ZAGREB ENERGY WEEK
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City Assembly Zagreb
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The 'Why' and 'How' for the step-change to Zero Carbon

Chris Twinn
奥雅納院士 | 董事 | 可持续发展顾问
Arup Fellow | Director | Senior Sustainability Advisor
英国皇家艺术协会资深会员 英国皇家建筑师学会荣誉院士 英国屋宇设备工程师学会资深会员 英国能源学会会员 英国认许工程师 荣誉理学士
FRSA HonFRIBA FCIBSE MEI CEng BSc(Hons)
奥雅纳上海/伦敦 Arup Shanghai / London

UK GREEN BUILDING COUNCIL UKGBC Ambassador

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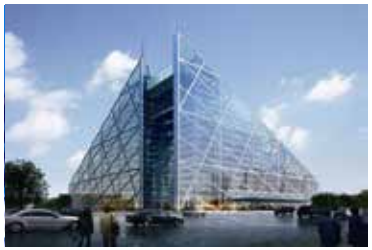

The 'Why' and 'How' for the stepchange to Zero Carbon

1. UK's route map to Zero Carbon new-build
2. The UK wider policy context
3. Why LEED Platinum & similar is not enough
4. Bringing higher standards into mainstream
5. Next steps: Zero Carbon at zero extra cost






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Acoustics and vibration engineering 声学和振动工程
Airport masterplanning 机场总体规划
Architecture 建筑
Audiovisual 视听
Bridge engineering 桥梁工程
Building Engineering 建筑工程
Business continuity planning 业务持续规划
Civil engineering 土木工程
Communications and IT 通讯和IT
Construction management 建筑管理
Controls and commissioning 个控制和调试
Cost management 成本管理
Economics and planning 经济和规划
Electrical engineering 电气工程
Energy 能源
Environmental 环境
Façade engineering 幕墙工程
Fire safety 消防
Geotechnical engineering 地理工程
Highways 高速公路
Impact and blast 冲击力和爆炸工程
Industrial facilities工业设施
Industrialized construction工业建设
Land reclamation and regeneration 土地开垦和再生
Lighting design 照明设计
Logistics 物流
Manufacturing 制造
Maritime engineering 海事工程
Materials technology 材料技术

10,700名员工，90多个办事处
10,700 staff in over 90 local offices

机械工程 Mechanical engineering
机电工程 MEP engineering
近海工程 Offshore engineering
产品设计 Product design
项目建立 Project creation
项目管理 Project management
项目规划 Project planning
样机试验 Prototype testing
轨道系统 Rail systems
研发 Research and development
修复和翻新Restoration and refurbishment
风险咨询 Risk consultancy
安全咨询 Security consultancy
防震Seismic
壳体结构 Shell structures
软件开发 Software development
体育场馆运营 Stadium operations
结构工程 Structural engineering
结构异常 Structural pathology
可持续咨询 Sustainability consultancy
交通咨询 Transport consultancy
隧道工程 Tunnel engineering
城市总体规划 Urban masterplanning
价值管理 Value management
车辆设计和样式 Vehicle design & styling
场地咨询 Venue consultancy
视觉化和模型化Visualization & modelling
水工程 Water engineering
风工程 Wind engineering

员工所有 Owned by our staff

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奥雅纳研究 & 教育
Arup Research & Education

Foresight and Innovation team help

Arup and clients understand the future of the built environment

前瞻和创新团队帮助奥雅纳和客户理解建筑环境的未来

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BedZED

Hanham Hall

Jubilee Wharf, Penryn

Dongtan

Pennbury Eco-town

Kingspan Lighthouse

Barratt Greenhouse

Arup：15年来，学习推广零碳规划建设项目
15 years of learning & sharing on Zero Carbon Masterplans & Projects

Earth Centre Conference Building

BowZED ZEDfactory

Stratford City

Samsung Zero Energy House

Vanke Green Building Park Beijing

HK CIC ZCB

Upton Square

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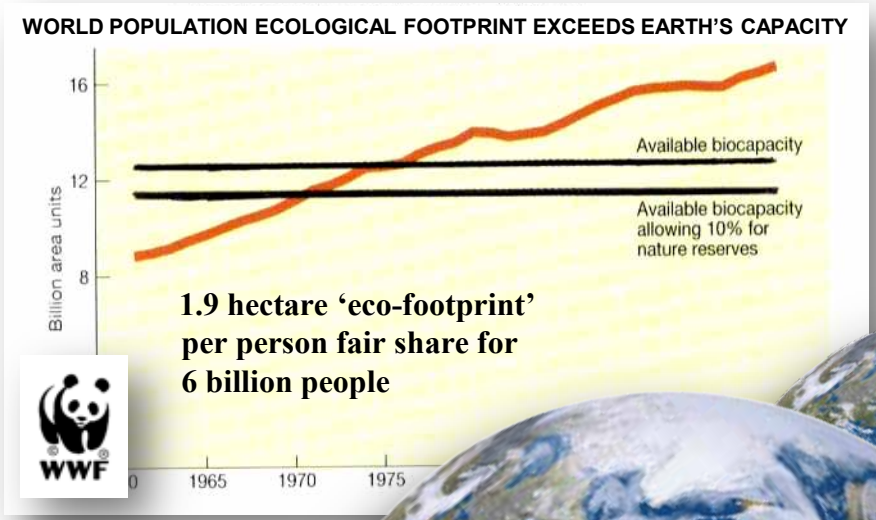

Our shrinking planet!

Population stabilises at 10 billion (ref UN)

Only 1.2 ha to provide each of us with our resources

Living within the resource capacity of our planet

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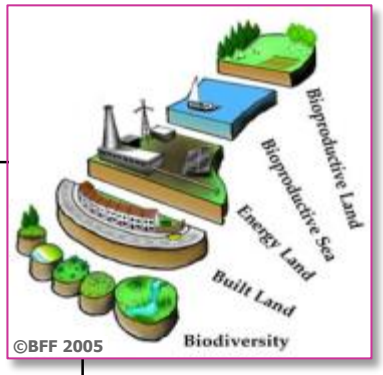
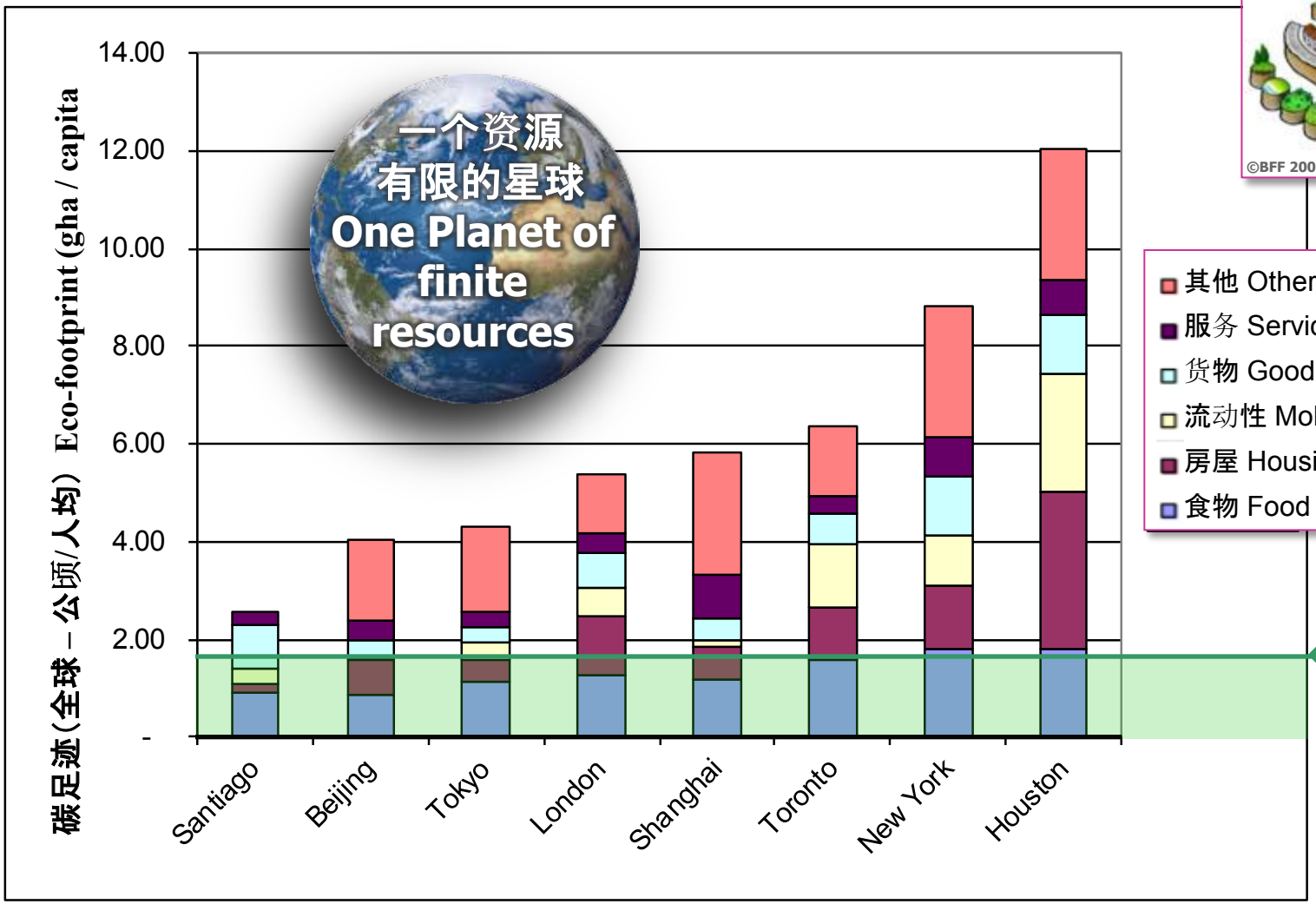
碳足迹决定了可持续性
Eco-footprint defines Sustainability





全球人均碳足迹相当于每人1.8全球公顷
Global fair share equals 1.8 global-hectares per person

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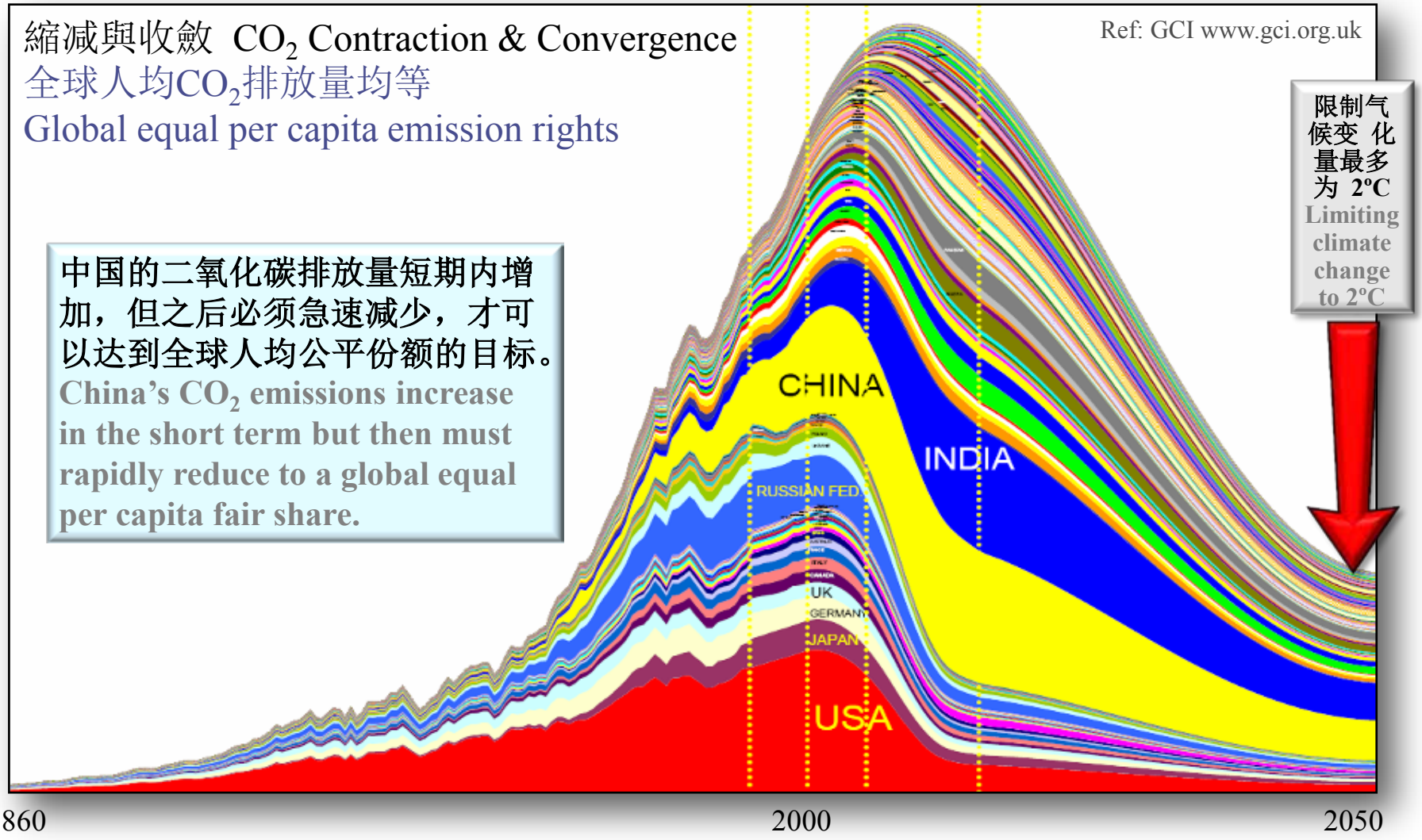
减少对环境的影响在我们一个星球能力范围内
Reducing environmental impact to within our planet's capacity



