Build Truly Green Buildings: The Case of Denmark and Practices in Asia

构建真正的绿色建筑--丹麦的实例与亚洲的实践

By

Gregers Reimann

managing director

IEN CONSULTANTS

绿色建筑咨询 | 节能与环境设计及改造 | 可持续城镇规划 | 区域能源规划

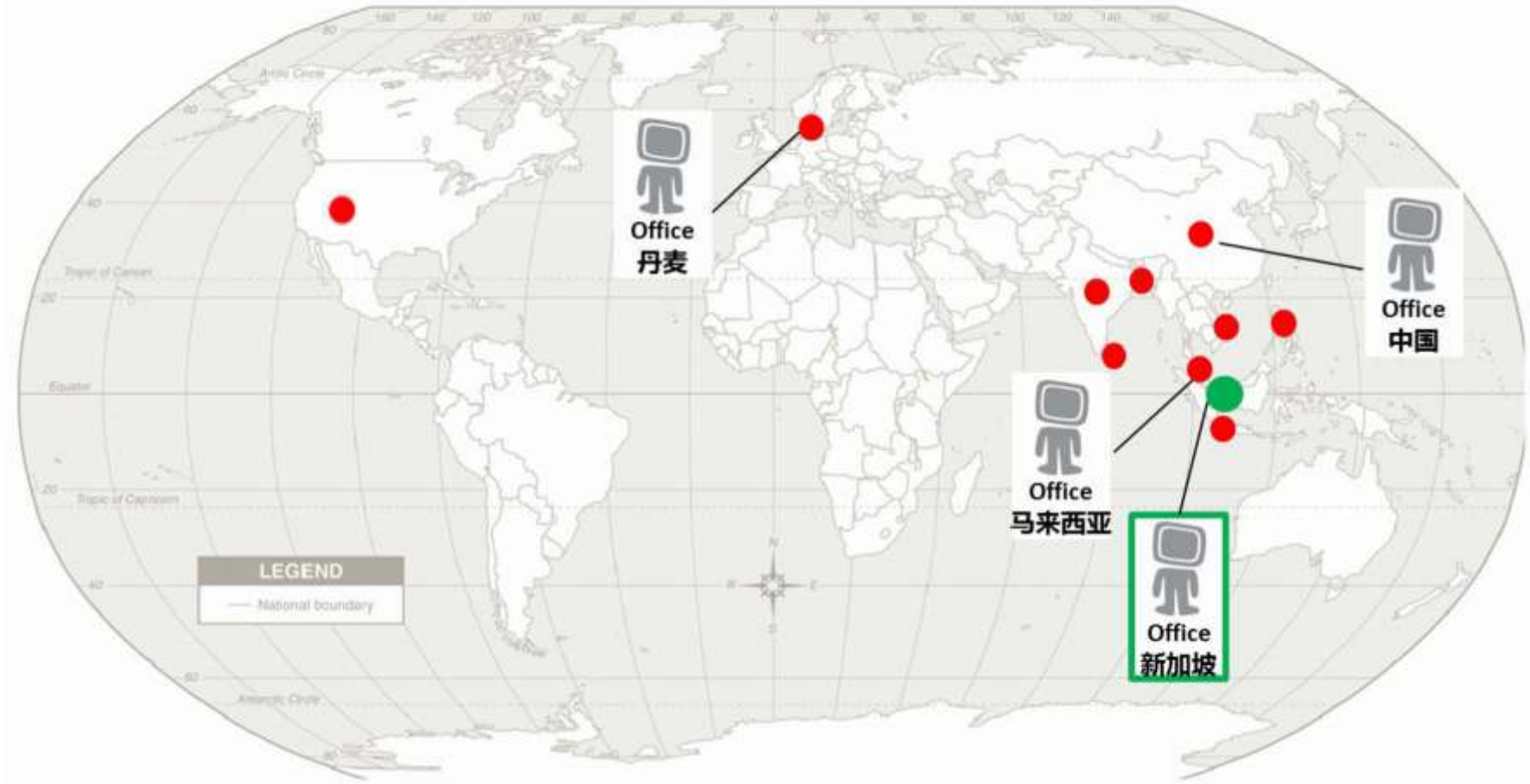
Green Building Consultancy | Energy & Environment Design Retrofit | Sustainable Urban Planning | District Energy Planning

www.ien-consultants.com

AT Magazine conference
15 Nov 2014, Beijing

3.2 million square meters of green building space in Asia

320多万平米在亚洲的绿色建筑项目



I|E|N CONSULTANTS

Our Opinion

我们的观点

”If you’re involved in a new project and you are not making it as green and low energy as possible, it will be functionally obsolete the day it opens and economically disadvantaged for its entire lifetime”

” 假如你在做一个新项目，而你没有使它尽可能地做到绿色与低能耗，那么从开业运行的第一天起，它就将功能过时，并在整个生命周期经济性上落后。”

