Seminário de Mudança do Clima e Eficiência Energética

Brasilia, 24 de abril de 2013

programmes and policies

Projetos desenvolvidos com o suporte e estímulo dos programas e diretrizes da União Europeia

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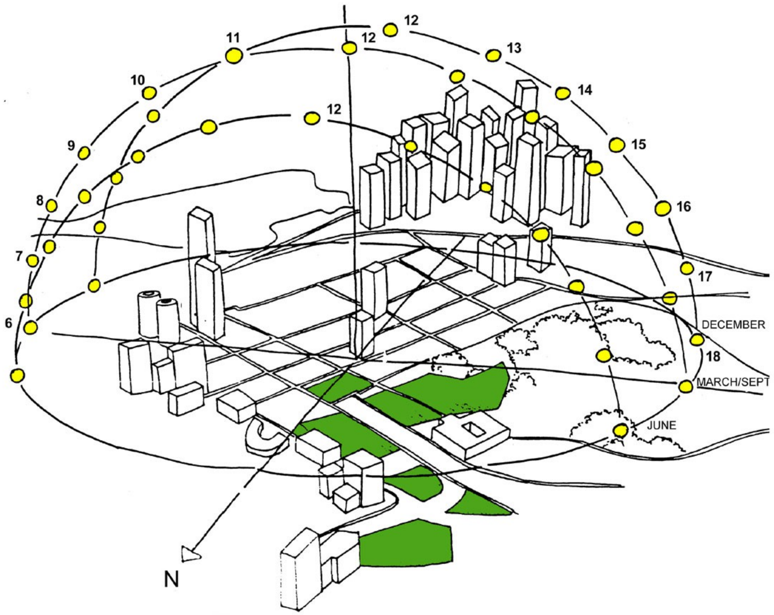
The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Projects developed under the stimulus of EU Programmes and Policies

Background - Combining ***regulation & market incentives, + R&D.***

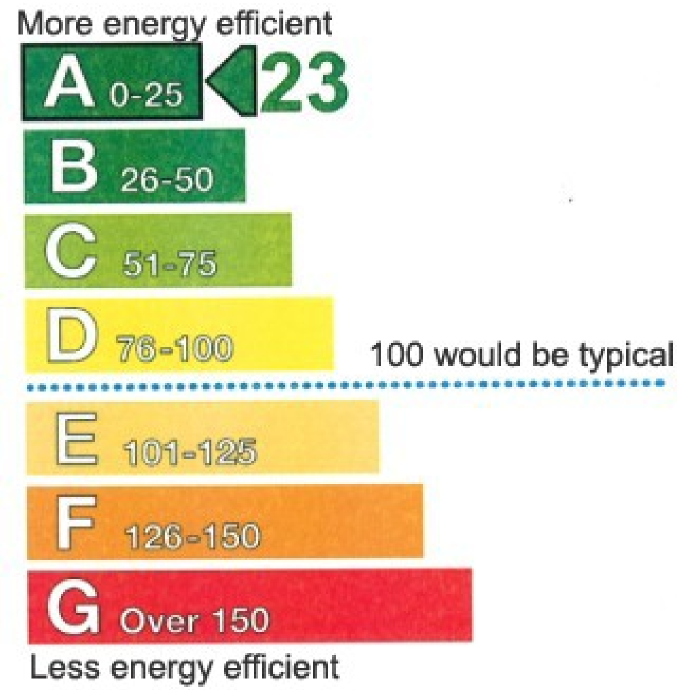
What have we learnt ?

1. ***Urban microclimate & urban morphology***
2. ***Building Performance in Use***
3. ***Fabric First is the design priority***
4. ***Professional Education & Training is vital***



Background. Regulation & Market Incentives

- The European Building Performance Directive (EPBD – 2002, 2010)
- UK Building Regulations – Part L (2002, 2006, 2010…)
- Energy Performance Certificates (UK- 2007)
- The 'Feed-In' Tariff (2008)
- The 'Green Deal' (UK - 2012) existing buildings



UK Government Targets in 2008/ 09

2013 Zero Carbon New Publicly Funded Homes

2016 Zero Carbon New Homes, Schools & Colleges

2018 Zero Carbon New Public Sector Buildings

2019 Zero Carbon New Non-Domestic Buildings

And…

2050 Zero Carbon Existing Buildings

But what do we mean by ‘zero-carbon’ ?

And what about existing buildings ?

**Zero Carbon Hub (UK)
October 2012**

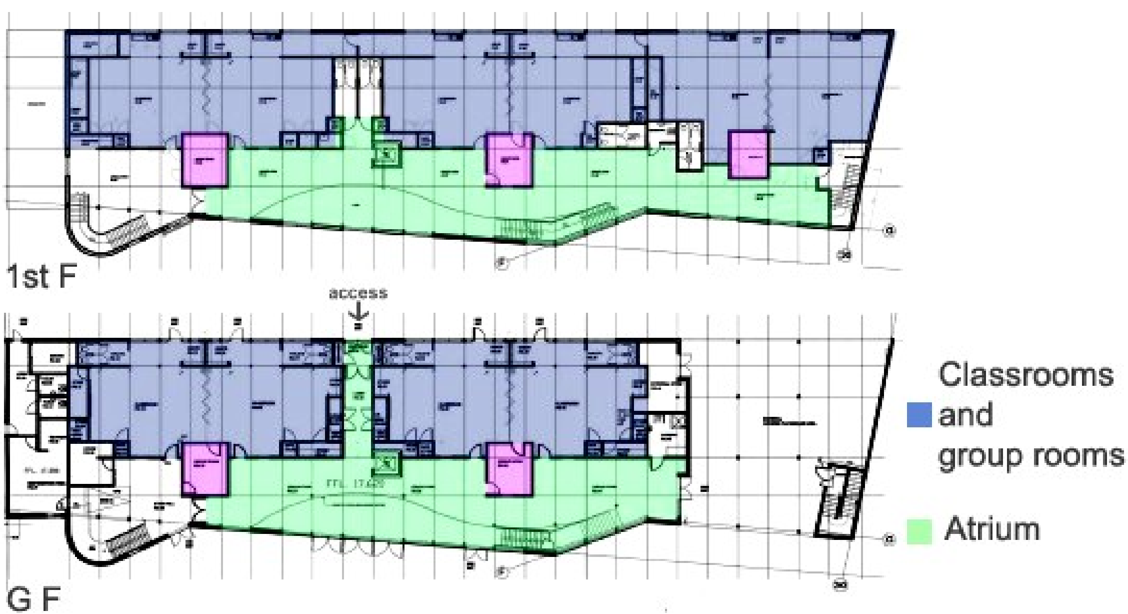
Victoria Miller Building, Bowbridge Primary School