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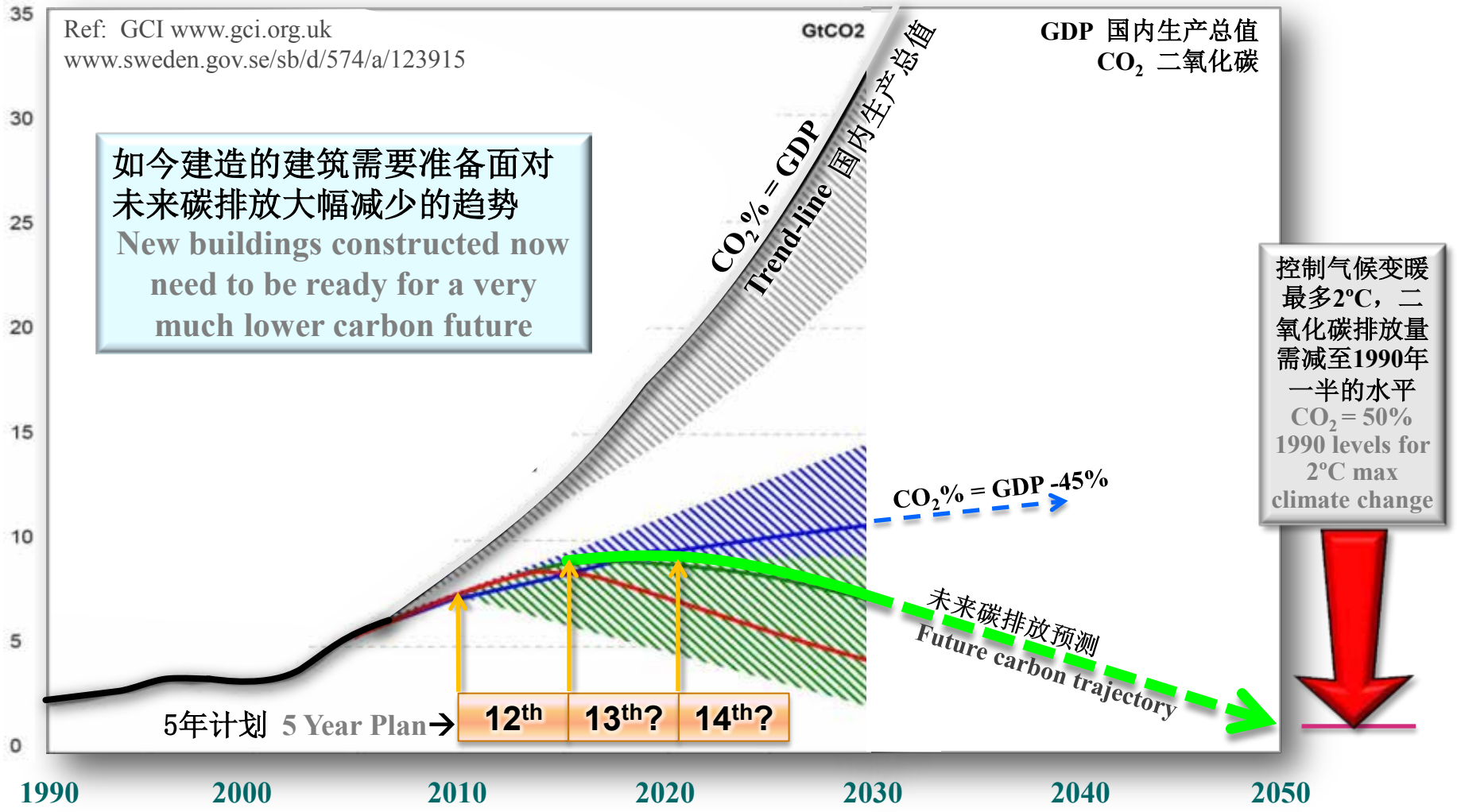
未来中国的碳排放情况？
China's carbon emissions future?



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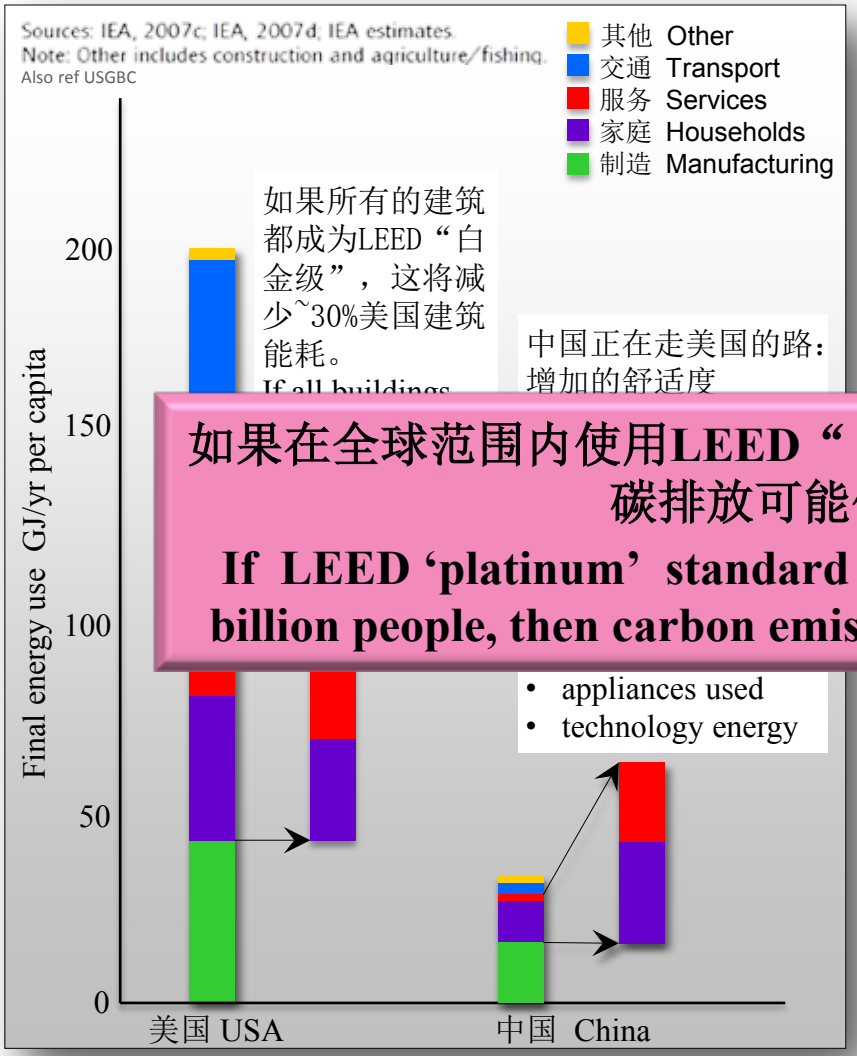
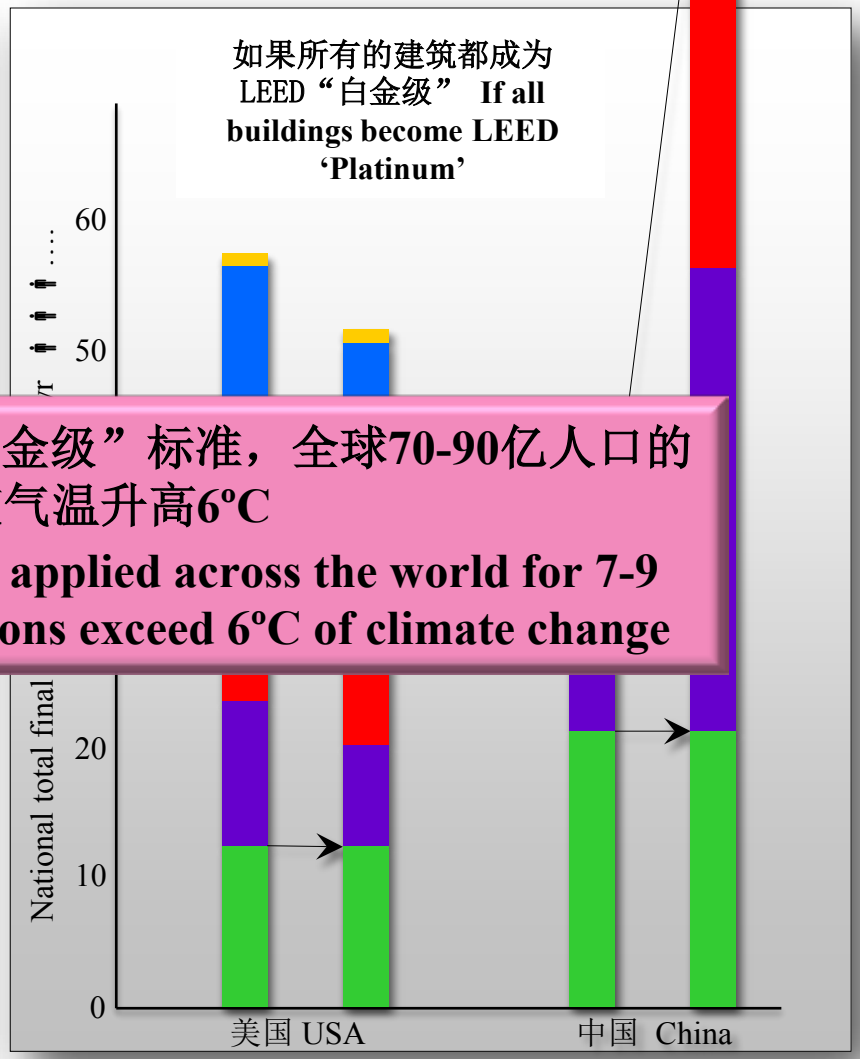
LEED和三星的标准设的足够高吗?
Do LEED and 3-Star, set high enough standards?





如果在全球范围内使用LEED“白金级”标准，全球70-90亿人口的碳排放可能使气温升高6ºC

If LEED ‘platinum’ standard is applied across the world for 7-9 billion people, then carbon emissions exceed 6ºC of climate change

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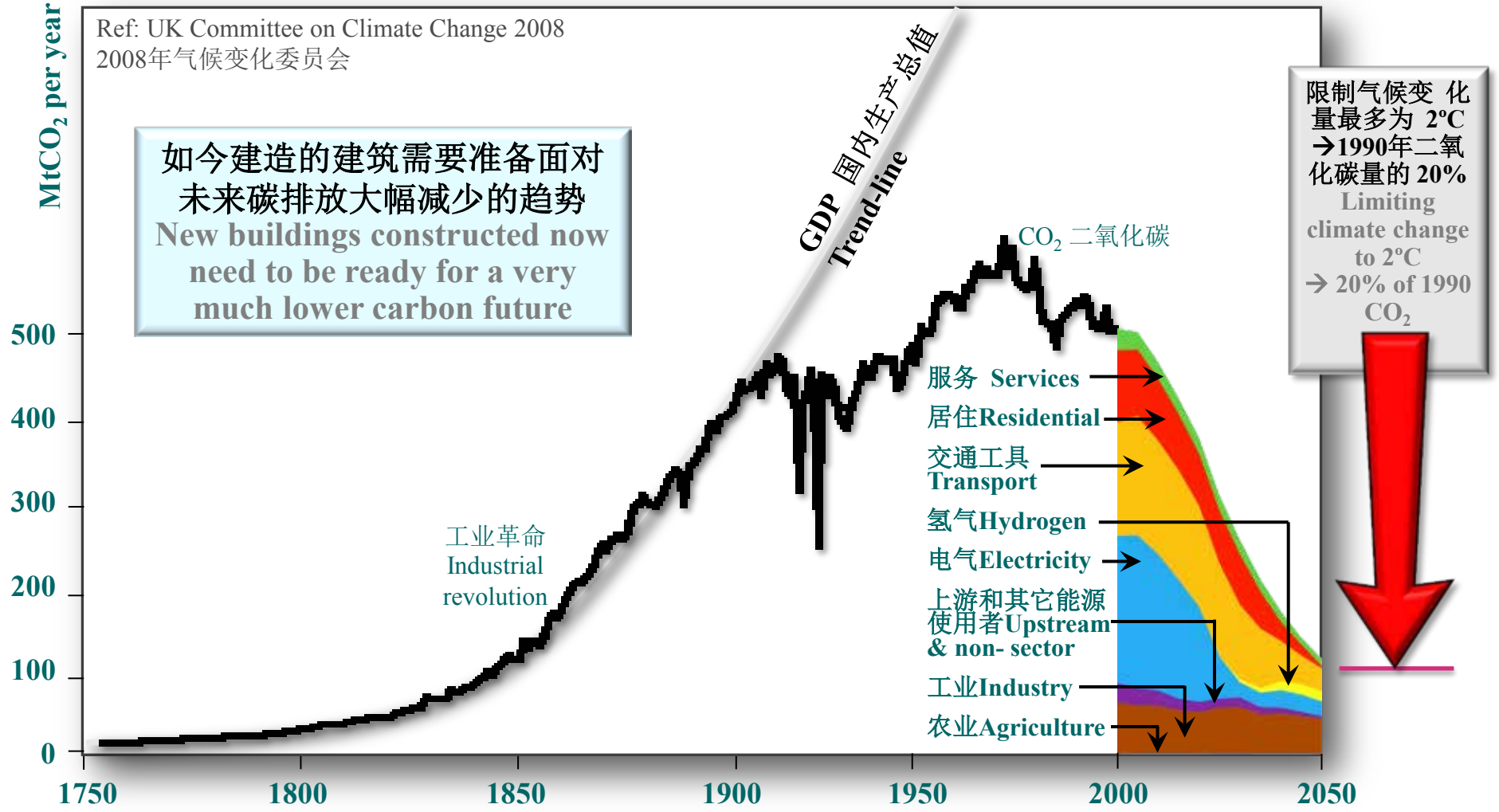
应住建部副部长仇保兴邀请与会讨论课题
Keynote presentation at invitation of Vice Minister Qiu Boaxing of MOHURD

Chris即将借调至住建部协助生态规划事务
Shortly Chris will be joining MOHURD as a secondee to assist their eco-planning

Summary key UK policy, strategies, regulations

1999 May	**A Better Quality of Life:** A Strategy for Sustainable Development for the UK,
2000 Jun	**Scientists: 2050 - 60% less carbon** Royal Commission for Environmental Pollution
2001 Apr	**Climate Change Levy** on non-domestic energy use
2003 Oct	**Energy White Paper Policy:** 60% carbon reductions by 2050
2004 Apr	**Implementation Plan:** 10% renewable electricity by 2010 & 20% by 2020.
2004 May	**Planning Act:** Overhaul land-use planning to underpin sustainable development
2005 Mar	**Securing the future:** New UK sustainable development strategy
2006 Apr	**Building Regulations:** Start of 3 year steps of 25% carbon reductions for new-build
2006 Dec	**'Zero Carbon' for all new homes from 2016** becomes Government policy
2008 Mar	**'Zero Carbon' for new non-domestic from 2019** becomes Government policy
2008 Nov	**Climate Change Act:** enshrined in law UK target of 80% carbon reductions by 2050
2008 Dec	**Committee on Climate Change:** 5 yearly carbon budgets – Government to respond
2008 Jun	**Zero Carbon Hub launched:** technical development for zero carbon homes
2009 Jul	**Low Carbon Transition Plan:** Cross sector contributions to change

