounding in the beautiful life-style.

Be a part of Yishun. Suggest an inspiring name for this exciting project now!

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Khoo Teck Puat Hospital
Alexandra Health

Singapore

- ➔ a great city to live, work & play
- ➔ flora & fauna of Southeast Asia




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Khoo Teck Puat Hospital
Alexandra Health

City In A Tropical Rainforest ?



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Khoo Teck Puat
Hospital
Alexandra Health

Gardens Everywhere



7328

Gardens Everywhere (including the Rooftops)



Khoo Teck Puat
Hospital

Ponds Everywhere



Khoo Teck Puat
Hospital
Alexandra Health

Staff Involvement



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Ministers' Involvement





Our First Nesting Bird



A Healed Environment is a Healing Environment

Hospital within a garden, garden within a hospital

Tranquil, restful, healing environment

Sight, scent and sound of nature

Surrounding patients with nature



Challenges Encountered & Solution

- Water drainage during heavy storm
- Strong wind
- Extreme heat on roof
- Pest control without insecticide
- Maintenance
- Doubling, tripling size of drainage
- Careful selection of plants
- Preference for robust indigenous species
- “Tropical” garden instead of mini-cured garden
- Mixed planting for balanced ecosystem
- Planters with healthy soil with thriving population of earthworms and other organisms
- Solar panels and trees with spreading canopy to reduce heat load on roof

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Finding The New Breakthrough

- Learn from everyone
- Follow no one
- Look for pattern
- Work like hell

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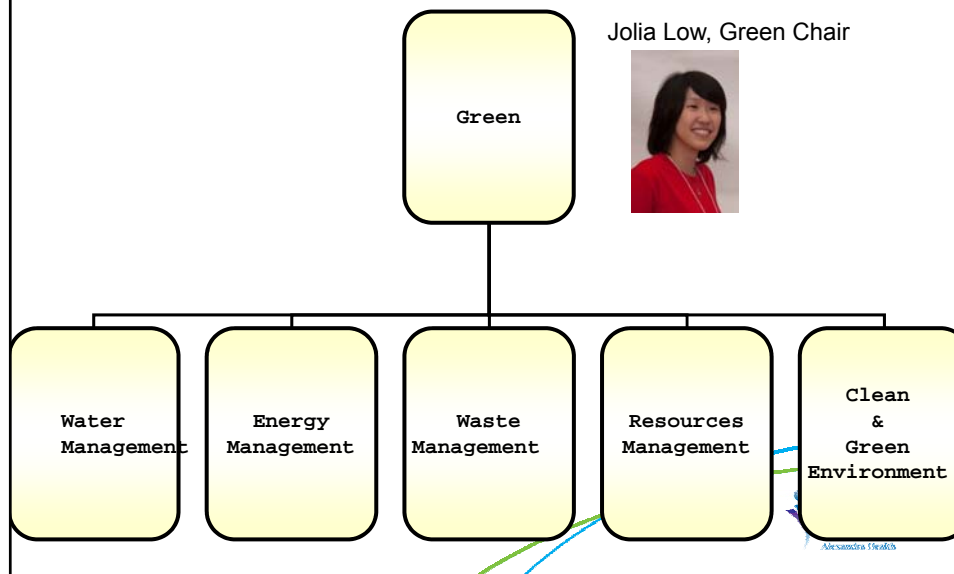


Environmentally Friendly Hospital

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Structure



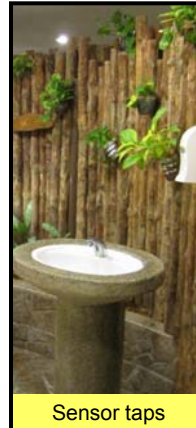
Objective of Committee

- Create a culture of environmental awareness
- Ensure effective management of resources, especially electricity & water
- Measuring & monitoring our progress for each project.
- Encouraging all partners to share in our mission.