BSCE 'Greening the School Community' Industry Award 2009

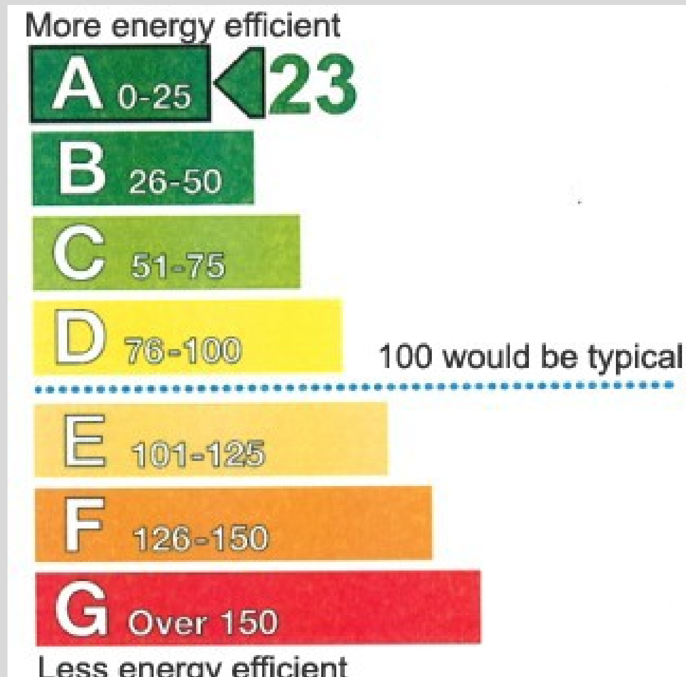
Energy Certificates required for all new & existing public buildings

Display Energy Certificate Rating

(Source: Display Energy Certificate)



(Source: Building plans offered by Daniela Besser Jelves)



UK Government Initiative
for housing refurbishment

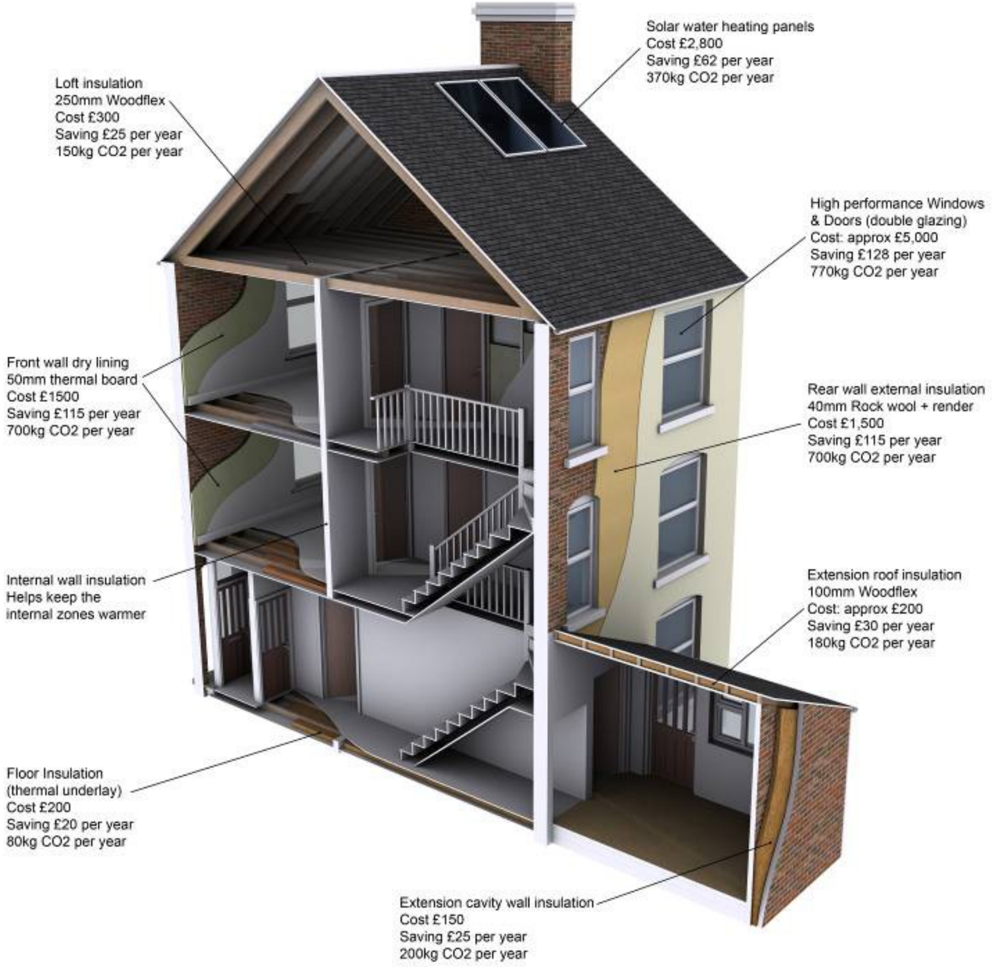
The 'GREEN DEAL'

- **Launched by UK Government October 2012**

- **To promote loans to support energy efficiency measures to existing buildings,**

But…

- **Criticised for complexity, +**
- **May disadvantage the poor**



Funding for Energy Efficiency under the current EC annual Framework (2007 – 2013)

Funding Source	**Instruments/ Mechanisms**	**Total Funding Available**	**Funding for Energy Efficiency**
Cohesion Policy Funding	Operational Programmes incl. financial instruments	E10.1 billion planned for sustainable Energy.	E5.5 billion planned for EE, co-gen and energy management
Research Funding	**FP7 (eg EEB, Concerto, Smart Cities)**	**E2.35 billion for energy research**	**E290 million for energy efficiency**
Enlargement Policy Funding	IFI Facilities	E552.3 million	One third of funding for industry & buildings
Programme for European Energy Recovery (EEPR)	European Energy Efficiency Fund	E265 million	70% of funding to be dedicated to energy efficiency
Competitiveness and Innovation Funding (CIP)	Intelligent Energy Europe Programme	Approx E730 million	100% funding for non-technical issues

Source:EC Report on Financial support for Energy Efficiency in Buildings. Brussels 18.4.13

290m Euro Research Funding FP7 (2007 – 2013)

Focus on energy efficiency in buildings:

1. ‘Energy Efficient Buildings’ Programme promoted R&D for projects focused on new and existing buildings.