英国碳排放历史及未来的预测
UK carbon emissions history and projections



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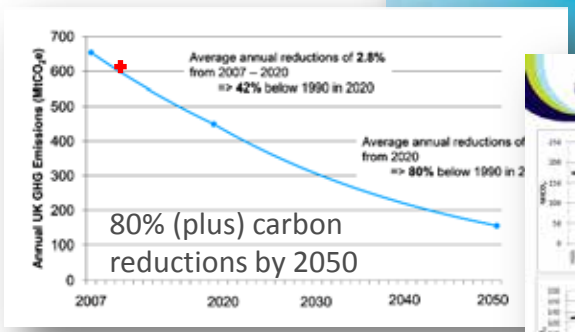
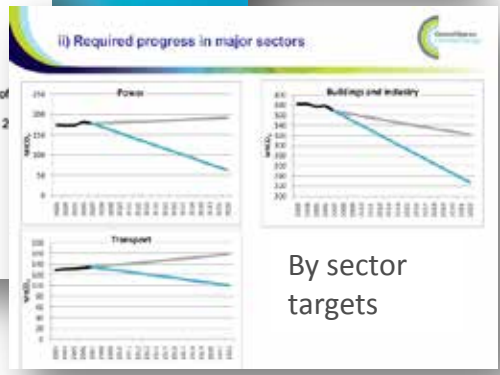
The UK Committee on Climate Change

- Established by Climate Change Act 2008
- Independent body to advise on emissions targets
- Sets UK national 5 yearly carbon budgets
- Monitors & report to Parliament on progress
- Government legally required to respond





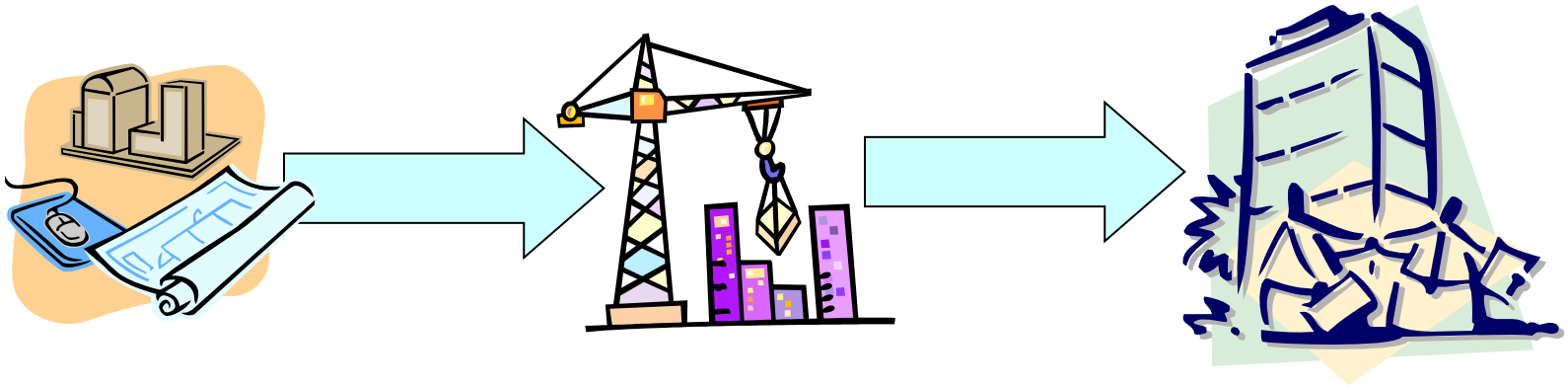
Annual review 2008-2009

- **UK national 'interim' target -34% by 2020**
- **UK national 'intended' target -42% by 2020**

Ref: www.theccc.org.uk

UK policy suite for buildings whole life

Planning | Construction | Operation



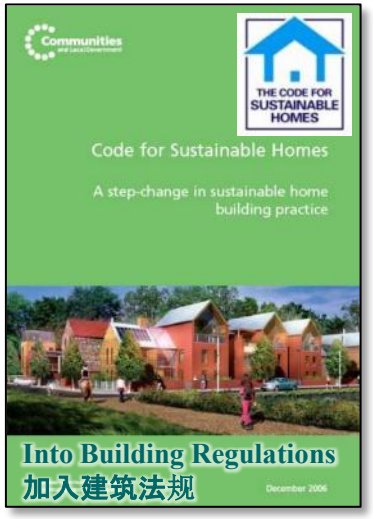
- Long & medium term national targets & route map
- Local planning polices
- Eco-town demonstrators
- Community energy systems
- EU-Emissions trading system
- Off-site 'Allowable Solutions'
- Sustainability of the Government Estate (SOGE)
- Electric vehicles policy

- Building Regulations 'escalator'
- Zero carbon new-build
- Building energy labelling
- Component energy labelling
- Smaller demonstrators
- As-built verification
- Sustainability of the Government Estate (SOGE)

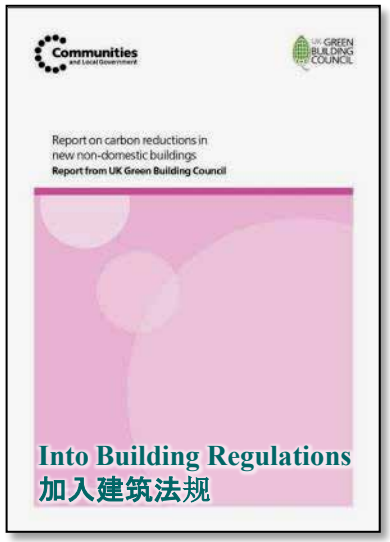
- Carbon Reduction Commitment (CRC)
- DECs / energy declarations
- Feed-in-tariffs / Renewable heat incentive
- Climate Change Levy
- Renewable generator ROCs
- 'Green Deal' for refurbishment
- Sustainability of the Government Estate (SOGE)

UK Pathway to Zero Carbon

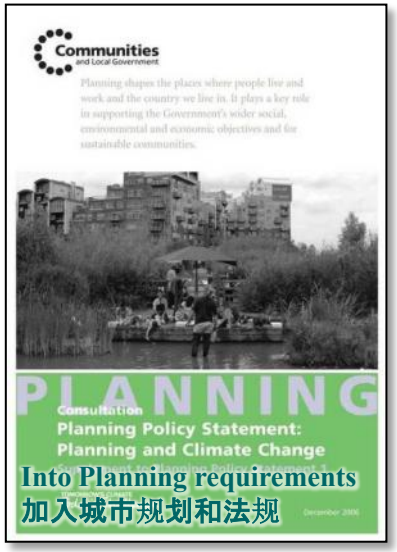
Homes



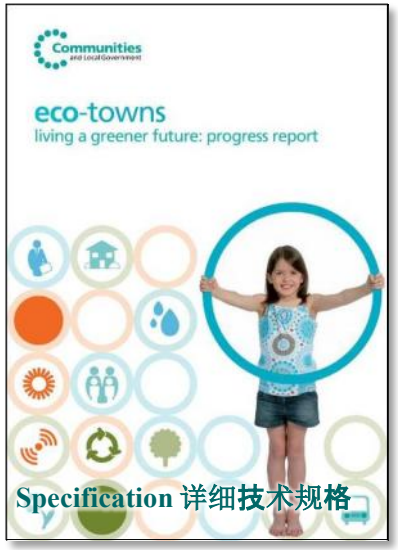
Non-domestic

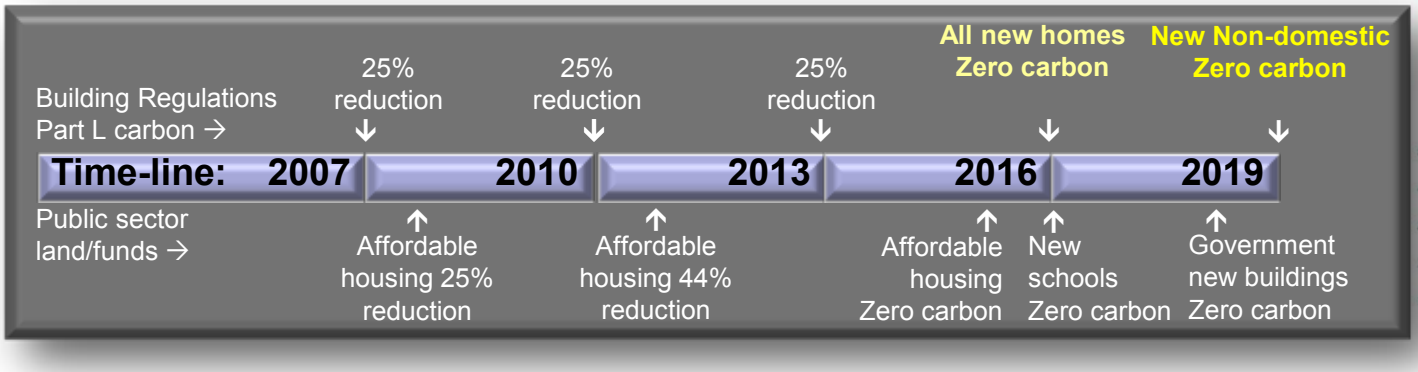


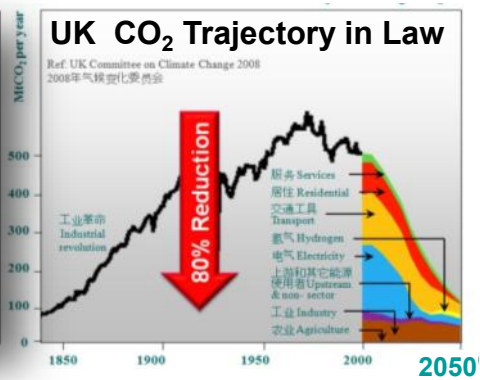
Communities



Eco-Towns / Demos







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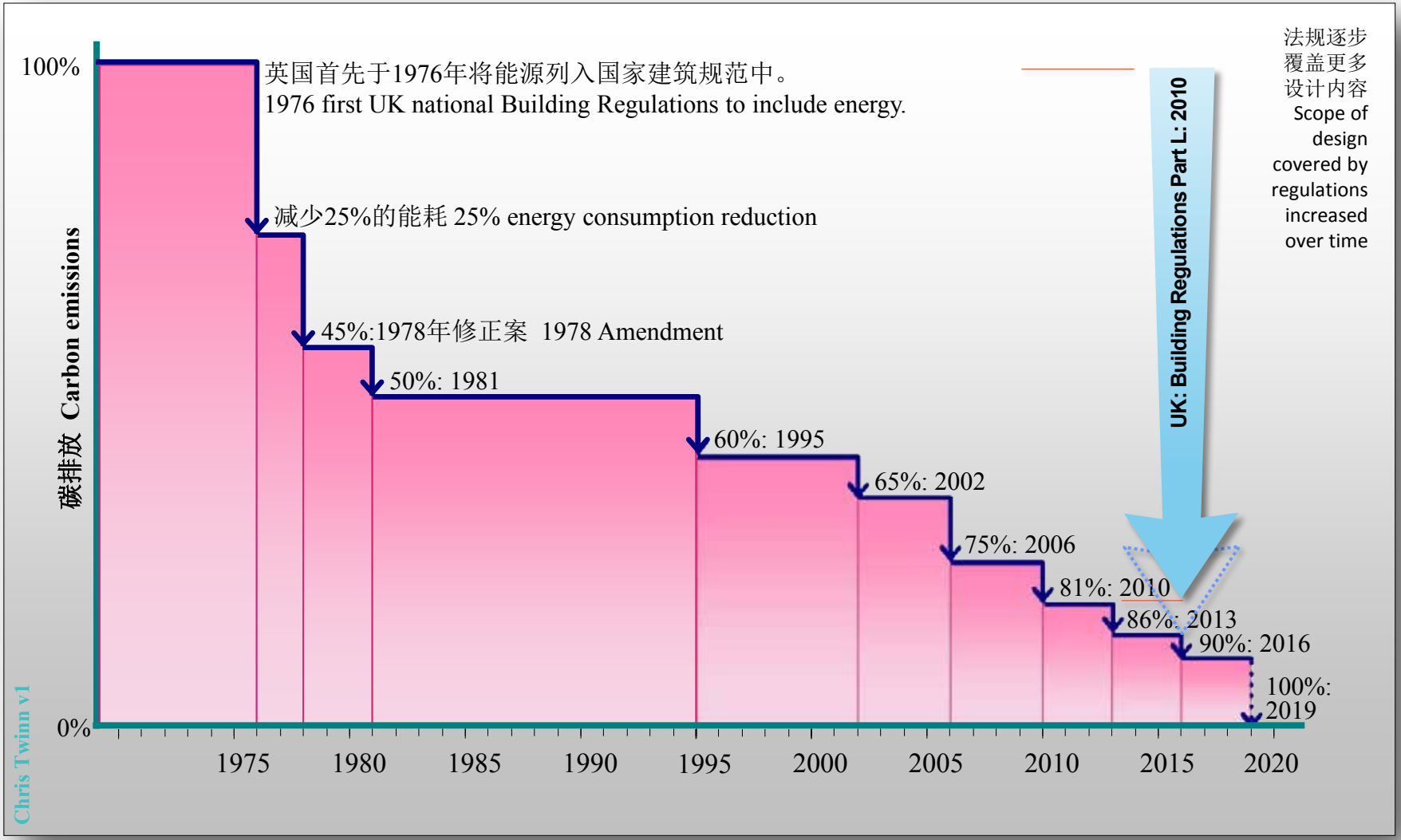
英国新建筑的零碳之路
UK Roadmap Zero Carbon for all new buildings