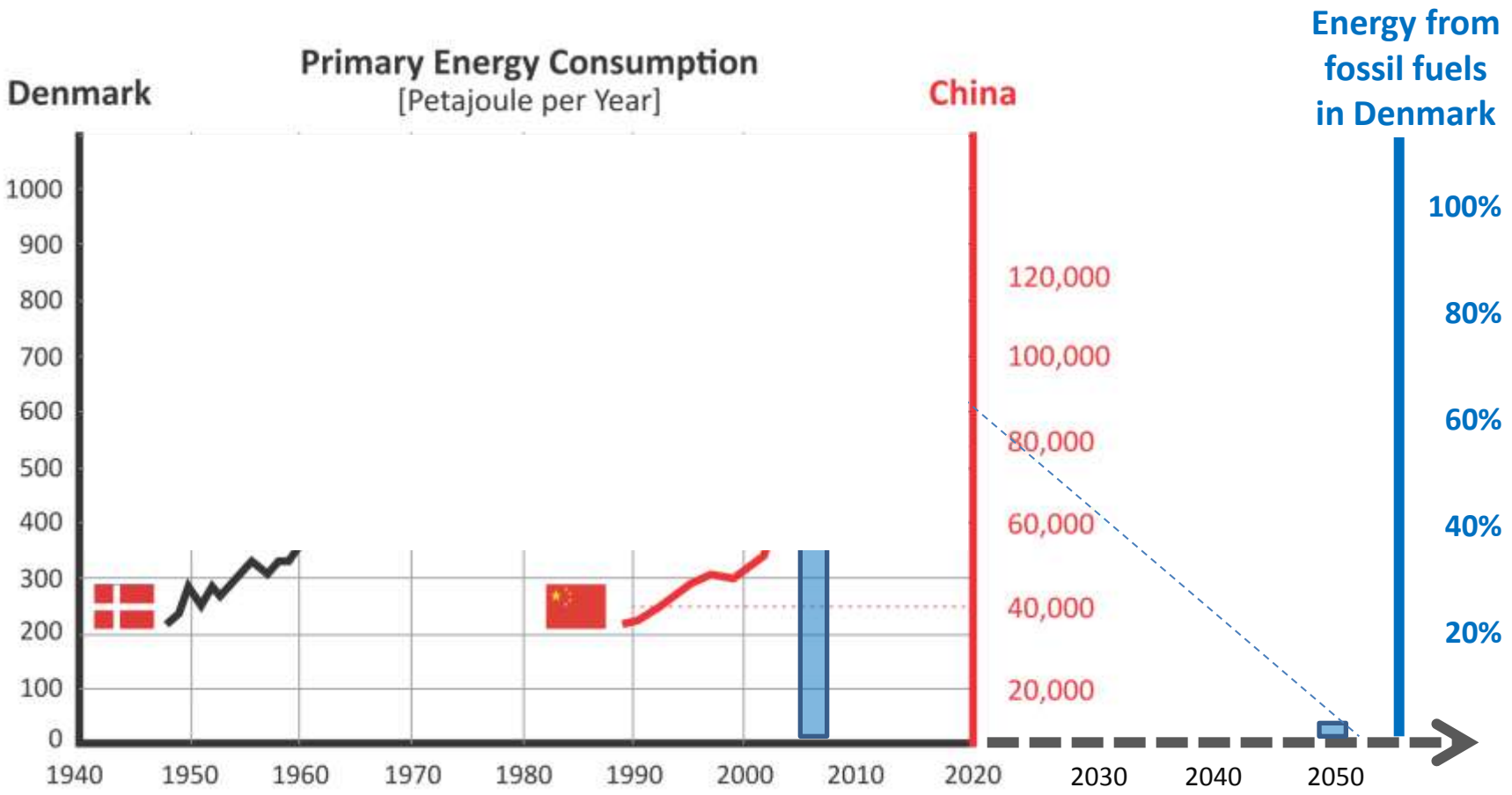
Mr. Jerry Yudelson (2008)
国家董事会成员
美国绿色建筑理事会

Cartoon by IEN Consultants / The Star newspaper (2014)

IPCC November 2014 report:
Green house gas emissions must reduce to zero by year 2100

IEN CONSULTANTS

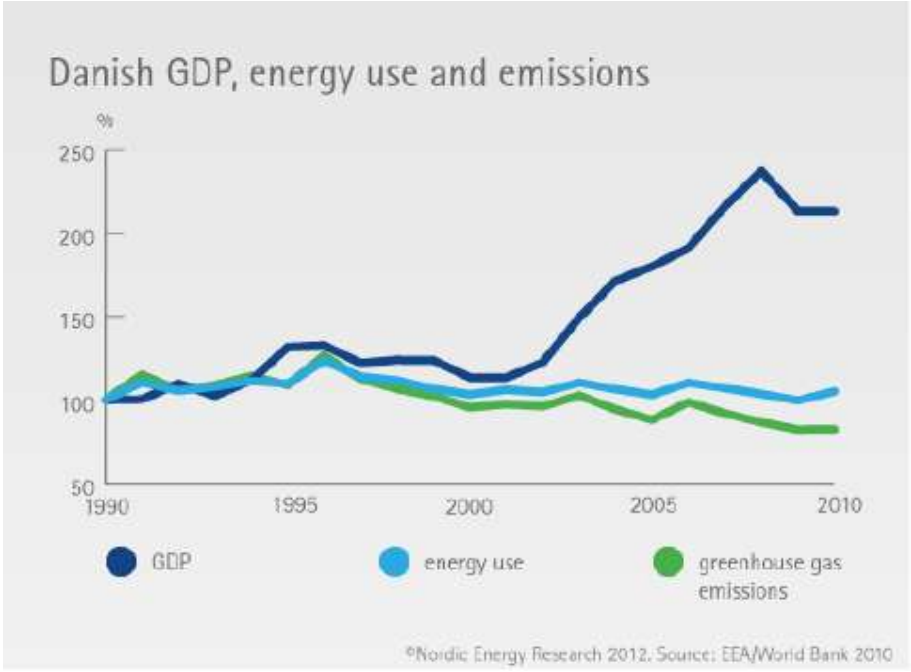
CHINA & DENMARK: National Energy Development
丹麦与中国能源发展历程