2. ‘Concerto’ Programme promoted energy efficiency demonstration projects at a community/urban scale.

Regulation, Market Incentives + R&D

Across EU, the combination of regulation & market incentives + R&D is improving energy efficiency in buildings…

But,

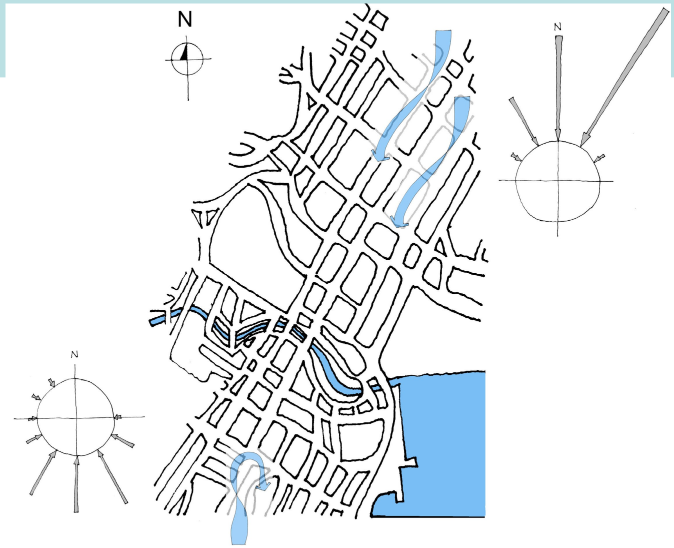
1. *Influence of urban micro-climate & morphology poorly understood,*
2. *Building performance in use also poorly understood'*

And,

3. *'Design' more important than 'technology'*
4. *Professional education & training fundamental*

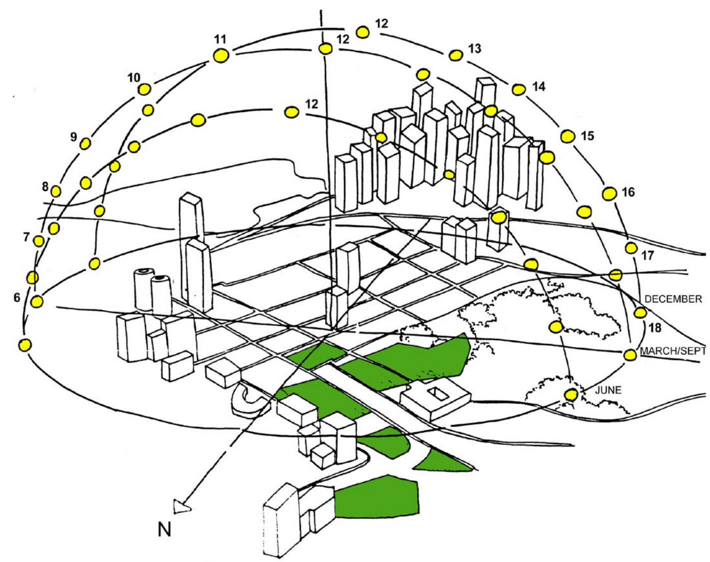
1. Urbanisation, Micro-climate & Morphology

Impact of urbanisation on energy use, building performance and health & well-being.