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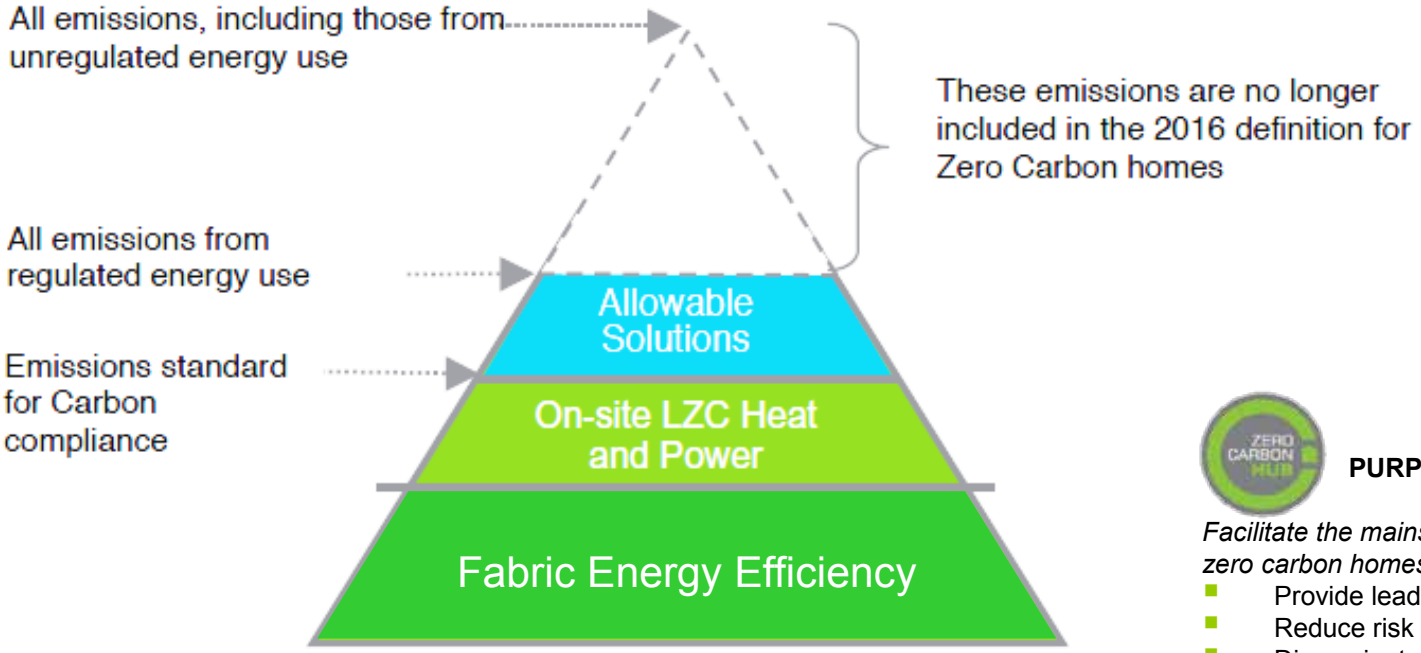
Industry develops the technical basis for new-build Zero Carbon

"We want an approach that encourages house builders to go further onsite than the minimum carbon compliance level, and reduce emissions from energy used by the development where that is appropriate.

We want to promote innovation in a low carbon built environment ..."

DCLG, December 2008, Definition of Zero Carbon Homes and Non-domestic buildings consultation



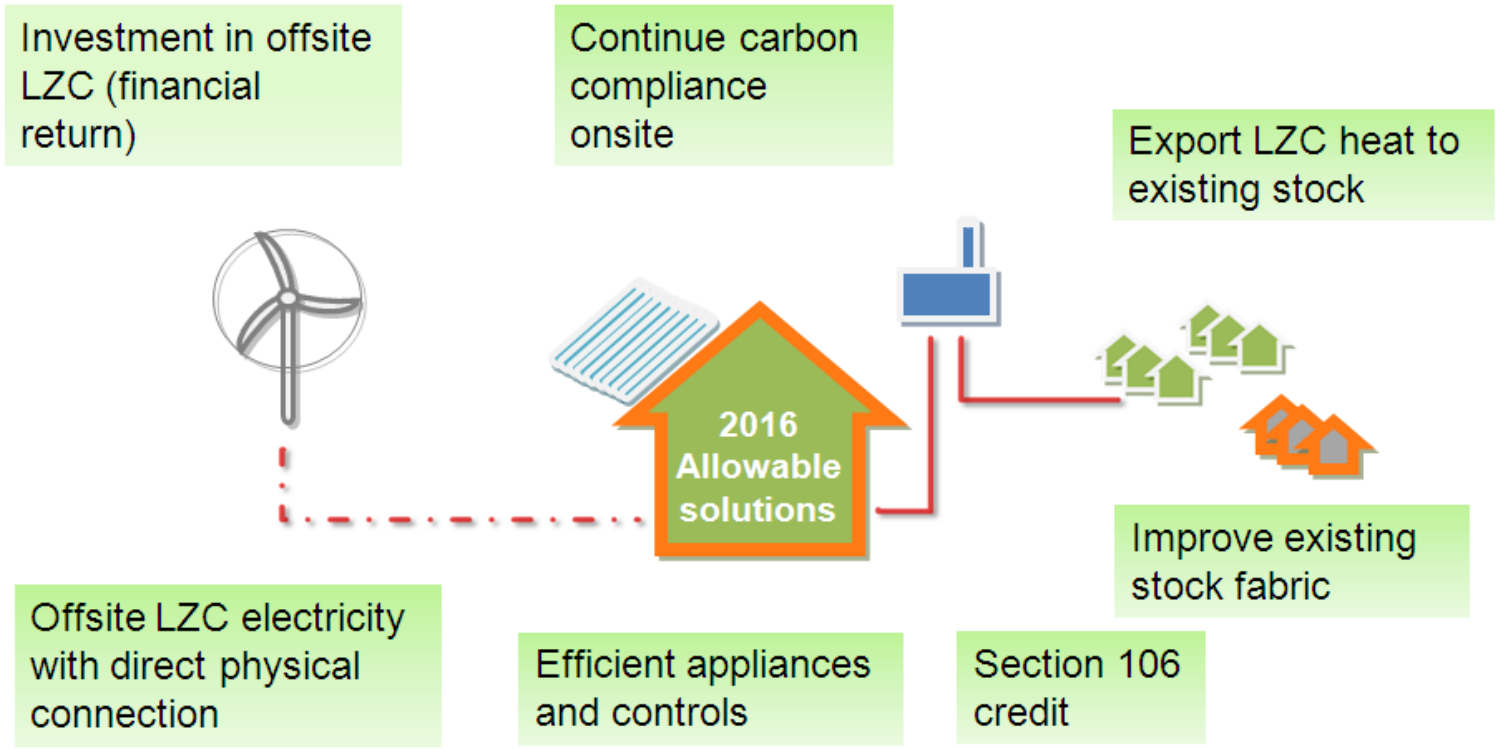
PURPOSE AND STRATEGIC OBJECTIVES

Facilitate the mainstream delivery of low and zero carbon homes

- Provide leadership & create confidence
- Reduce risk and clear obstacles
- Disseminate information
- Partnership: Industry & Government

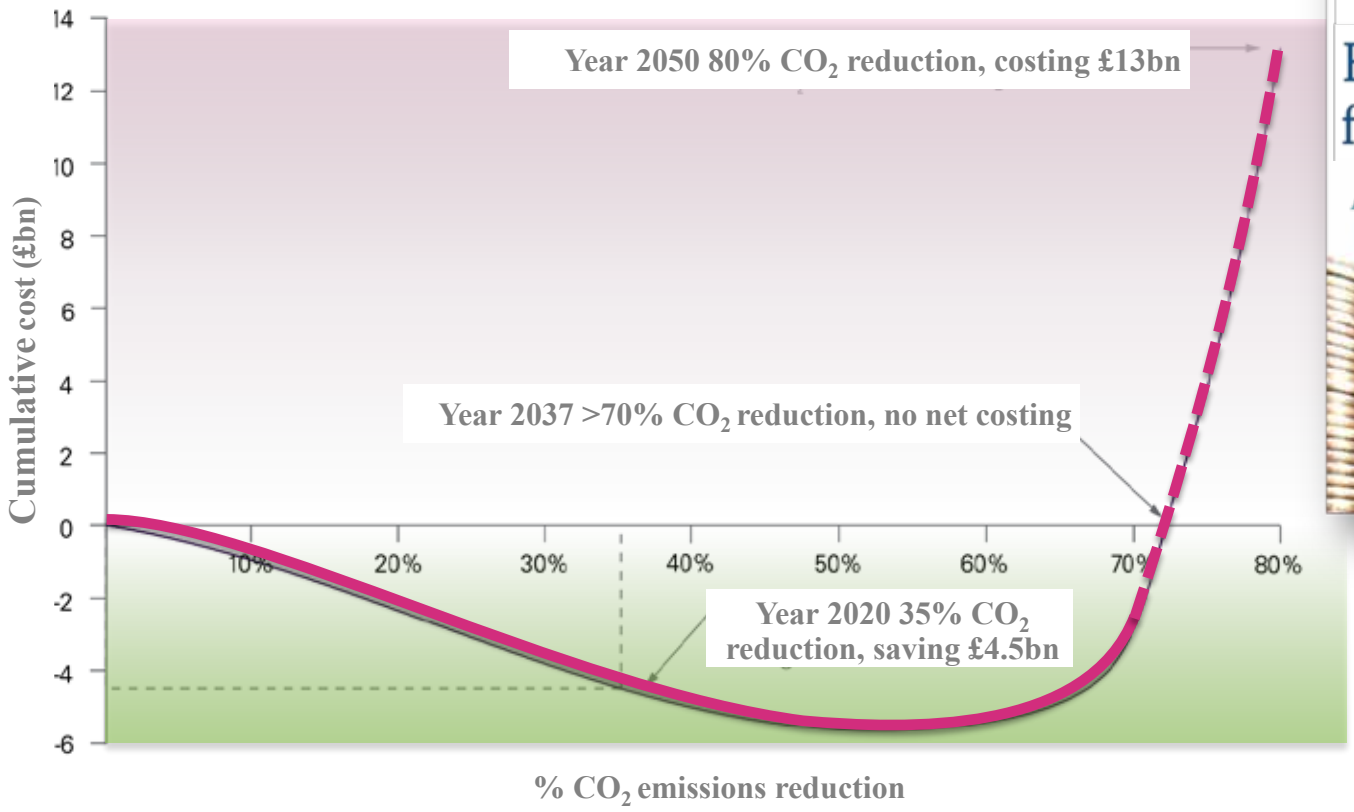
Zero Carbon definition - 2008 Consultation's proposed approach for Allowable Solutions

Where insufficient on-site renewables is practical developers can employ some combination of the following 'Allowable Solutions'



Some 80% of existing buildings in 2050 are already built
However, 70% less carbon could be achieved at no extra cost

Chart ES-d *Cumulative net cost against cumulative carbon saving for non-domestic buildings*
Success Scenario up to 2050



Note: other scenarios, such as those which achieve less than 35% reductions by 2020, will have a different cumulative cost profile, all with a greater cumulative cost to achieve an 80% reduction by 2050.

Source: Carbon Trust and Arup analysis

Future energy bill savings need to pay for investment now

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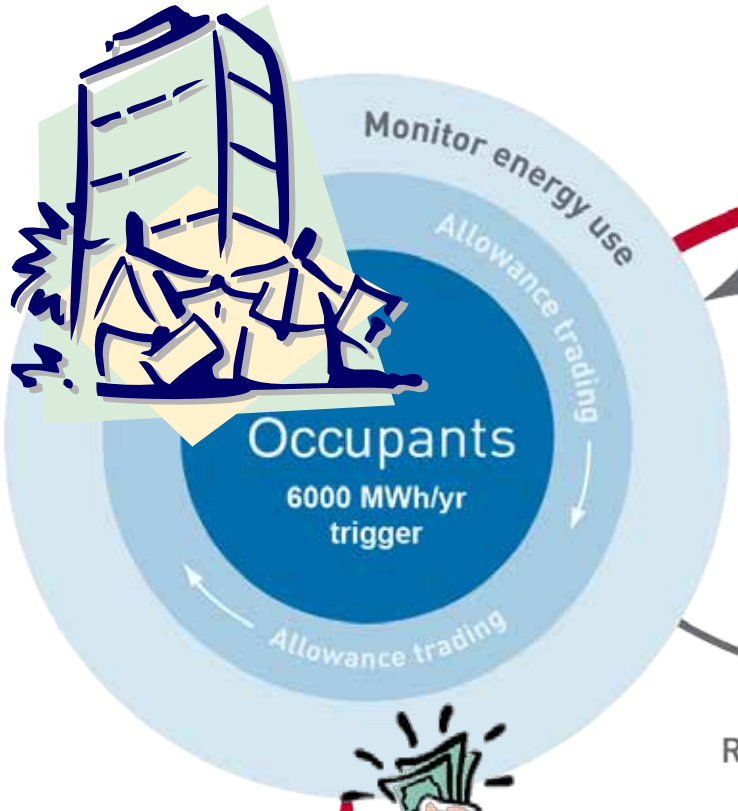
Incentivising the building users! (Carbon Reduction Commitment)



Purchase allowances

Start-up price: £12/tonne CO_2

Allowances cap to reduce year on year

CRC scheme year	1	2	3	4	5	6	7	8….
Allowance cap:	Monitored emissions		Capped at previous year			Progressive reduction		

UK Government Agency

Report and surrender allowances

Organisations ranked by improvement

Participants	Improvement %	League Position
A B C .	Max Min	1 2 3 .

3 Receive revenue recycling

Better performers get more back

CRC scheme year	1	2	3	4	5
Bonus/Penalty Rate:	+/-10%	+/-20%	+/-30%	+/-40%	+/-50%

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Green Deal for homes: What is it?...