IPCC says: Green house gas emissions must reduce to by year 2100

IEN CONSULTANTS

CHINA & DENMARK: National Energy Development
丹麦与中国能源发展历程



哥本哈根CASE：2025年，世界第一个实现零碳(碳中和)的首都

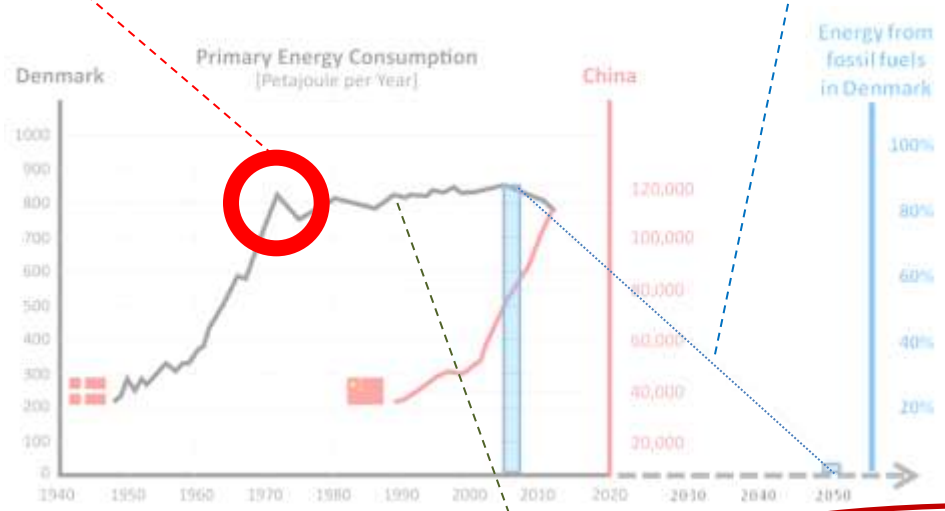
75%的碳排来自建筑

Buildings responsible for 75% carbon emission in CPH

Case DENMARK: What happened?
丹麦的实例：究竟发生了什么

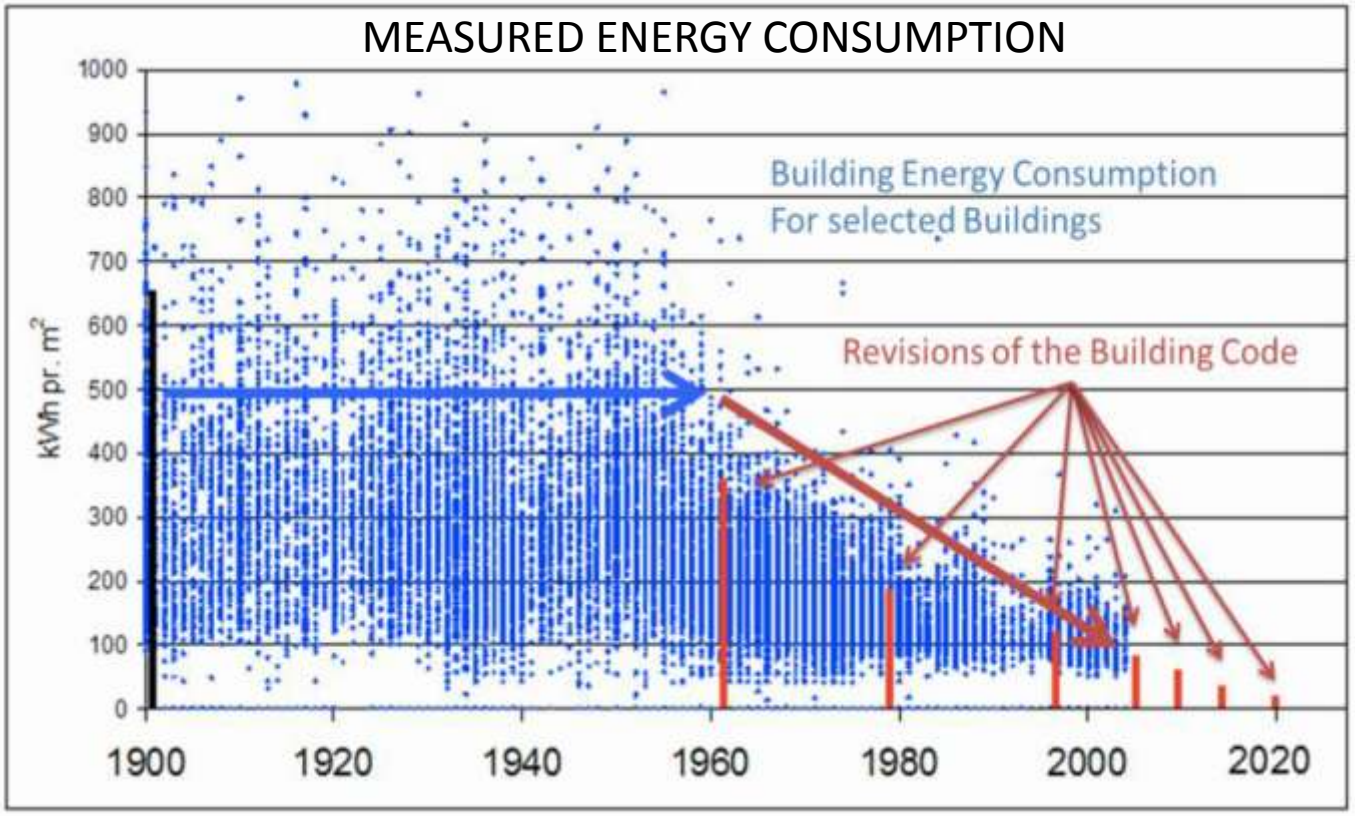
Oil Crisis
- Price of oil x 3
- 96% imported energy (Denmark)

Renewable Energy
- Wind, Solar and Biomass
- No nuclear



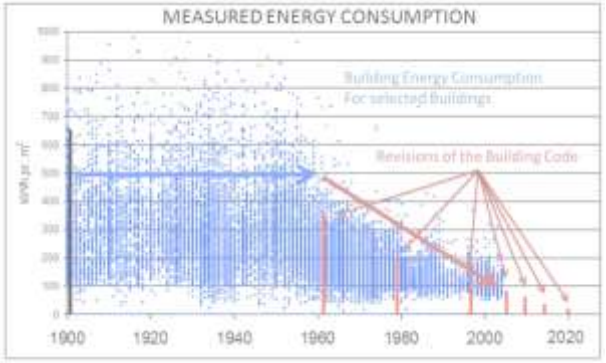
Energy Efficiency
- Energy codes
- Energy labels
- Energy efficiency incentives

Case of DENMARK: 50% Energy Savings for Building Stock
丹麦的实例：实测建筑整体能耗降低50%



- Mandatory Building Energy Code
- Mandatory Building Energy Labeling
- Incentives for Energy Efficient Retrofitting

Case of IEN CONSULTANTS:
50% Energy Savings or more for our Building Projects
IEN的实例：实测建筑能耗降低50%，甚至更多