Water Management



Sensor Urinals



Sensor taps

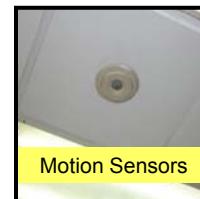
Energy Management



Earth Hour 2010



Incandescent bulbs
Vs
Energy Saving light tubes



Motion Sensors

- Energy Saving light tubes instead of Incandescent Bulbs (98% of power is converted to heat)
- Power consumption: 8W
- Lifespan: 8,000 Hours
- Generates electricity savings due to lower power consumption
- Locations: Staircases and corridors

Waste Management

Recycling Bins @ Strategic Locations



Paper Recycling Boxes in Offices

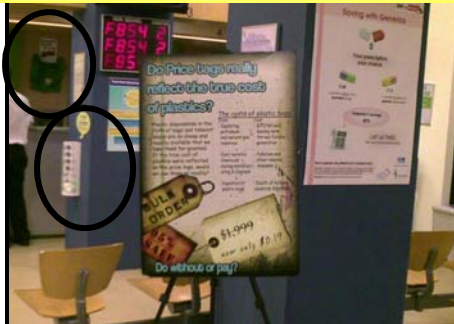


Food Waste Collection



Resource Management

Refuse Plastic Bags Initiative @ Pharmacy



Working with Vendors to Go Green



Donate your "5 legged"

Plastic Bottles



to Portering Office, Level 1 , (next to Admin Office 1)

We are RE-USING  to make



No Styrofoam



CornWare, which can be popped into the microwave and is designed to decompose after 102 days, is brought in by local company OliveGreen.

Resource Management



Paper instead of styrofoam cups



Reusable Melamine Cups rather than disposables



Messages to switch off engine while waiting



Clean & Green Environment



Germs Stopper



Self-Cleaning Initiative



No Smoking Rule

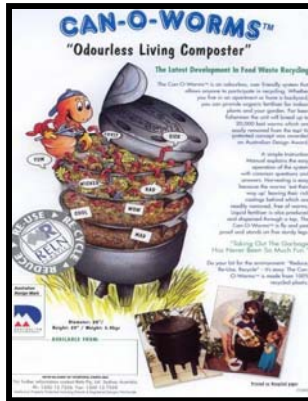


BASIC 10: Maintain Highest Standards of Hygiene



Alexandra Health

Worm Compost Project



The "Can-O-Worms" is one of the GCC initiative to implement the 3Rs. We are recycling our kitchen waste using this donated multiple layered cans which is made from 100% recycled plastic.

The can holds 4000 bait worms which will eat their way and leave their rich castings behind and provide us with organic fertilizer for our garden. It also provides liquid fertilizer which is a good source of nutrient for our plants.

Khoo Teck Puat Hospital
Alexandra Health

Clean and Green Month

Reuse. Reduce. Recycle. Refuse.



Mini-Exhibition + Free Recycled Books
24th Dec 2009



KTPH Clean-Up with Naval Base
5th Dec 2009



Plant Sales

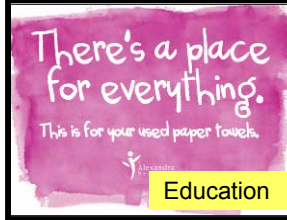
Karang Guni
Sales of Recycled Items

Khoo Teck Puat Hospital
Alexandra Health

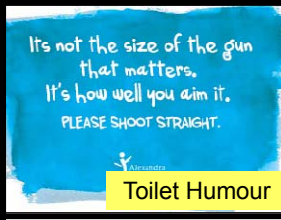
5 Star Toilets



Good Toilet Etiquette Rewards



Education



Toilet Humour



Toilet Competition



DIY Toilet Painting

CYCLING OUR WAY TO HEALTH PROMOTION

KTPH Bicycle Post Competition

www.ktph.com.sg

In partnership with Temasek Design School and DesignSingapore, we are pleased to announce the launch of the KTPH Bicycle Post Competition. We are looking for the creative designs of the design community for the promotion of our facilities.

Judging Criteria

- Innovation and design
- Creativity in design
- Feasibility
- Environmental friendliness
- Cost of materials

Participants

This KTPH Bicycle Post competition is open to all designers - professionals or students.

Entries

Entries must be the original works of entrants and must not have previously received copyright.

Winning Entry

1st Prize - Cash prize of S\$2,000 & a 3-wheeled bicycle - Danon Marks worth S\$1,450
 2nd Prize - S\$1,000
 3rd Prize - S\$2,000

E-Submission

1. Preparation of e-Designs from www.ktph.com.sg
 2. E-Design images in JPEG format
 3. 3D model images in PDF format

Sent to: kphdesign@temasek.edu.sg

There is no limit to the number of submissions but each submission has to be accompanied with a registration form.