- A regulatory framework enabling companies to offer householders:
  - **accredited** advice and recommendations
  - home energy efficiency improvements at **no up-front cost**
  - Repayments less that savings in energy bills (**Golden rule**)
  - much easier, **co-ordinated offers** (**one point of contact**)
  - reassurance that work is of a **high standard**
  - the ability to **pay via energy bills over the long term** (for example, 25 years), making use of the money saved on fuel
  - only to **pay whilst they remain in that property**

DEPARTMENT OF ENERGY & CLIMATE CHANGE

UK GREEN BUILDING COUNCIL

Key role of UK-GBC
Green Deal: creating a market in refurbishment


Industry

Consensus

GRAND DESIGNS
GREAT BRITISH
REFURB
CAMPAIGN

Finance

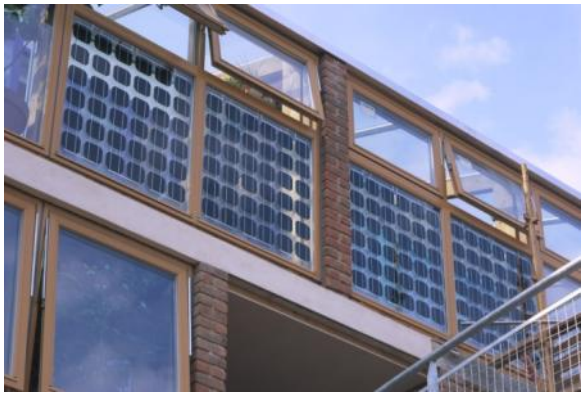
Politicians

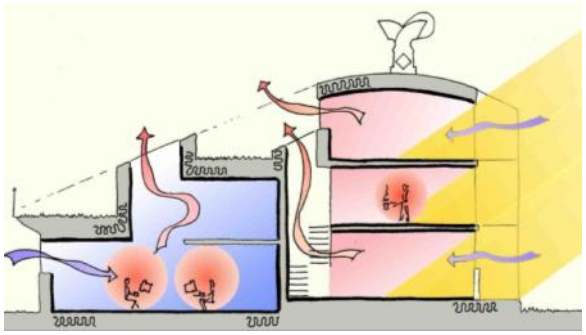

Media


Policy


Green Deal

UK GREEN BUILDING COUNCIL

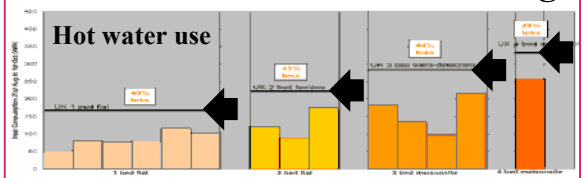


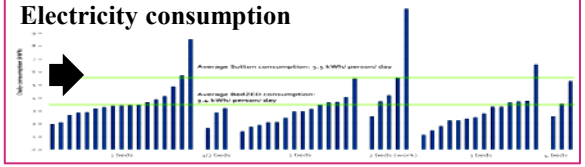


BedZED : Beddington Zero (fossil) Energy Development

Client: Peabody Trust
Architect: Bill Dunster
BioRegional Developments
86 homes, live/work, community uses

Feedback from In-use monitoring





- Zero Carbon design
- Zero heating homes
- Bio-mass CHP prototype
- Wind-cowl heat recovery ventilation
- Water recycling
- PV & electric cars

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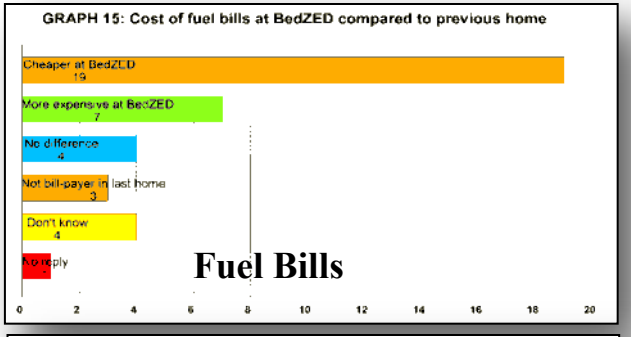
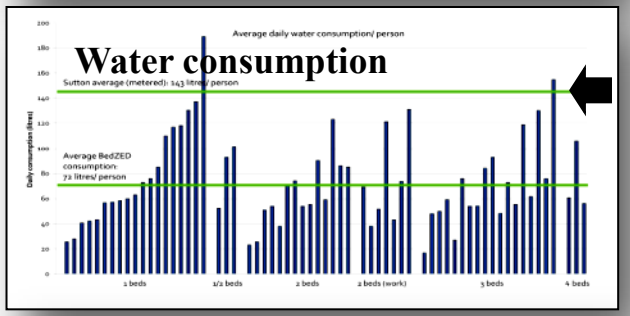
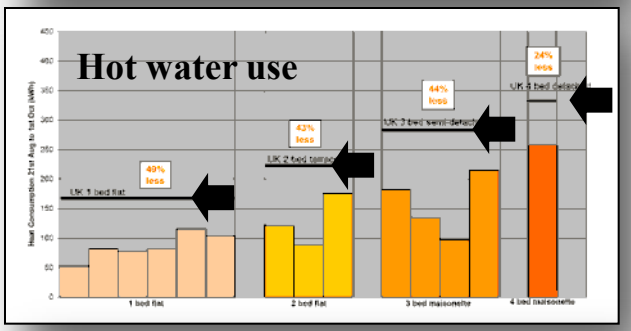
BedZED feedback

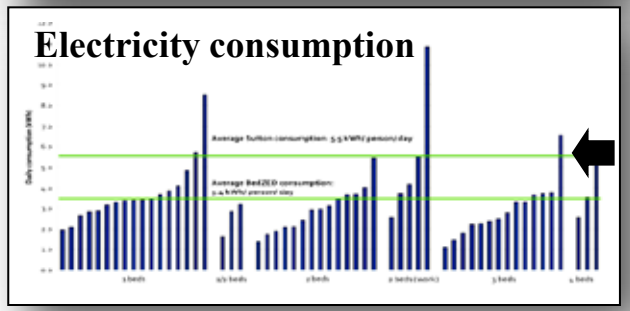
- 10 years of full occupation
- 20+ research projects - including social feedback
- Environmental monitoring:
  - Hot water is ~ 45%* less
  - Electricity for lighting, cooking & all appliances ~55%* less
  - Water is ~60%* less
  - Space heating ~88%* less
  - User influence – up to 4:1 ratio between homes!
- Passive measures more reliable than active
  - Traditional passive design rules need changing
- Occupants unsure on how best to use their homes
  - Education & support needed

*** Ref: UK typical in-use values**
Source: www.bioregional.com









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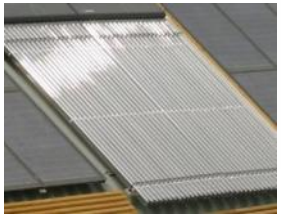

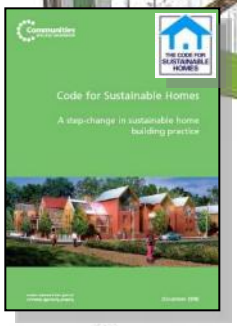

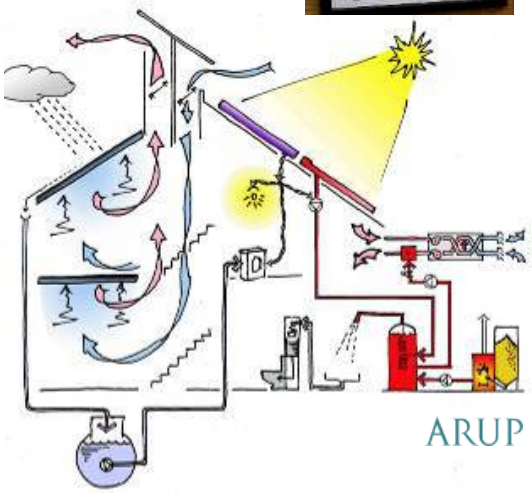

lighthouse

Kingspan Lighthouse

- Level 6 Star - Code for Sustainable Homes
- First built example June 07 completion
- Zero Carbon using on-site renewables
- U-values ≈ 0.1 W/m^2.K
- Triple glazing
- ≈ 1 ac/hr test air leakage
- Lightweight timber structural insulation panel -SIPS
- 80 L/person water use

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BARRATT HOMES

Barratt Greenhouse

- First volume house builder CSH6*
- On BRE Innovation Park
- Zero Carbon using on-site & near-site renewables
- Exposed thermal mass for cooling
- Air-source heat-pump
- PV & solar hot water

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Sustainable living centre where residents are given training. Permanent exhibition for visitors on the features of the project

Retirement home

Prototype trialling of UK Building Regulations 2016 'Zero Carbon' with on-building micro-generation and 'Allowable Solutions' option

Open parkland used for orchards, wildlife meadows and sustainable drainage

Refurbished Grade 2* listed building converted for community and employment uses

Necklace of water pools which are part of the drainage system and also benefit the ecology in the landscape

185 new homes with community facilities & refurbished existing buildings

BARRATT HOMES

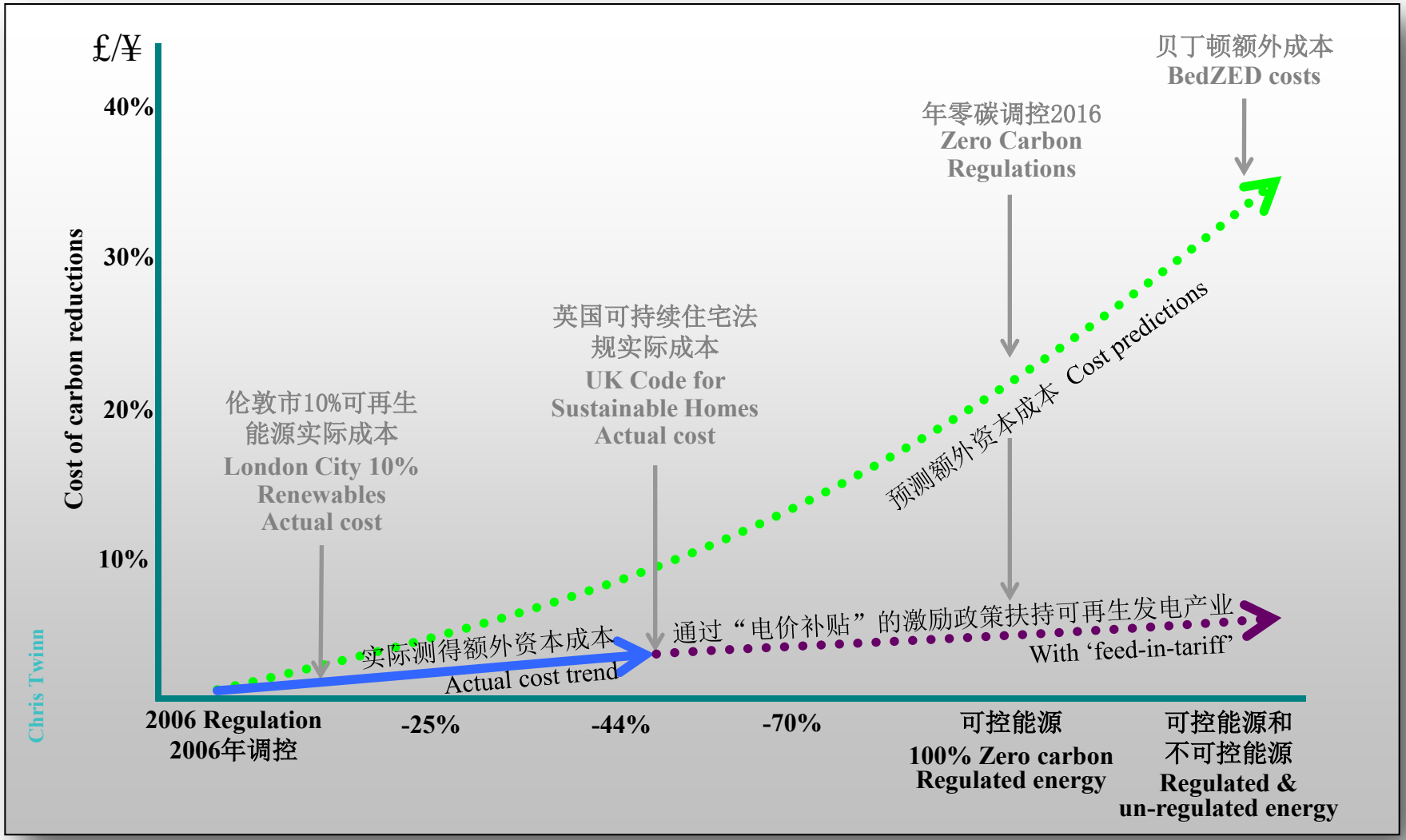
HTA

Hanham Hall

THE Carbon CHALLENGE

The challenge to build quality sustainable homes

零碳成本趋势：与英国实际完成的建筑物成本相比所做的预测
UK Zero Carbon cost trends: predictions verses actual



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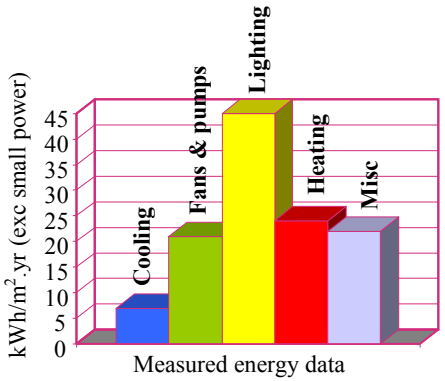
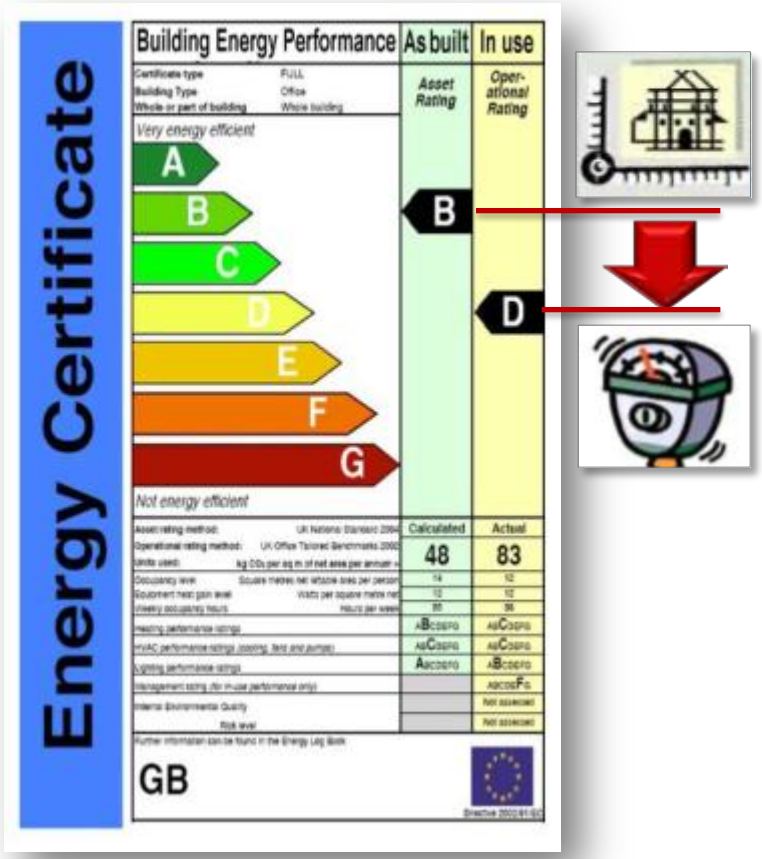
公布反馈，提升行业及其管理标准
Public feedback so industry & regulations can improve

通过公众反馈来快速获悉哪些政策、法规和设计特性能起到好的效果，哪些不能。经验显示许多都未达到预期的结果。

Using feedback to quickly understand what policies, regulations and design features deliver good results and what does not work. Experience shows many do not deliver as intended.