Annual energy bills show

- 50-80% energy savings
- 3 year pay-back time

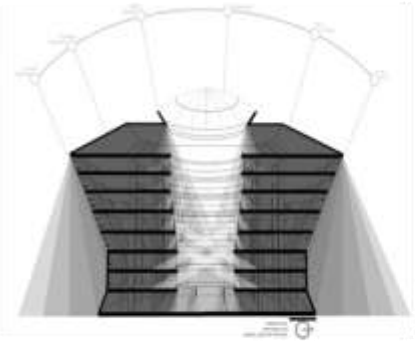
IEN Core Values

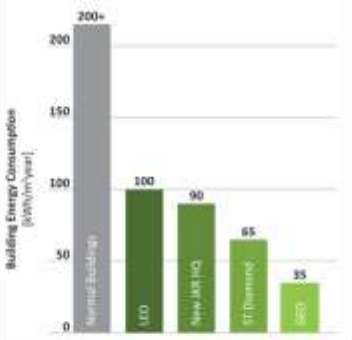
- Effective design solutions
- Ensure long-term benefit to client, occupant and environment

IEN CONSULTANTS

IEN Philosophy : PLEASE

PLEASE：被动式、超低能耗、令人愉快的绿色建筑





Passive　Low Energy　Affordable　Sustainable　Educational

PLEASE

被动优先　实测超低能耗　不贵可负担　全面可持续　教育示范推广

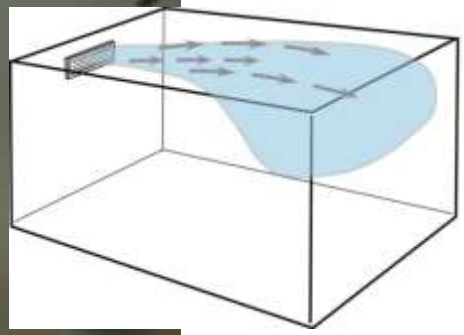
CUBE/The NCC Building (Denmark)

Pioneering office building to be fully naturally ventilated with window automation

Image courtesy of SHL (architects for the project)

CUBE/The NCC Building (Denmark)

Pioneering office building to be fully naturally ventilated with window automation



Coanda Effect

for natural ventilation where the air clings to the ceiling surface and discomfort from draught is avoided

Window & External Blind Automation

The top windows are opened automatically for temperature and fresh air regulation.
The external blinds automatically block direct sun light and have manual override.
Both automation systems are still operating after 15 years

IEN CONSULTANTS

CUBE/The NCC Building (Denmark)

Atrium with pleasant diffuse daylight, acoustic fountain and fresh air storage

Image courtesy of SHL (architects for the project)

White Noise from Fountain & Air Storage

Splashing water stops voices across the atrium. Atrium is filled with fresh air at summer nights, so windows can be kept closed during hot days and still meeting the fresh air requirements

Diffuse daylight from North facing skylights

The skylight windows face North away from the sun and the daylight in the atrium becomes diffuse, soft and pleasant.

I|E|N CONSULTANTS

Winner of 2012 ASEAN Energy Award

ST 钻石大厦

(ST Diamond Building, Malaysia)

Architects: Soontorn Boonyatikarn (Thailand)
and NR Architect (Malaysia)
Energy efficiency and sustainability: IEN Consultants

Mechanical & Electrical: Primetech Engineers
Contractor: Putra Perdana Construction
Client: Malaysian Energy Commission

IEN CONSULTANTS

Different process, but same end result!

不同的过程，相同的结果

MANY computer simulations vs **MANY** generations

Malaysia and Denmark's, commitment to the field of

Green Energy in Architecture

as well as in cooperation and capacity building within the field, can be illustrated by the mutually beneficial involvement of IEN Consultants with the development of this field in Malaysia over the years. IEN Consultants was originally a proprietorship established by a Danish Chief Technical Advisor involved in the identification of energy projects in Malaysia. When the company took on the LEO Building projects it gained recognition in Malaysia and IEN Consultants managed to build up a team of consultants, most of them Malaysian, who with their experience on the LEO Building, became known further afield. This helped gain further commissions on such projects as the Green Tech Building and what has become known as The Diamond Building in Putrajaya.

"Green Buildings" are perceived to be expensive, both because of the costs of employing the expertise necessary to develop and refine the building and system designs, and because of the relatively high capital costs of green technology items. It takes time for reduced operating costs, which come with reduced energy usage, to counterbalance the increased capital investment and this has been a significant brake on development worldwide. However, given that approximately 40% of worldwide carbon emissions come from buildings, it is clear that the there is a need for the "greening" of buildings to make a significant contribution to carbon reductions.

As a result much effort has gone into the dissemination of green ideas to the Malaysian building industry, including the idea that the advantages of reduction of whole life costs of buildings as opposed to just capital costs are worthwhile. The fact that some "green" input to building design in Malaysia has moved from a subsidised base, using for example Danish funding for the LEO Building and European Union funding for the Green tech Office Building, to a fully Malaysia funded base in the case of the so-called "Diamond Building" indicates some success in changing attitudes to operating costs vs capital costs ascribed to "Green Buildings".

Improved energy efficiency is already recognised by the Malaysian government to be more important than mere certification under the Green Building Index (GBI) scheme. That scheme therefore carries tax and stamp duty benefits to encourage the real application of green ideas in the design and operation of buildings.

Beyond this, IEN Consultants is now involved with a UNDP funded project, with the Ministry of Works, to promote low carbon buildings in Malaysia. It is hoped, amongst other things that it will lead to a building code by 2015 specifying much lower carbon footprints even than the LEO Building or the Diamond Building.

Another major area of involvement was in

Capacity Building for Malaysian Industry and Academia in EE Building design.

The objective of the scheme, which was implemented by the Ministry of Energy, Communications and Multimedia (now Ministry of Energy, Green Technology and Water), was to develop capacity in the optimisation of energy efficient building design. This was done through training sessions, seminars, specific analysis of existing buildings and design development of new buildings. A key partner in this endeavour was the Public Works Department (JKR) and there was close cooperation with Schools Division and Healthcare Division, so the lessons learned were comprehensive, and the dissemination of the results widespread.

The project produced reports outlining design strategies for new buildings, making lessons learned from the LEO Building described above available to practitioners and academics across Malaysia. The project also produced reports on "Energy Efficiency Promotion: Lessons Learned and Future Activities", and undertook an evaluation of JKR design standards.

The project certainly raised awareness and improved the country's knowledge base regarding energy efficiency in buildings and made recommendations to Ministry of Energy, Green Technology and Water and JKR to set up demonstration offices, a very successful example of which was in Wisma Darmaraya.