Important Dates

Phase 1-Design

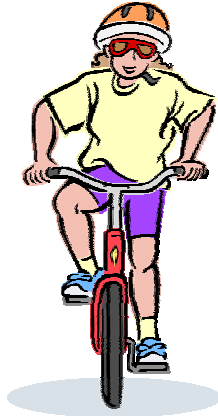
Open for Registration: 9 Dec 2009
 Deadline: 19 Jan 2010
 Shortlisting of 5 Finalists: 18 - 22 Jan 2010

Phase 2-Prototyping

Deadline for Prototypes: 27 Feb 2010
 Announcement of Winner: May 2010



Size of Carbon Footprint



Meat Eater riding a Bike



Vegetarian driving a SUV

Size of Carbon Footprint



Meat Eater riding a Bike



Vegetarian driving a SUV

Biodiversity Day 2010



Khoo Teck Puat
Hospital
Alexandra Health

Earth Day 2010



Khoo Teck Puat
Hospital
Alexandra Health

A Healed Environment is a Healing Environment

Hospital within a garden, garden within a hospital

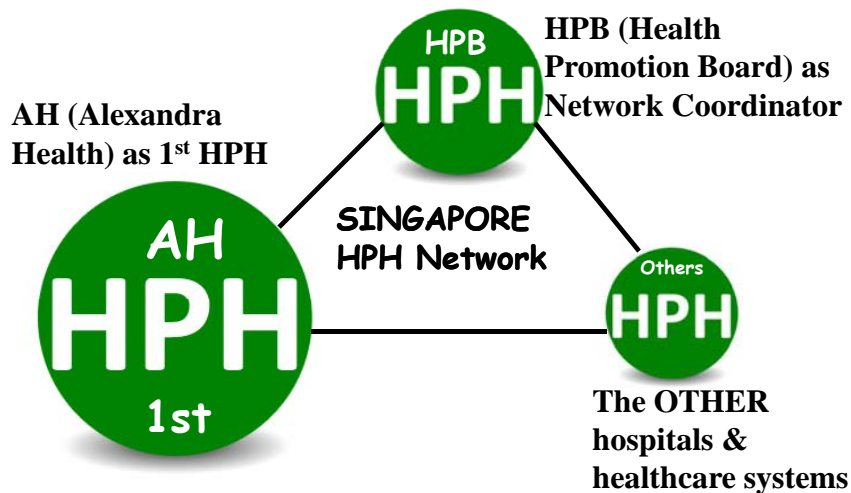
Tranquil, restful, healing environment

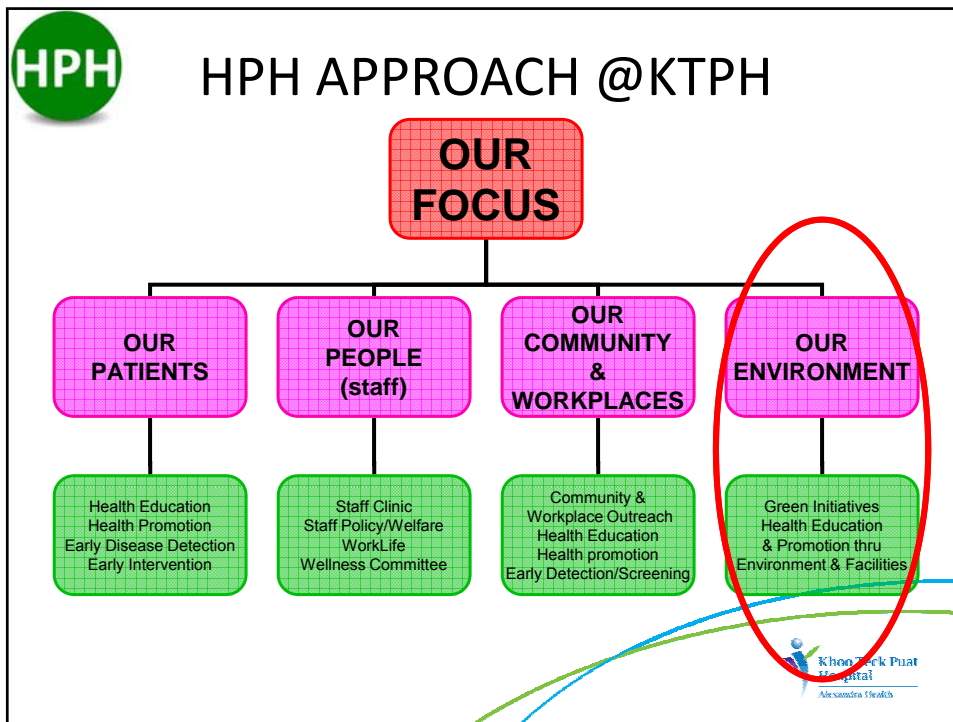
Sight, scent and sound of nature

Surrounding patients with nature




What Singapore is working towards...