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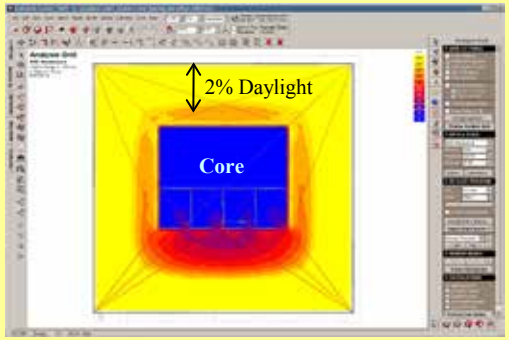
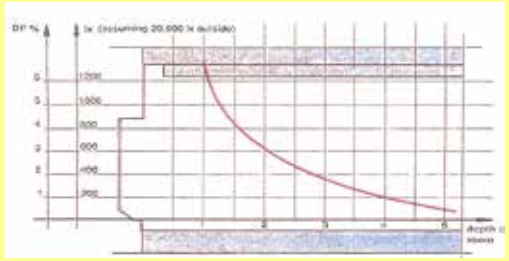
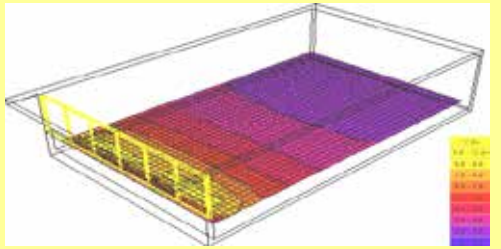
利用自然采光的反馈信息
Feedback on using daylight

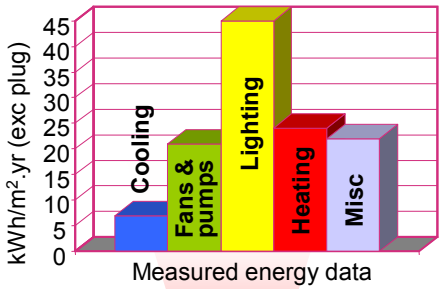
理论上的自然采光
The Theory





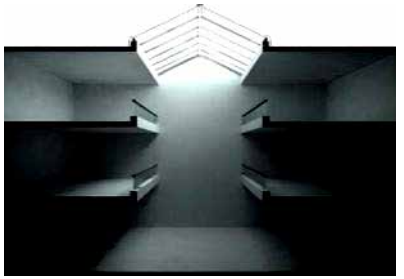


实际中的自然采光
The Reality



可替代的设计为:Instead design for

- 深达4米的日光，能自动控制 开关 Max 4m depth for Auto daylight switching
- 室内深处对日光的“感觉”更重要 Daylight ‘Perception’ important deeper into room
- 设计窗户是为了改善日光的“质量” - 而非“数量” Design windows for daylight ‘quality’ - not ‘quantity’



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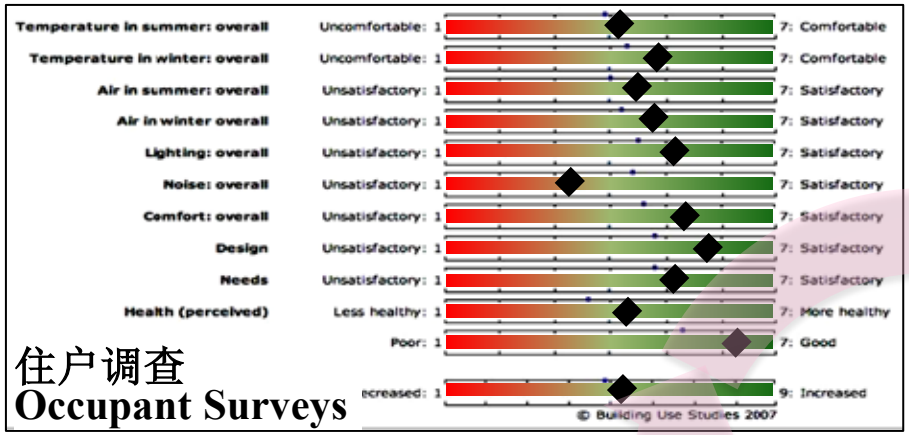
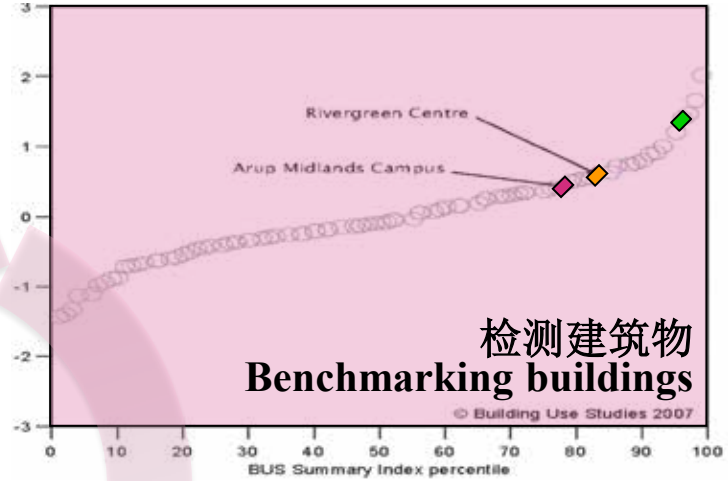
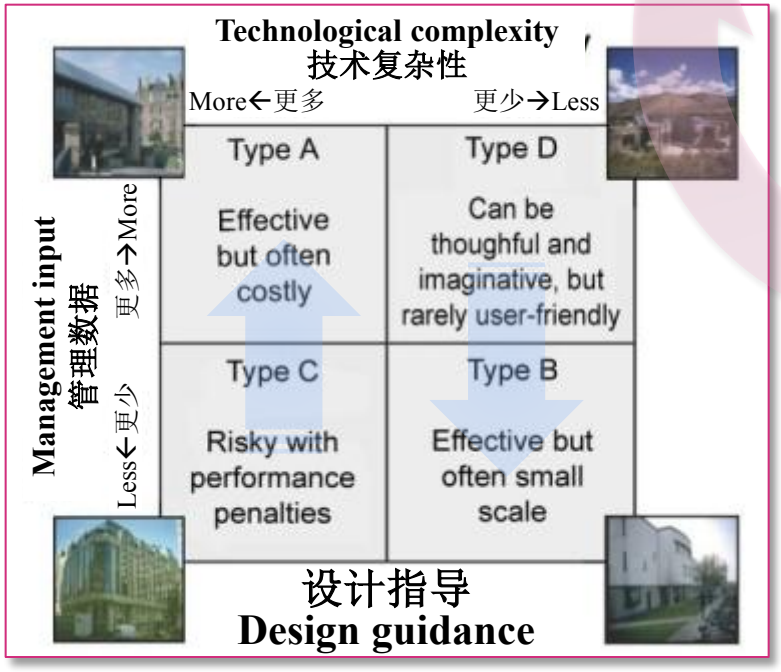
理解住户心理因素 → 提高住户生产力
Understanding human interface → Productivity



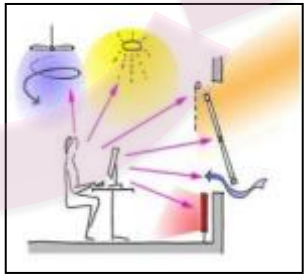
住户调查
Occupant Surveys



检测建筑物
Benchmarking buildings



设计指导
Design guidance



Trends:
AC reduces perception of control
NV increases perception of control

Control-group size matrix					
People to → negotiate with	1	2	4	8	8+
Heating			✓		
Cooling			✓		
Ventilation			✓		
Lighting				✓	
Glare	✓				
Overall = 4.2 (1=ideal, 8=typical)					

单独房间环境控制
Individual's room condition control

Chris Twinn v6 Ref : Adrian Leaman

Input from Building Performance Group, BLS, Twinn & ref: UBT

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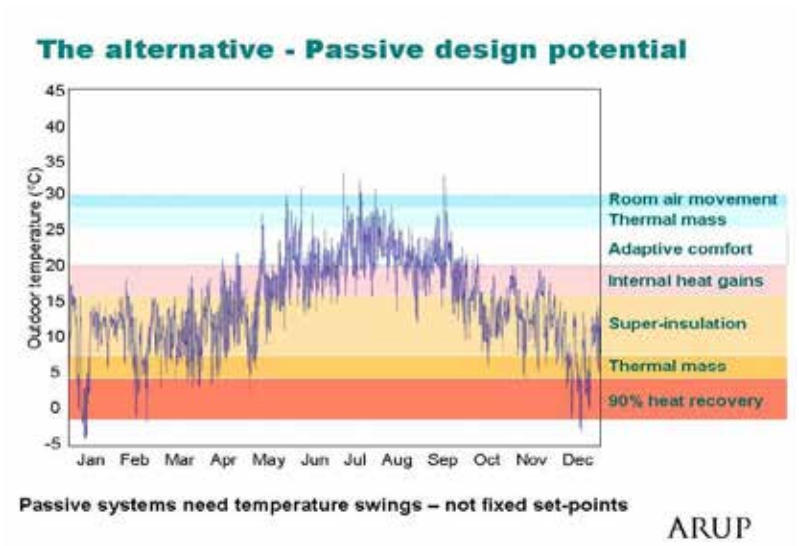
Comfort & passive cooling

From real feedback & learning

- *25-35 W/m^2 potential*
- *Room exposed ceiling thermal mass = cheapest*
- *Watch-it: keep exposed surface visually clear (cooling is ~66% radiant)*
- *Watch-it: needs good envelope (airtight & thermal) for full potential*
- *Requires daily set-point swing – as Adaptive Comfort control*
- *Most AC modelling software fail to predict full potential (no swing)*
- *Use simple control night ventilation algorithm (for each room)*
- *Also provides winter heat recovery (if good envelope)*



Reduced output due to radiant cooling area obscured

Feedback from Building Performance Group
& previous BEL4 & BLS completed projects

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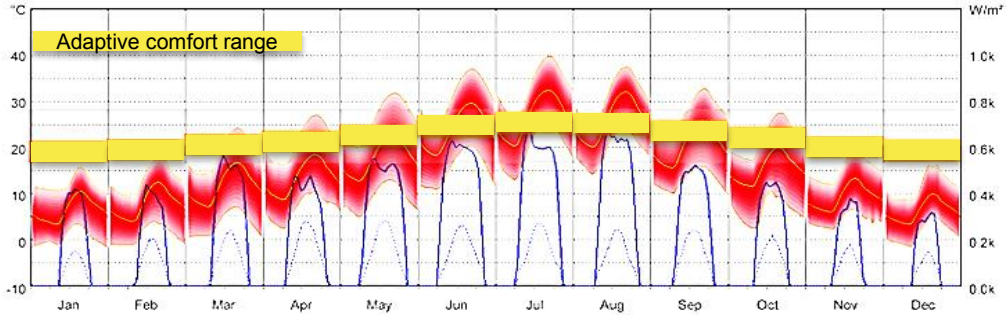
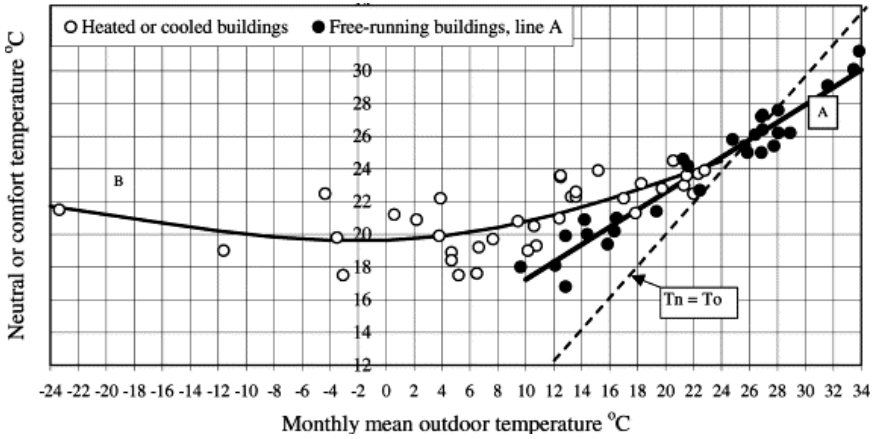
Adaptive Comfort – what is it



- *People can adapt to local weather conditions*
- *Allows occupants to be comfortable in a wider range of conditions than normal AC design suggests.*
- *Does not happen in automatically controlled sealed air-conditioned buildings*

- *Occupants individually must have ability to adjust their local environmental parameters*
- *Allows room comfort temperature to be adjusted using rolling average outdoor monthly temperature*
- *Evidence suggests similar daily lighting effects achieved if individuals directly control own lighting*



The effect of adaptive behaviours on optimum comfort temperatures. Taken from BRE Adaptive Thermal Comfort Models (Oseland, 1998).