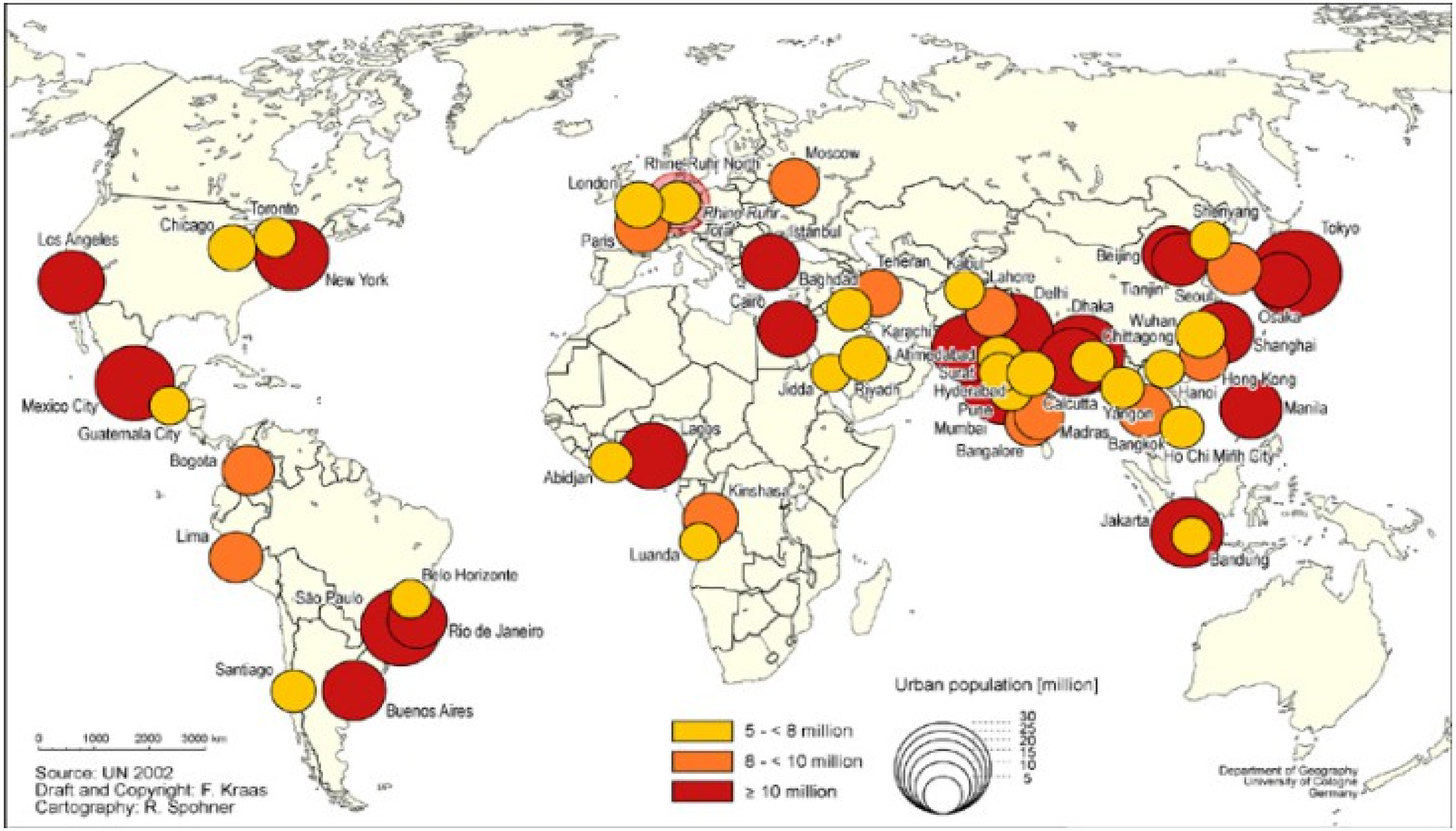


Singapore

- Urban Microclimate (Heat Island Effect)
- Urban Morphology
- Health & well-being

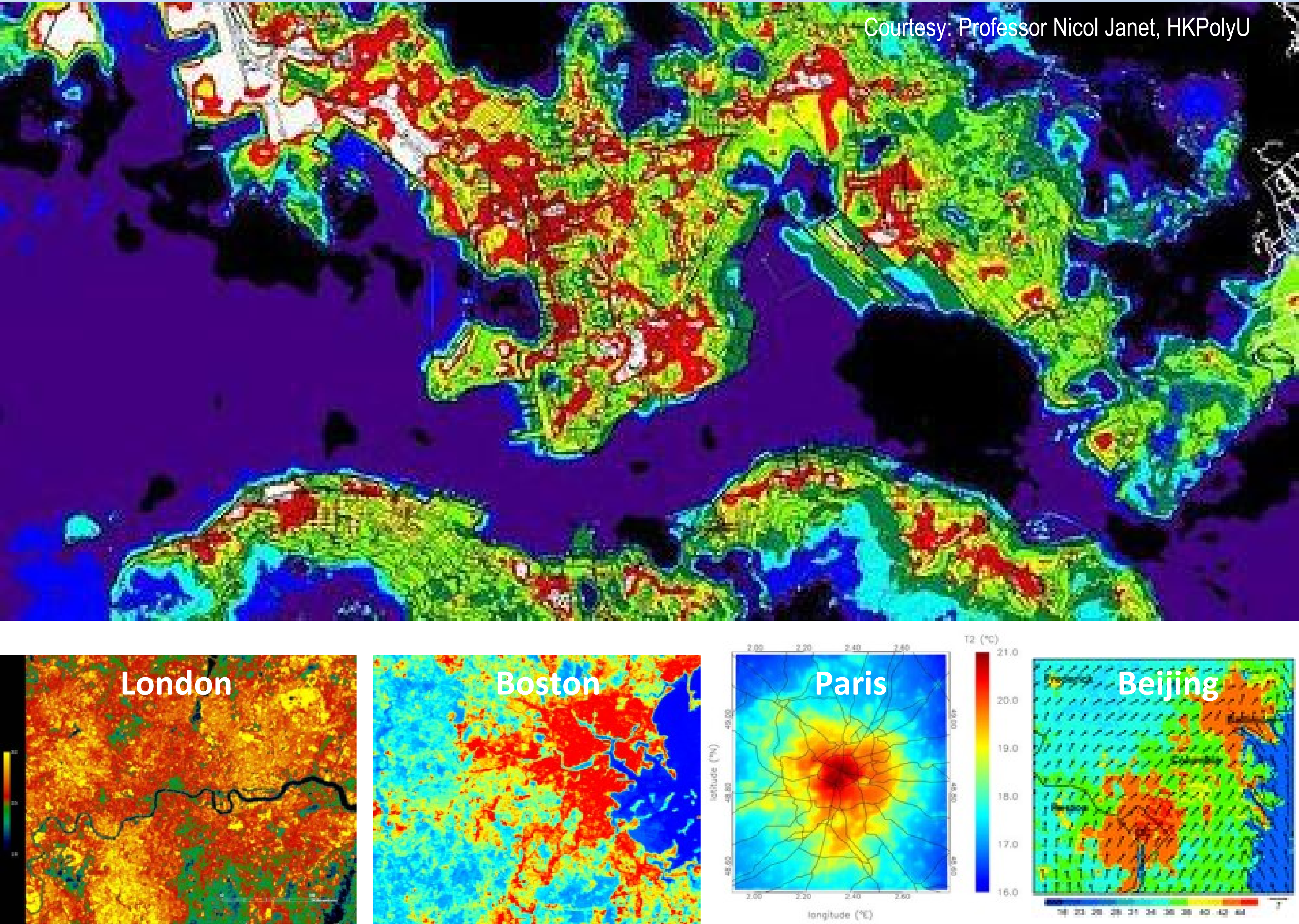


Over 50% of all people now live in cities: this will be 70% by 2050



Hong Kong: due to compact, high density living, …

Hong Kong suffers higher Urban Heat island (UHI) intensity. Also experienced in other cities



Stronger Urban Heat Island (UHI) intensity & weaker urban wind is impacting life

Increase heat stress related mortality

were examined.