Book download free online "The Cooperation" (2012):
http://um.dk/da/~/media/Malaysia/Documents/Other/Book%20Finalist%20LR.ashx

IEN CONSULTANTS

1/3 Energy Consumption

(Measured 4 years of data)

三分之一的能耗，四年的实测数据

Key Data

Gross Floor Are: 14,000sqm

Year of Completion: 2010

Building Energy Intensity: 69kWh/m2*year

Total Construction Cost: RM60mil

Additional EE Cost: 3.2%

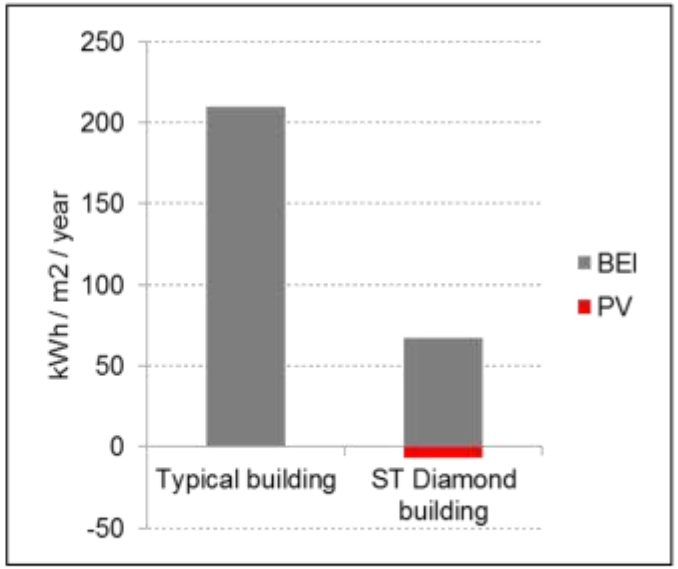
Payback Period: **< 3years**

IRR: 34% (based on 7year Lease Term)

GBI **Platinum**

Green Mark **Platinum**

2012 ASEAN energy award **Winner**



ASHRAE

2013 ASHRAE Technology Award (2nd place)

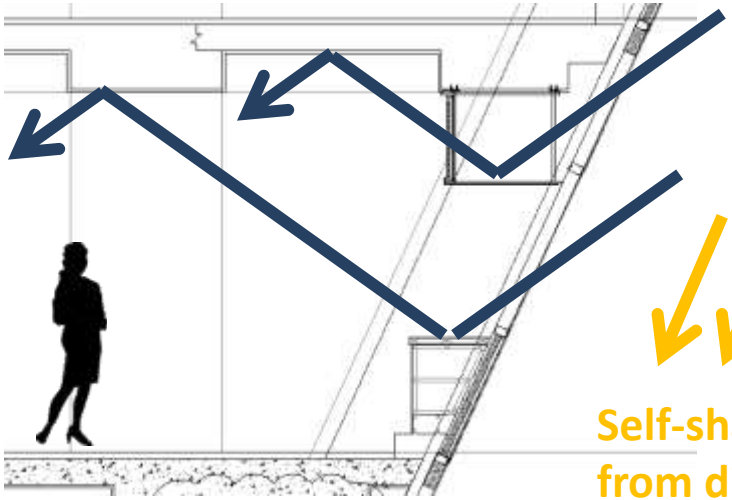
实测能耗数据：

65 kWh/m^2/年 (不包括光伏),

60 kWh/m^2/年 (包括光伏),

IEN CONSULTANTS

FACADE
围护结构采光

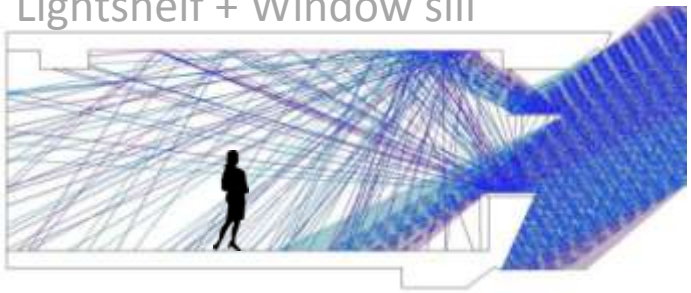


Diffuse light deflected into room by lightshelf and window sill

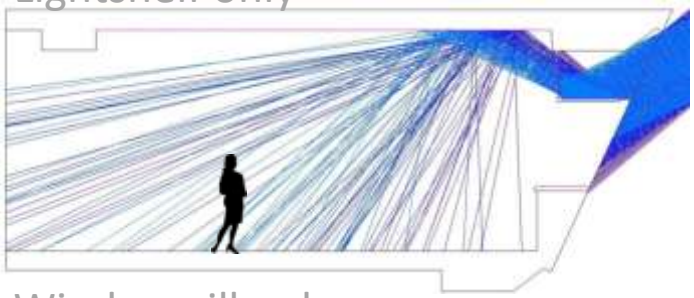
Self-shaded facade from direct sun

LIGHT REFLECTIONS FROM:

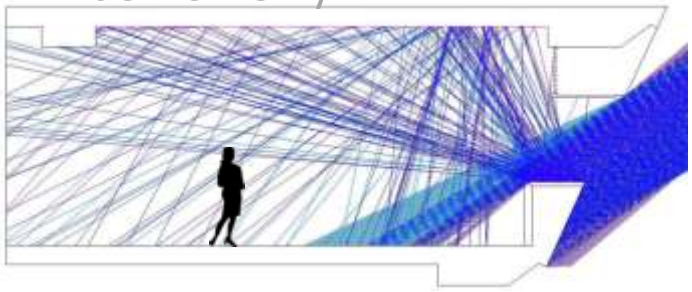
Lightshelf + Window sill



Lightshelf only



Window sill only



Façade Daylight Design

The building is 50% daylit. The façade daylighting system consists of a mirror lightshelf and a white painted window sill. Both deflect daylight onto the white ceiling for improved daylight distribution until 5 meters from the façade + 2 additional meters of corridor space. Installed office lighting is 8.4 W/m2, but measurements show consumption of only 1 W/m2 showing - a factor 15 lower than the code requirement.