BEHAVIOUR	EFFECT	OFFSET
Jumper/Jacket on or off	Changes Clo by ± 0.35	± 2.2K
Tight fit/Loose fit clothing	Changes Clo by ± 0.26	± 1.7K
Collar and tie on or off	Changes Clo by ± 0.13	± 0.8K
Office chair type	Changes Clo by ± 0.05	± 0.3K
Seated or walking around	Varies Met by ± 0.4	± 3.4K
Stress level	Varies Met by ± 0.3	± 2.6K
Vigour of activity	Varies Met by ± 0.1	± 0.9K
Different postures	Varies Met by ± 10%	± 0.9K
Consume cold drink	Varies Met by -0.12	+ 0.9K
Consume hot drink/food	Varies Met by +0.12	- 0.9K
Operate desk fan	Varies Velocity by +2.0m/s	+ 2.8K
Operate ceiling fan	Varies Velocity by +1.0m/s	+ 2.2K
Open window	Varies Velocity by +0.5m/s	+ 1.1K

- *Methodology developed by Humphreys and Nicol based on statistical analysis of large scale field measurements: Building occupants and their indoor climate were two parts of an integrated, self-regulating (feedback) system. If a change occurs that produces discomfort, people will tend to act to restore their comfort - Physiological acclimatisation & behavioural adaptation*

Ref: Humphreys & Nicol, CIBSE, BRE & ASHRAE

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如何减少零碳成本
How Zero Carbon can cost less

参考：城市精装修三层办公楼
Ref: Urban 3 storey top grade office with fitout

能耗 Energy

2010 年符合规范的建筑 2010 Regs

不可控能源 Unregulated

可控能源 Regulated energy

- IT server power
- Server AC
- Plug power
- Misc other
- Lighting
- Fans & pumps
- Cooling
- Heating & DHW

145kWh/m²

装修特色
- Tablet & 'Thin client' IT
- Mobile & 'Cloud computing
- Task lights + fewer fixed lights
- In-slab cooling (& heating)

建筑设计特色
- Added insulation & airtightness
- 30% glazing high performance
- Operable windows
- Enhanced ceiling slab finish

减少成本特色
- Design-out external shading
- Simple cladding
- Reduced storey height
- Reduced size central plant
- Omit FCUs
- No dropped ceiling

- Feed-in-tariff "电价补贴"

65kWh/m²

现场可再生能源 Renewables kWh/m²
- Roof area PV
- Biomass boiler

施工成本 Capital cost

Zero Carbon

£2050/m²

2010 年符合规范的建筑 2010 Regs

- Electrical
- HVAC
- Internal surfaces etc
- Envelope
- Structure
- Misc
- Prelims & BWIC

£2200/m²

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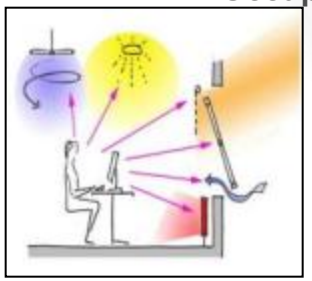
建立建筑设计标准的新方法 Setting new building standards

监控+ 目标
Monitoring + targeting

设计窗户是为了改善日光的“质量” – 而非“数量”
Design windows for daylight ‘quality’ - not ‘quantity’



住户控制： 生产力
Occupant control : productivity

较小基础设施
Smaller infrastructure

个人平板型桌面计算机设备
Personalised tablet desktop IT

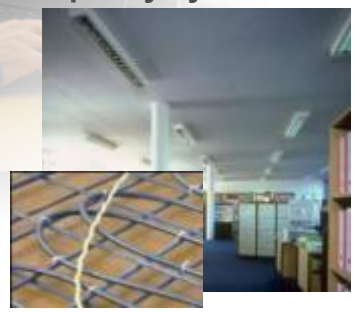
云服务器 Cloud servers

无线接口
Wireless interface

作业灯 LED
Task lighting

低能耗围栏设备
Low energy corralled equipment

低容量被动制冷系统
Passive cooling low capacity systems



新的水泵、风扇、控制系统和内装设计规则 New design rules for pumps, fans, controls, fitout

Chris Twinn v9

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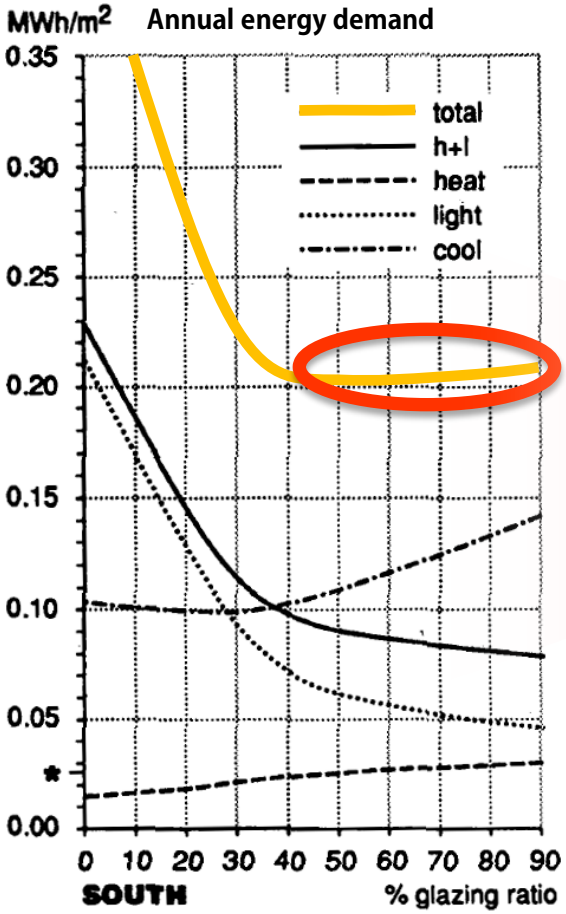
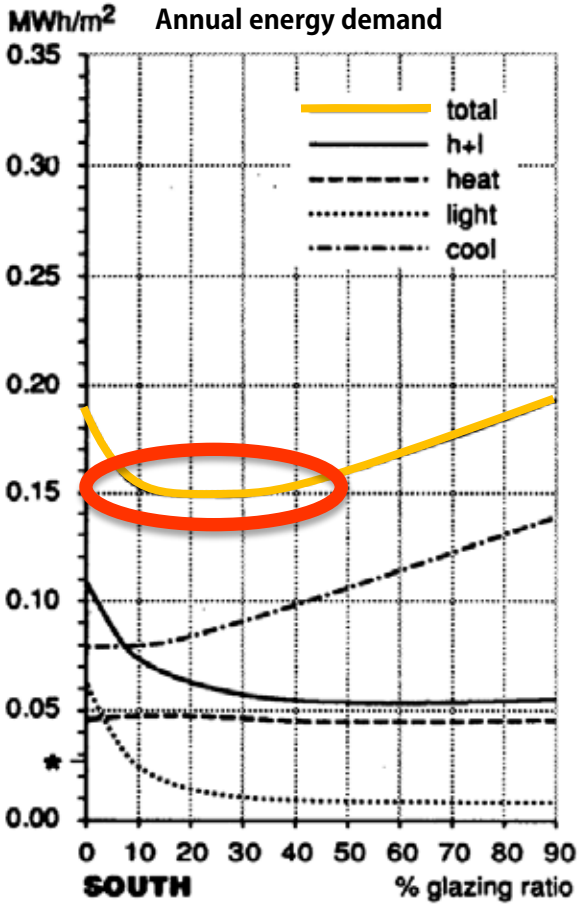
Extra low-energy lighting changes the optimum window area (and dramatically reduces solar gains)



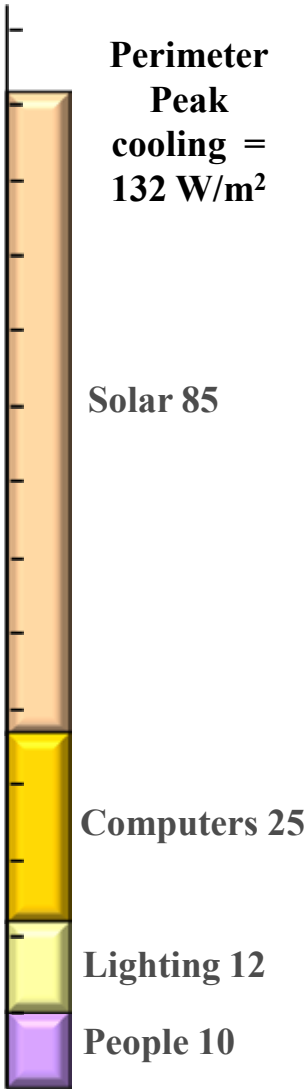
BAU office with 10W/m² lighting energy
Optimum ➔50-90% glazing



Low-E office with 5W/m² lighting energy
Optimum ➔ 15-35% glazing

Business as Usual:

- Windows designed for high quantity of daylight – not quality of daylight
- Sealed facade means 100% dependence of HVAC even during mild weather
- Fit-out and systems capacities based on yesterday's technology



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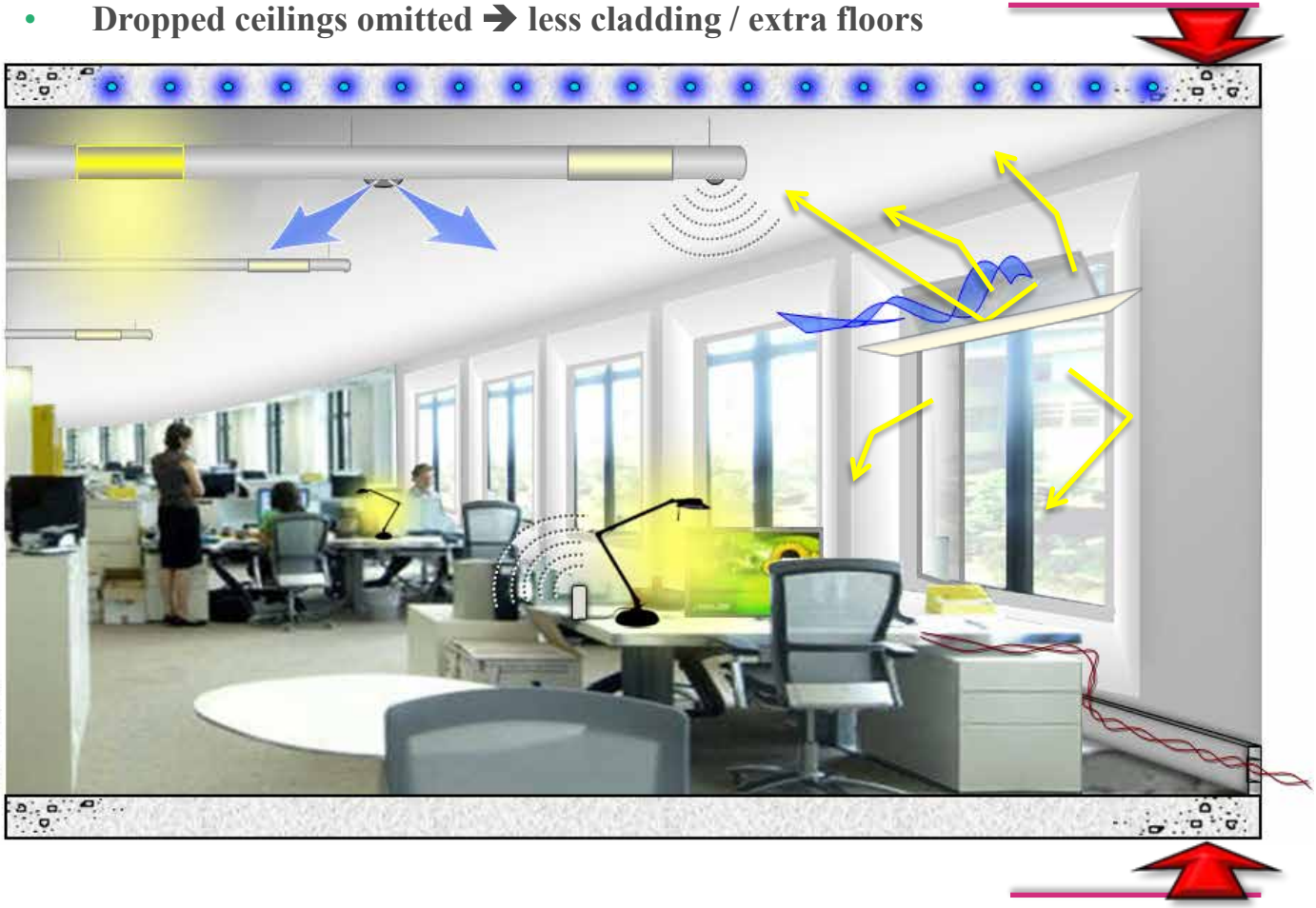
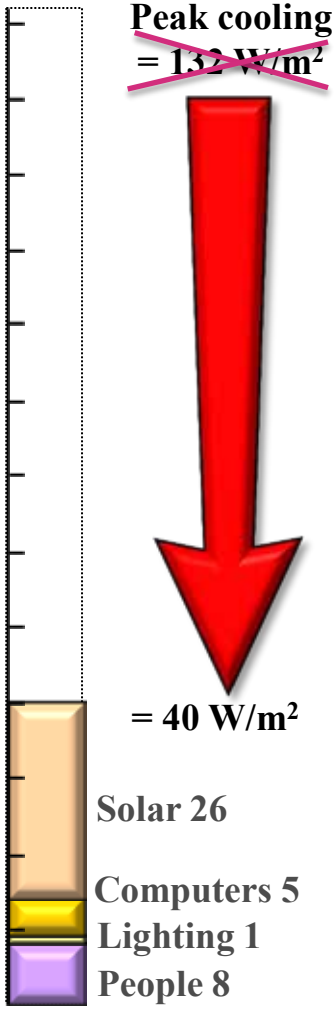
Extra low cooling: allowing new Mixed-Mode alternatives

- Window design ➔ good quality room daylight, used with task lighting
- Activated thermal mass cooled slab ➔ large area radiant coolth allows comfort at 26ºC
- Operable windows & night flush potential when weather/climate permits
- Water-side free-cooling + seasonal rescheduling, enhanced fresh air
- Dropped ceilings omitted ➔ less cladding / extra floors