Results An average 1°C increase in daily mean temperature above 28.2°C was associated with an estimated 1.8% increase in mortality. Heat-related mortality varied with sociodemographic characteristics;

A study of intracity variation of temperature-related mortality and socioeconomic status among the Chinese population in Hong Kong

Emily Ying Yang Chan, William B Goggins, Jacqueline Jakyoung Kim, Sian M Griffiths

Increase hot days and nights

HKO data	**Very hot days**					**Very hot nights**
T_{iu} increase	T_{iu}= 0	T_{iu}= +1	T_{iu}= +3	T_{iu}= +3	T_{iu}= +1	T_{iu}= 0
	No., of very hot days			No., of very hot nights		
2008	**15**	42	74	115	48	**15**
2007	**25**	61	117	121	52	**23**
2006	**3**	25	82	117	53	**15**
2005	**12**	33	93	135	51	**26**
2004	**6**	26	94	123	47	**19**
2003	**14**	40	91	139	62	**20**
2002	**10**	32	93	133	45	**17**
2001	**9**	38	90	121	41	**16**
2000	**10**	40	99	124	51	**22**
1999	**6**	49	113	133	55	**17**
average	**10.6**	38.2	96.9	127.3	50.8	**19.5**

(no. of very hot days) = 28.85*(Tiu)+ 10.1 $R2 = 0.99$
(no. of very hot nights) = 36.26*(Tiu) +17.5 $R2 = 0.99$

Higher energy consumption

Increasing electricity demand percentage per year	Temperature increase by		
	1°C	2°C	3°C
Domestic	9.02%	16.15%	30.97%
Commercial	3.13%	6.26%	9.38%
Industrial	2.64%	5.28%	7.91%
Total	4.53%	9.52%	14.98%