Floor Slab Cooling in ST Diamond Building

TABS主动式建筑结构蓄能制冷系统

Floor slab cooling system embedded in RC slab

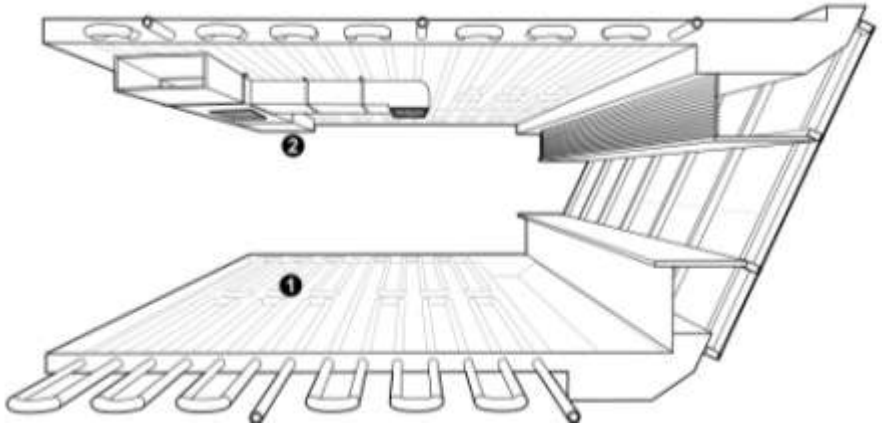
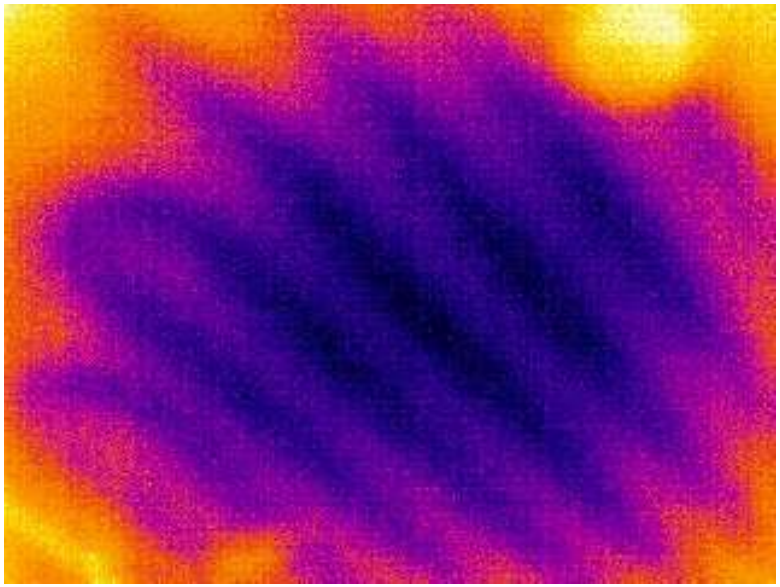
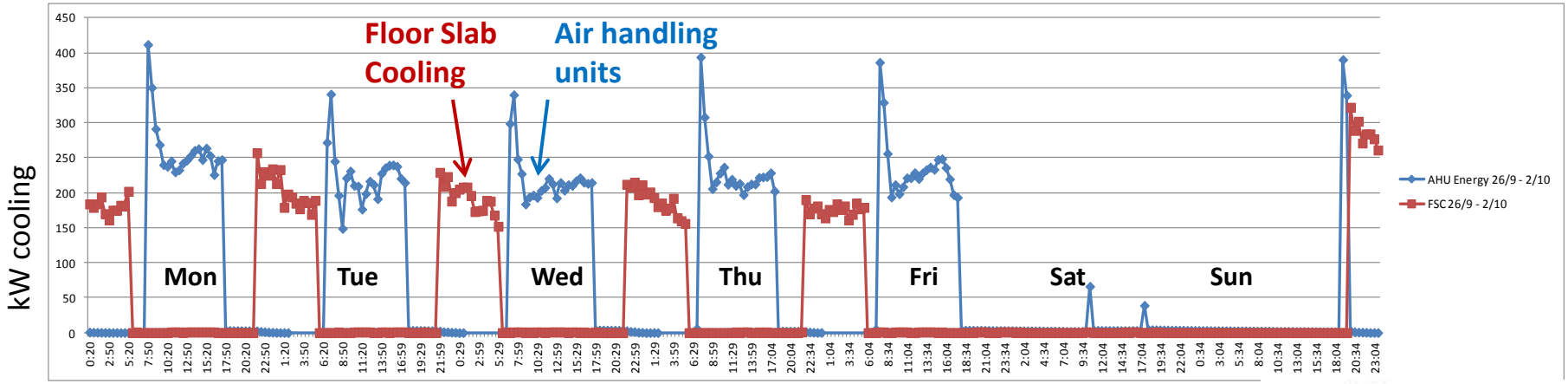


Illustration courtesy of:
Greening Asia – Emerging Principles for Sustainable Architecture.
Copyright: Nirmal Kishnani, 2012. Publisher: FuturArc



Thermographic image of floor slab cooling in ST Diamond
Picture courtesy of: PS Soong, Pureaire

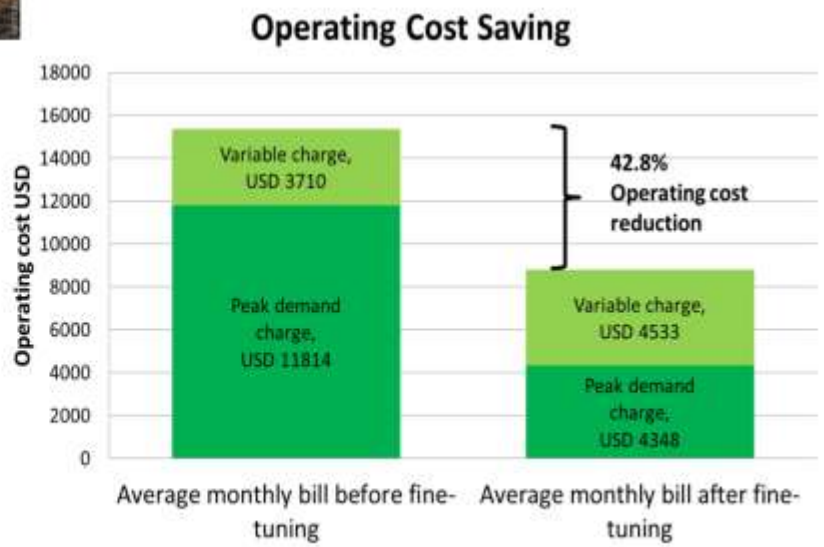


Improving operation:
42% monetary savings for energy operation
改善实际运行效果：节约能耗费用42%