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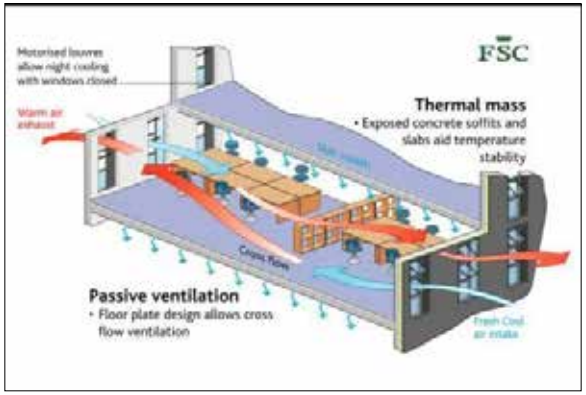
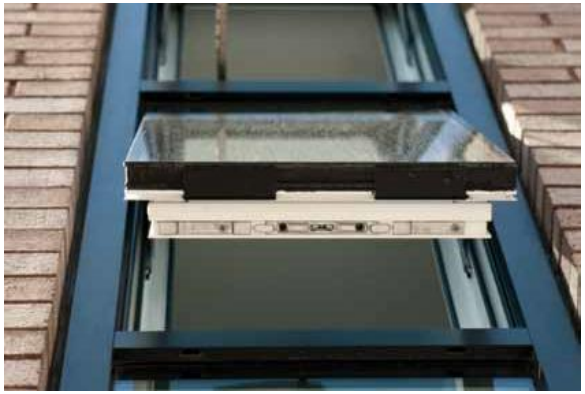
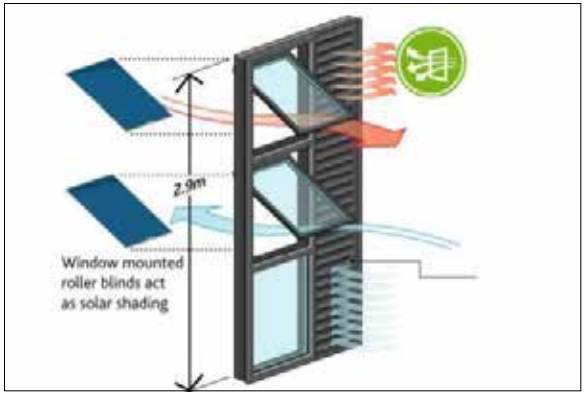


英国曼彻斯特The Hive公寓
The Hive　Manchester, UK

业主 Client: Argent
建筑师 HKR Architects
获BREEAM“优秀奖”‘Excellent’
年完工Completed 2010
当代风格的办公空间
Contemporary style office space

- 被动制冷与自然通风 Passive cooling & natural ventilation
- 自然采光设计的未来趋势是“质量”而非“数量” Future design ‘quality’ daylight - not ‘quantity’
- “精益”最小化材料，低造价成本 ‘Lean’ build & low cost
- 欧盟“B”级能源标签 Energy label ‘B’
- “A+”级零碳“已完成” ‘A+’ Zero carbon ‘ready’





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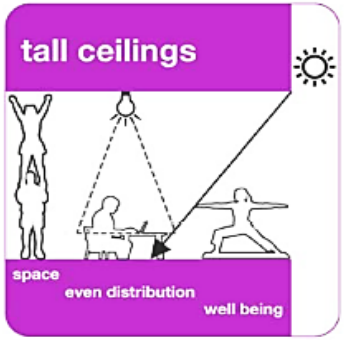
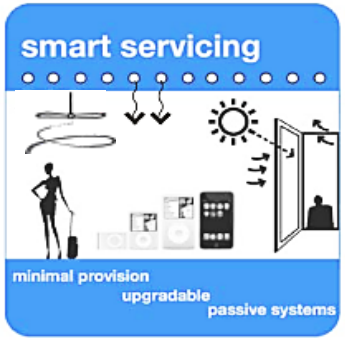
- “A”级商业办公楼 Grade ‘A’ office
- 伦敦城 City of London
- 减少25%的施工成本 25% less build cost
- 减少50%的能源账单 50% less energy
- “精准建造” ‘Lean Construction’
- 能源性能证书= ‘B’，附加升级到 ‘A+’ 零碳的可选方案 Energy ‘B’ label, with upgrade to ‘A+’ zero carbon

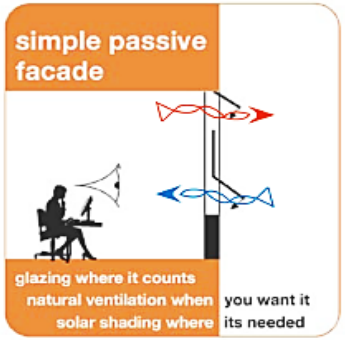
1. 高天花板



2. 智能化服务

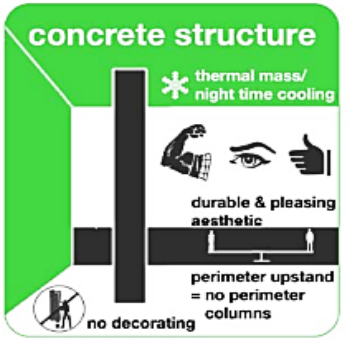


3. 简单的被动幕墙



4. 大进深建筑

5. 混凝土结构



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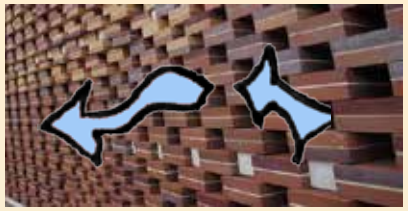
与基准相比游客中心机组容量的削减量
Comparison between Visitors Centre reduced size of plant compared with a business-as-usual base-case.

4300m² GFA Summer 34ºC 65% RH Uses: Visitor facilities Conference Exhibition R&D offices Harnessing: Building physics Low capacity systems Thermal inertia Control systems	新风机 PAU m³/s	冷机 Chiller kW	冷却塔 Heat Rejection kW	锅炉/热电联产 Boiler /CHP kW(th)
				
基准设计 Base-case	6.75	549 127 W/m²	671	437 101 W/m²
本项目设计 Design	4.47	100 23 W/m²	143	126 29 W/m²
容量的削减量 Reductions	-34%	-82%	-78%	-71%

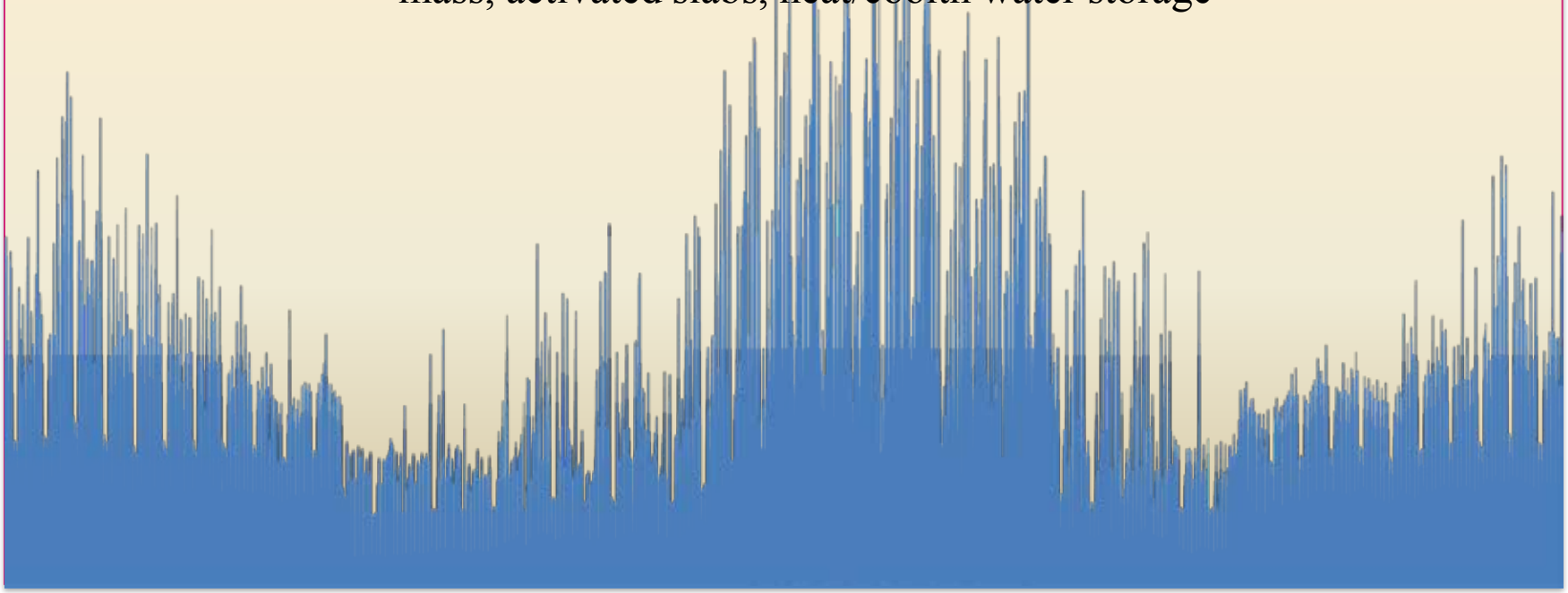
每天的平均需求变化
Smoothing demand profile across each day

使用新被动设计数字化模拟的热惰性、暴露在外的蓄热材料、可活动的隔板、热/冷蓄水





Thermal inertia using new passive design digital modelling, room exposed thermal mass, activated slabs, heat/coolth water storage



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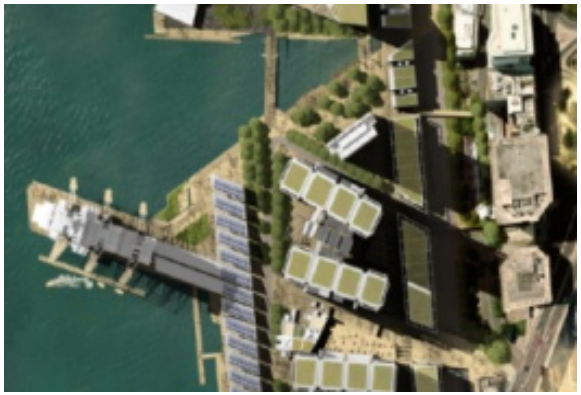

Barangaroo, Sydney

甲方: Client: Bovis Lend Lease
建筑方: Architect: Rogers Harbour Stirk
500,000平方米混合城市更新项目
500,000m² mixed –use regeneration
建设启动: 2010
Construction start: 2010

- 碳平衡概念 Carbon neutral concept
- 蓄积更多水资源 Water Positive
- 能源消耗降低了80% 80% less in-operation energy consumption
- 隐含碳减少了20% 20% less embodied carbon
- 废弃物零填埋 Route-map to Zero waste to landfill
- 环境策略赢得了土地招 Environmental strategy won the land development rights

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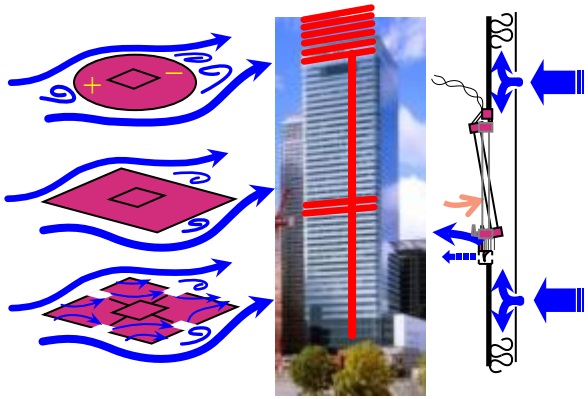

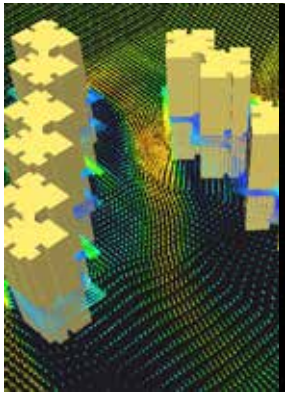

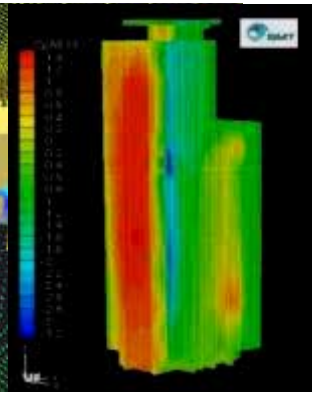

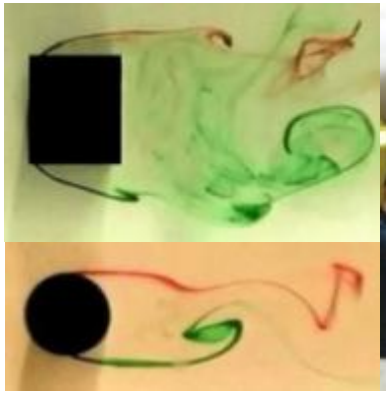

研究和设计50+层高层建筑的自然通风

Research & design for 50+storey hi-rise natural ventilation buildings

- 不同建筑形式与体量
  Different building form & massing
- 可打开窗户设计
  Operable window design
- 需求量更小的系统容积
  Smaller systems capacity needs
- 增加可出租建筑面积
  Increased lettable area

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香港40层高办公楼 – 零碳排放，零附加资本成本
Hong Kong 40 storey office tower Zero carbon for Zero extra capital cost

目的是为了修改 Aims to rewrite:

- 修改传统的设计原则 Rewrite conventional design principles
- 修改被动设计原则 Rewrite Passive design principles
- 修改内装标准 Rewrite Fitout standards
- 修改规划和政策 Rewrite planning & policy
- 修改建筑环境评估方法 Rewrite building Environmental Assessment method
- 修改所有权益相关者的期许 Rewrite expectations for all the stakeholders

建立新的可持续标准

And establish a new standard for sustainability

为达到这一目的奥雅纳设计范围包括
Integrated Arup design scope including:

- 概念设计 Concept design
- 内装简述 Fitout brief
- 建筑规划 Building planning
- 初始成本建议 Initial cost advice
- 深化设计 Detailed design
- 施工图和规格书 Construction drawings & specifications
- 现场工作审查 Review of site works
- 代业主检查调试工作 Checking commissioning on behalf of developer

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The 'Why' and 'How' for the stepchange to Zero Carbon

ZAGREB ENERGY WEEK
Croatian Chamber of Architects
City Assembly Zagreb
14 May 2013

- **UK route map to Zero Carbon new-build**
- **The UK wider policy context**
- **Why LEED Platinum & similar is not good enough**
- **Bringing higher standards into mainstream**
- **Next steps: Zero Carbon for Zero extra Cost**

Thank you for your attention

chris.twinn@arup.com

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