Table 3.4 Percentage Increase of Electricity Consumption due to Temperature Rise

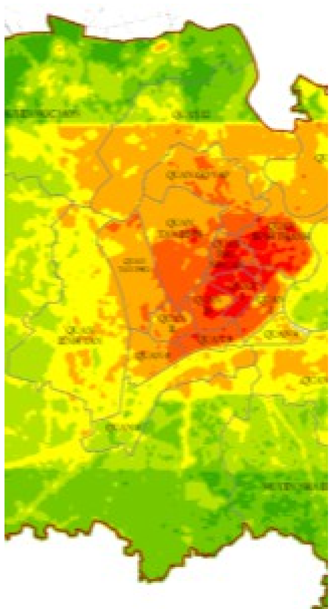
Courtesy: Professor Edward Ng, HKPolyU

The drafting and implementation of Urban Climate Maps

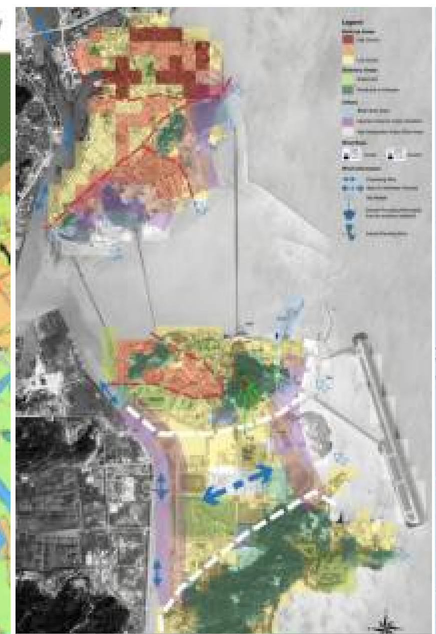
Urban Climatic Maps

Courtesy: Professor Edward Ng, HKPolyU

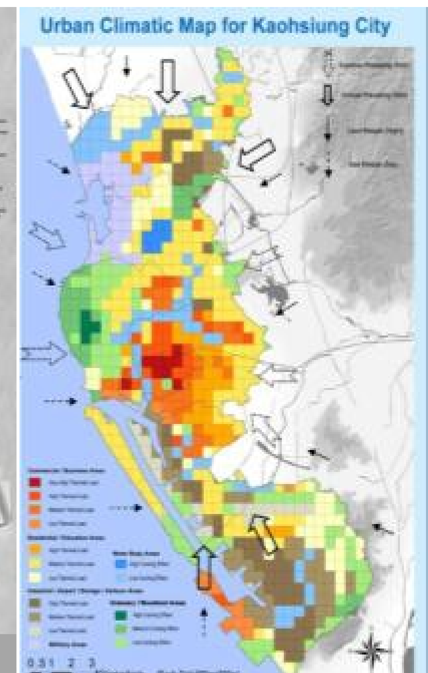
Singapore



Ho Chi Minh City



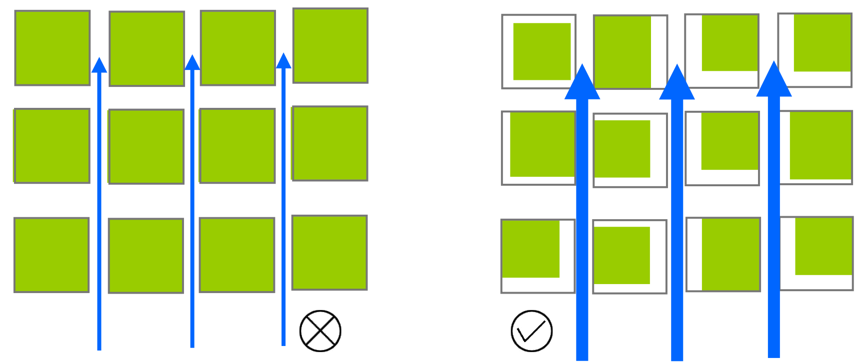
Macau urban climatic analysis map



General Guidelines on District Planning Parameters

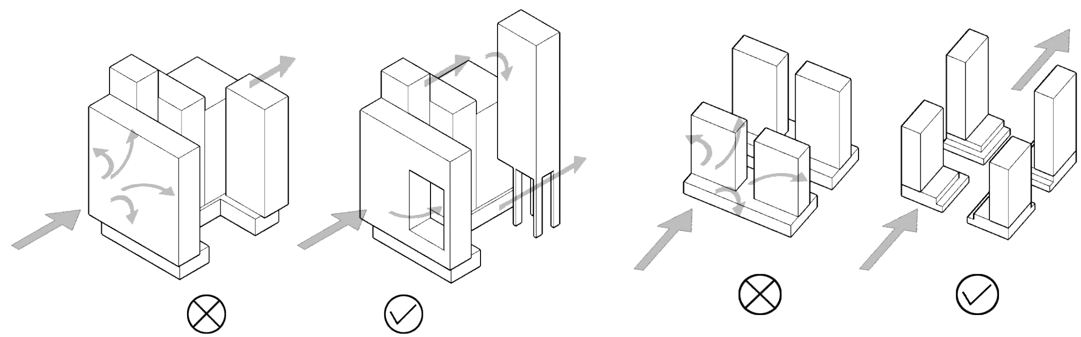
Ground Coverage

open space,
building set back,