政府示范：一体化设计降低运行费用
钻石大厦低能耗地板制冷系统设计

地板制冷系统埋设在加强混凝土楼板中

主动式建筑体蓄能（TABS）地板制冷系统将能耗降低至普通建筑的1/3。

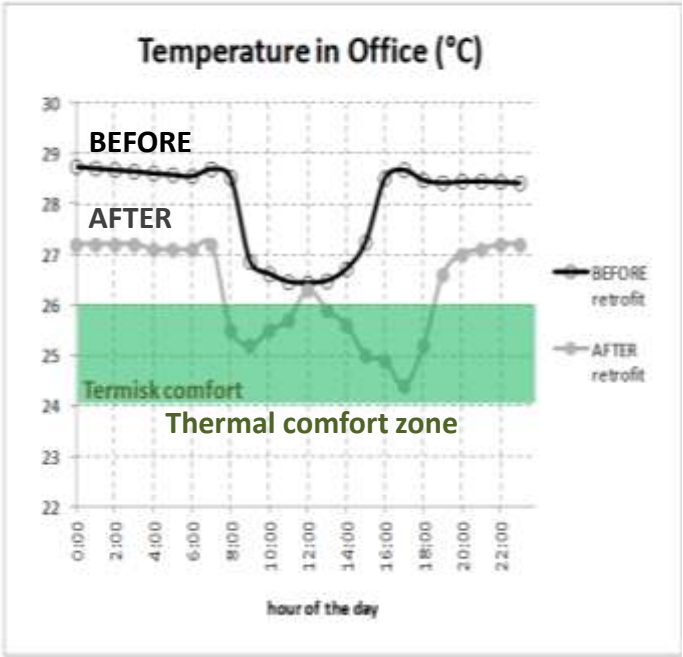


IEN CONSULTANTS

Case Indonesia: Energy Efficient and Environmental Retrofit

印尼的实例：节能与环境改造

Measured thermal comfort



Before Retrofit

- Blinds down
- Lights on
- Central cooling system
- No fresh air control
- Facade not air tight
- Single glazing

ENERGY SAVED 40%

After Retrofit

- Natural light enters
- Lights off
- Efficient VRF cooling system
- Demand ventilation (CO_2 sensor)
- Air tight facade - quiet inside
- Extra pane of clear glass added

大幅改善室内环境品质，

降低建筑能耗40%

IEIN CONSULTANTS

Case ZERO energy

Designed to become the first
ZERO energy skyscraper

超高层：零能耗

印尼国家石油公司（Pertamina）能源塔大厦
目标成为世界上第一座零能耗的摩天大厦

99 floors
Pertamina Energy Tower
Jakarta, Indonesien

On-going project

Architect: SOM

Expensive Not to Go Green!