HPH Health Advocacy Course
 → Empowering Staff

Healthy Living




Eat Wisely **Exercise Regularly** **Being Happy** **STOP Smoking** **Personal & Public Hygiene**

Environmental Impact → go green




HPH Opportunistic Subliminal Education
 → Love Your Heart, Give your Heart a Lift by Using the Stairs




Use less Lifts → use less energy




Motion sensor Escalators





Foodfare Serves Up Educated Eating



NTUC Foodfare runs on the principal of 4R (Refuse, Reduce, Reuse and Recycle). It's purpose of implementing a charge for every take-away box is to encourage consumers to 'Refuse' the use of a take-away box when not necessary. However, they do acknowledge that there are times when a take-away box is necessary, thus they ensure that the boxes used must be recyclable and sustainable so that it is environmentally friendly.



Refuse. Reuse. Reduce. Recycle.

- **Refuse** disposables, water bottles & plastic bags.
- **Reuse** paper, takeaway boxes
- **Reduce** paper, electricity & water consumption.



Switch off when not in use. Air-con to be between 23-25°C. No screensavers.

- **Recycle** paper, plastic, cans and batteries



Healing The ENVIRONMENT





Healing Hands to Our Patients & Our Environment



Puat

We are on the right track

NEWS TODAY THURSDAY OCTOBER 21, 2010 12

Circle Line on the right track to eco-friendliness

SINGAPORE – The first MRT line to be graded on eco-friendliness has passed with flying colours.

The Building and Construction Authority (BCA) said yesterday it had awarded the Circle Line (CCL) the Green Mark Gold Award for its environmentally-friendly features.

Over the next two years, the other parts of the entire rail network will be assessed

based on the Green Mark for Rapid Transit System (RTS) framework, which was jointly developed by the Land Transport Authority (LTA) and BCA.

Under the framework, existing and future lines will be graded according to three criteria: Environmentally-friendly design, effective energy use and the presence of water-saving features.

Speaking separately at the World Urban Transit Conference at Resorts World Singapore yesterday, Transport Minister Raymond Lim said the framework would "pave the way for the adoption of green technologies". Said Mr Lim: "For the operators, there will be tangible benefits in the form of lower energy consumption and added hedging against rise in energy costs."

In particular, CCL's regenerative braking system was awarded high scores. Energy produced by the train during braking is re-used by an on-board train or channelled through an inverter system used by the station.

The energy saved by the CCL is enough to power about 90 HDB flats annually. CCL's other green features include energy-conserving escalators that reduce speed when not in use or stop completely when not in use for an extended period.

NEWS

Two more research centres to be set up in Singapore

SINGAPORE – Two more research centres, which will focus on energy efficiency, will be set up here under the National Research Foundation's (NRF) Campus for Research Excellence and Technological Enterprise programme, bringing the total number of centres under the programme to seven.

The new centres, which will be up and running next year, will be associated with

the University of California, Berkeley (UC Berkeley) and the Ben-Gurion University of the Negev in Israel, in collaboration with the Hebrew University of Jerusalem and the Nanyang Technological University.

The Israeli university will jointly develop new nano-materials to increase efficiencies of energy and water management, while the Berkeley university will establish

a research centre focusing on reducing the carbon footprints of buildings. UC Berkeley professor S Shankar Sastry said it will work with Singapore researchers on making tropical buildings sustainable and energy-efficient. For example, smart dust sensor networks could be used to monitor and tweak temperature and lighting.

The NRF has set itself high targets for

the next five years, such as cutting energy use by 80 per cent in new buildings.

NRF chairman Tony Tan noted that the research will stimulate Singapore's economy, while NRF chief executive officer Francis Teoh added: "We think these two centres, plus the five that are already here, would give a lot of depth, breadth and vibrancy to the research eco-system in Singapore." JARA 09/2010



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