Non-building area



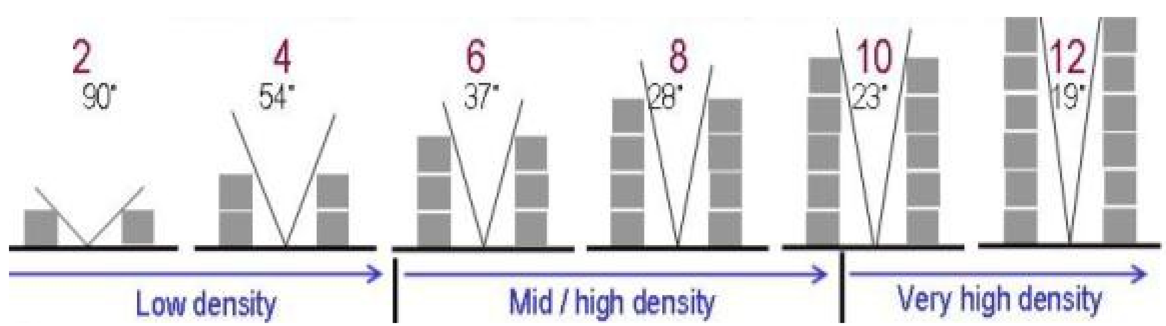
Building Separation

Permeability, gaps and voids



Building Volume

Plot ratio, building bulk

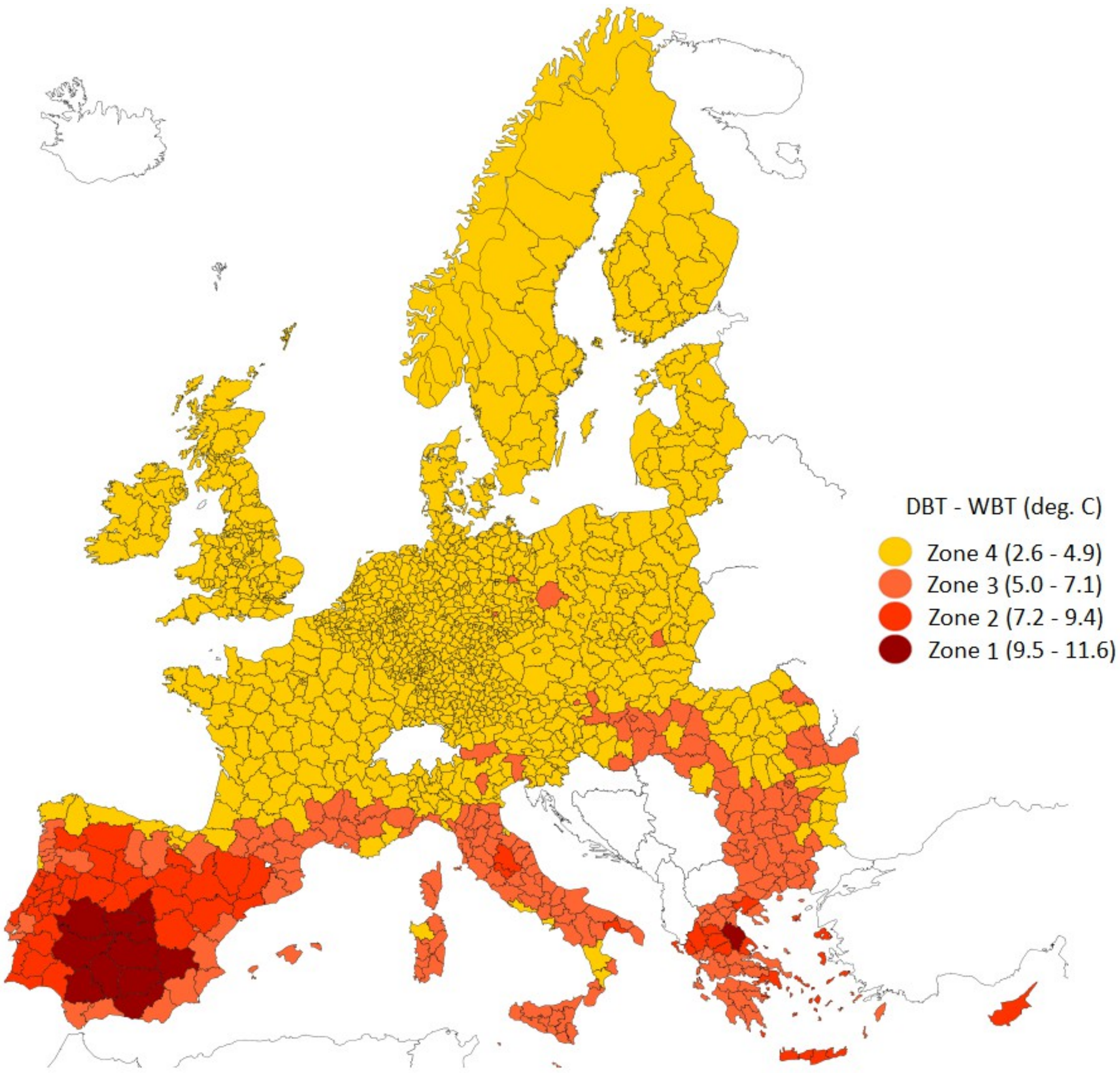


Courtesy: Professor Edward Ng, HKPolyU

Evaporative Cooling Applicability Map for Europe

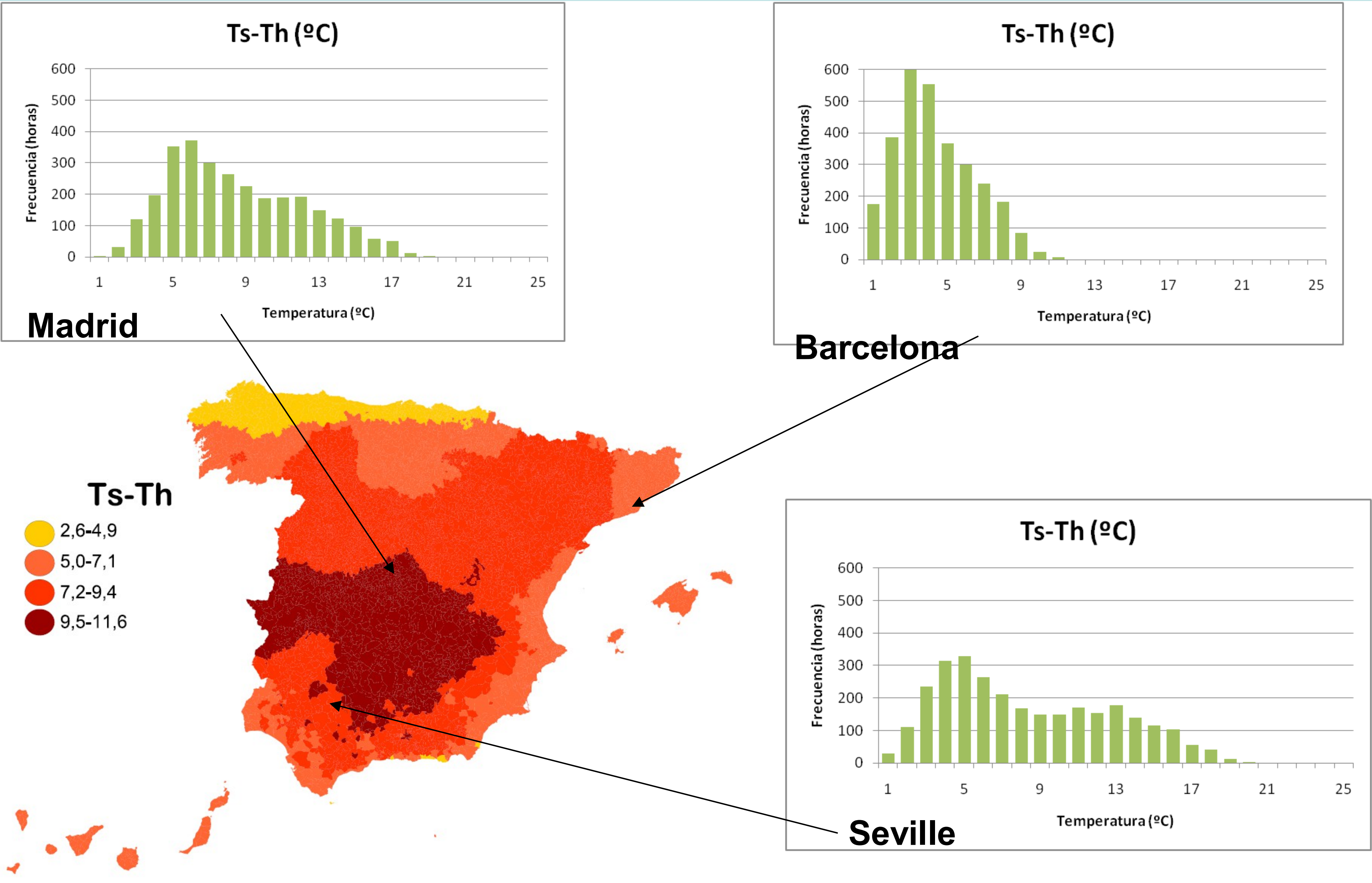
Courtesy Professor Servando Alvarez, University of Seville

Zones of applicability based on differences between outdoor dry bulb temperatures (DBT)and outdoor wet bulb temperatures (WBT).



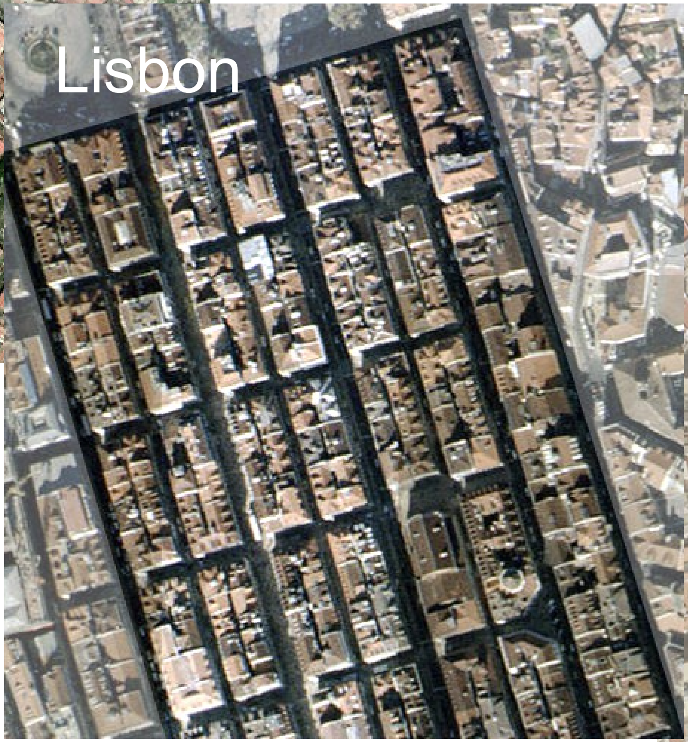
Cooling the Air
(Dry bulb Temperature – Wet bulb Temperature)