不做绿色才贵：优而廉的设计

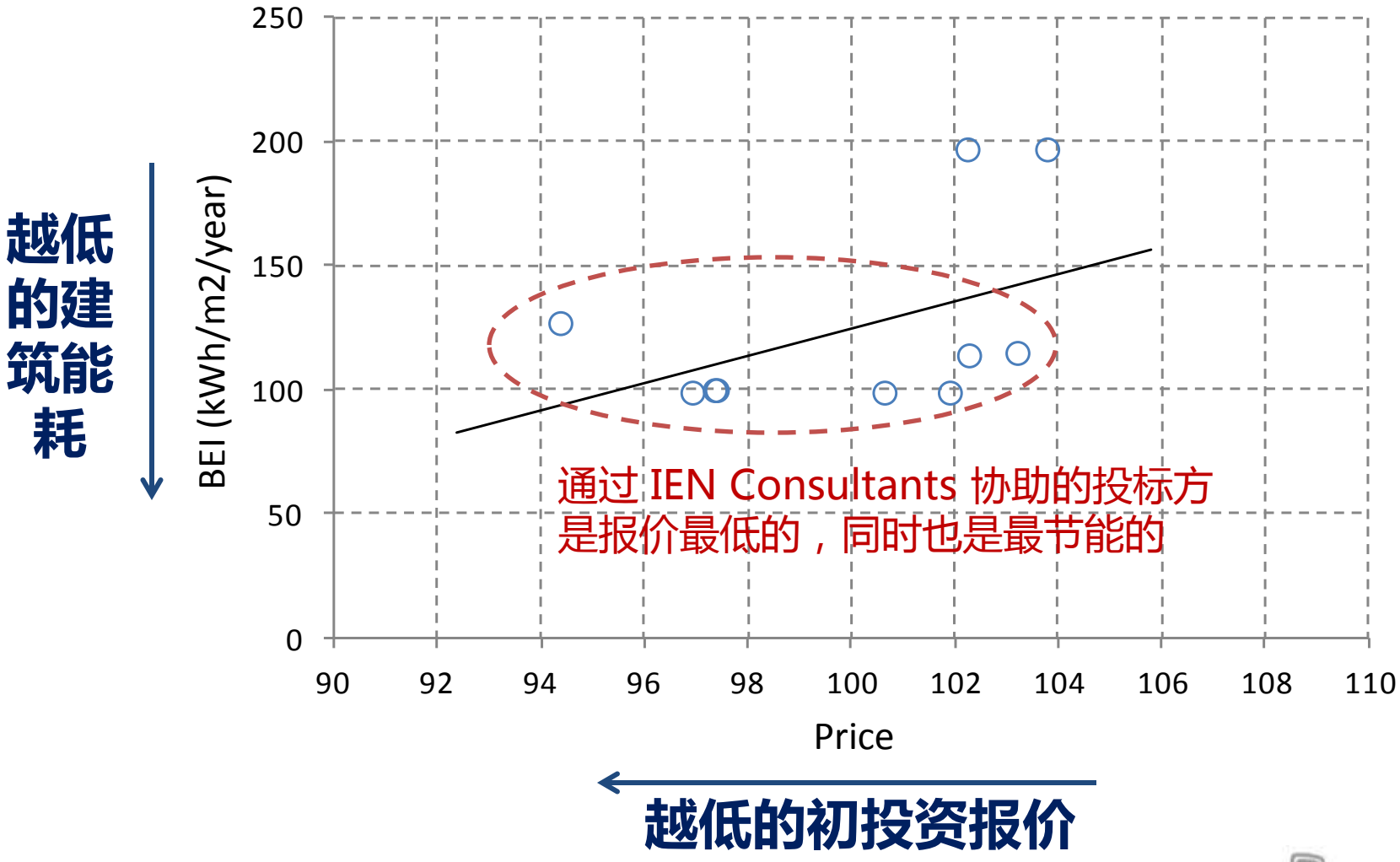
公开招标结果表明：更合理的节能设计同时也是总报价成本最低的

建筑类型：办公楼
总建筑面积:：51,000 m^2 （停车场除外）
开业年份: 2014年
高度：180m

Expensive Not to Go Green!

不做绿色才贵：优而廉的设计

公开招标结果表明：更合理的节能设计同时也是总报价成本最低的



IEN CONSULTANTS

CONCLUDING REMARK:
Buildings are Like a Leaky Bucket

建筑就像一个漏水的水桶

with lots of unnecessary wastages

有许多不必要的浪费

Let us help you to plug the holes!

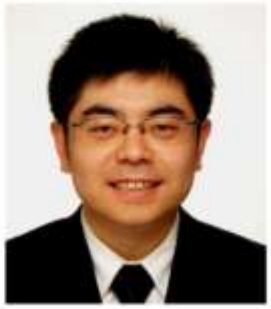
堵上这些漏洞，你将拥有一个并不昂贵且令人愉快的绿色建筑

谢 谢！
THANK YOU!

请联系我们

Gregers Reimann,
Managing Director
M +60 122755630
gregers@ien-consultants.com

Kevin Sullivan
Director, Singapore
M +65 92710067
kevin@ien-consultants.com



Sun Hansong
Director, China
M +86 15210220818
hansong@ien-consultants.com

IEN CONSULTANTS

www.ien-consultants.com

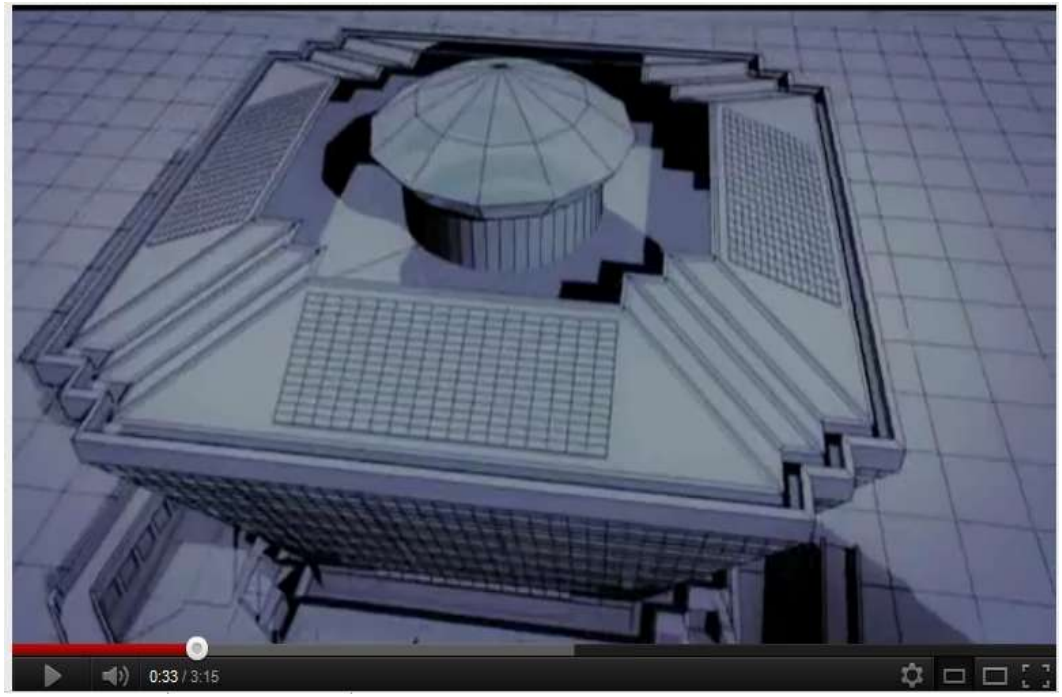
Download of presentation from: www.ien-consultants.com/news/at-ppt.pdf

Energy Efficient Building Stamp series

建筑节能系列邮票 (全部是IEN的作品)

All buildings by IEN Consultants

3-minute video



Sustainable Features of ST Diamond Building.
Available at YouTube:
http://www.youtube.com/watch?v=3H_sXCtDayc

Do People Appreciate the Green Features?

Yes, if it is convenient

Our survey showed the occupants of the mall appreciated the pleasantly daylit atriums

Atrium of Setia City Mall, Malaysia

Do People Appreciate the Green Features?

Yes, if it is convenient

People are willing to use the staircase in a nicely designed atrium.

NB. The lift is hidden in the back and not visible when entering the building

Atrium of GEO Building, Malaysia

Do People Appreciate the Green Features?

Yes, if it is convenient

After one year of operation, our survey found that 94% of the residents are willing to recycle and that the system enhances the attractiveness of the condominium

Recycling bins in trash room at each floor

How it works

- *Recycling bins installed in existing trash room making it easy for people to recycle*
- *Recyclables separated in:*
  - Bin for bottles & cans
  - Small basket for batteries and CDs
  - Shelf for paper & card-board
- *Cleaners earn extra pocket money by selling recyclables to recycling company*

Cost of implementation

- *USD 2.50 per apartment*

Lessons learned

- *Cleaners happy with recy-cling system as they can earn extra pocket money*
- *Label the bins and use lid for all bins, as people other-wise might throw all trash in the bin without a lid*

Recycling stations in condominium, Malaysia