Courtesy University of Seville

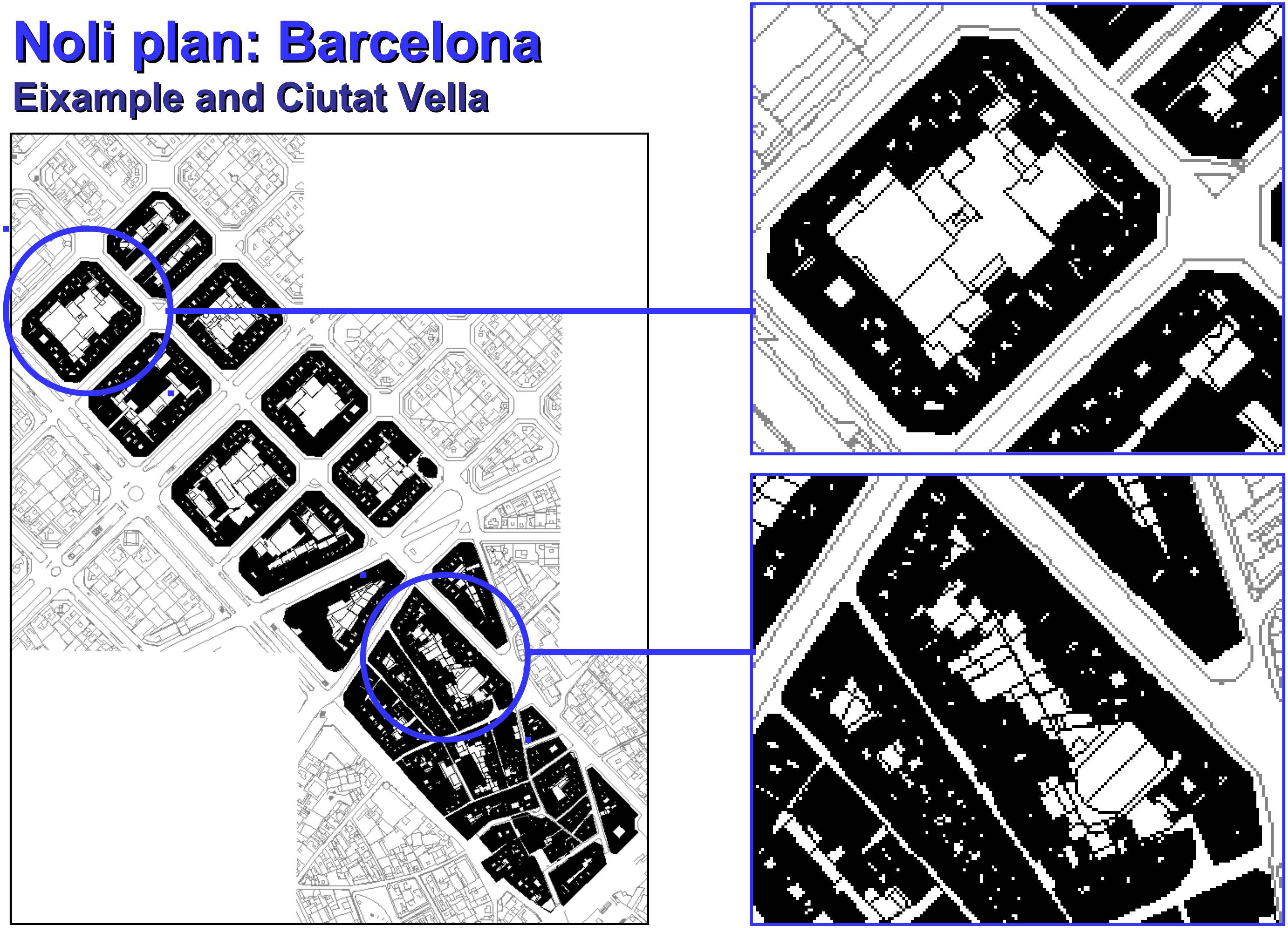


The influence of urban morphology on energy efficient refurbishment

Urban Morphology -
Street pattern, block geometry, courtyards & lightwells



Noli plan: Barcelona
Eixample and Ciutat Vella



Urban Morphology Assessment Technique

Applicability of Energy Efficiency Measures

Minor intervention:
- Distance of void to external wall <12m
- PDEC applicability factor >0.75
- Average of void areas between $9m^2$ and $16m^2$

Intermediate intervention:
- Minor intervention is not suitable
- Building depth <12m
- can also be used where the void $>16m^2$ and within 12m of an external wall

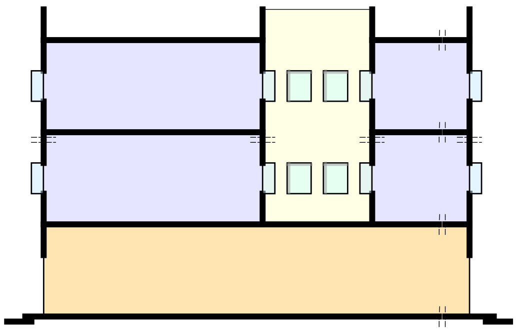
Major intervention:
- Neither of the previous interventions has been chosen
- The building depth >12m

				*	A	B			C		D	E	
Location	Block	Building		Maximum number of floors	Building Dimensions		Void Dimensions		Distance from void to nearest external elevation		Area		Average void area
					Front	Depth	Lengh	Depth		Property	Building	Void	
(Urban Semi-urban Rural)	No	generic No	No	No	(m)	(m)	(m)	(m)	(m)	(m2)	(m2)	(m2)	(m2)
urban	0241060	82	001	6	27.1	6.9	1 void	1.7	3.0	221.2	160.9	2.9	2.9
urban	0241060	83	002	5	12.6	13.4	2 voids	2.2	5.1	219.0	179.0	9.5	4.8
urban	0241060	84	003	5	11.9	18.4	2 voids	1.9	7.5	477.2	219.5	7.4	3.7
urban	0241060	85	004	6	11.6	18.7	3 voids	2.0	7.1	247.1	216.7	12.2	4.1
urban	0241060	86	005	6	22.0	31.0	4 voids	4.3	10.4	905.8	679.1	74.3	18.6
urban	0241060	87	006	9	16.3	30.1	1 void	3.4	12.7	691.3	506.9	11.6	11.6

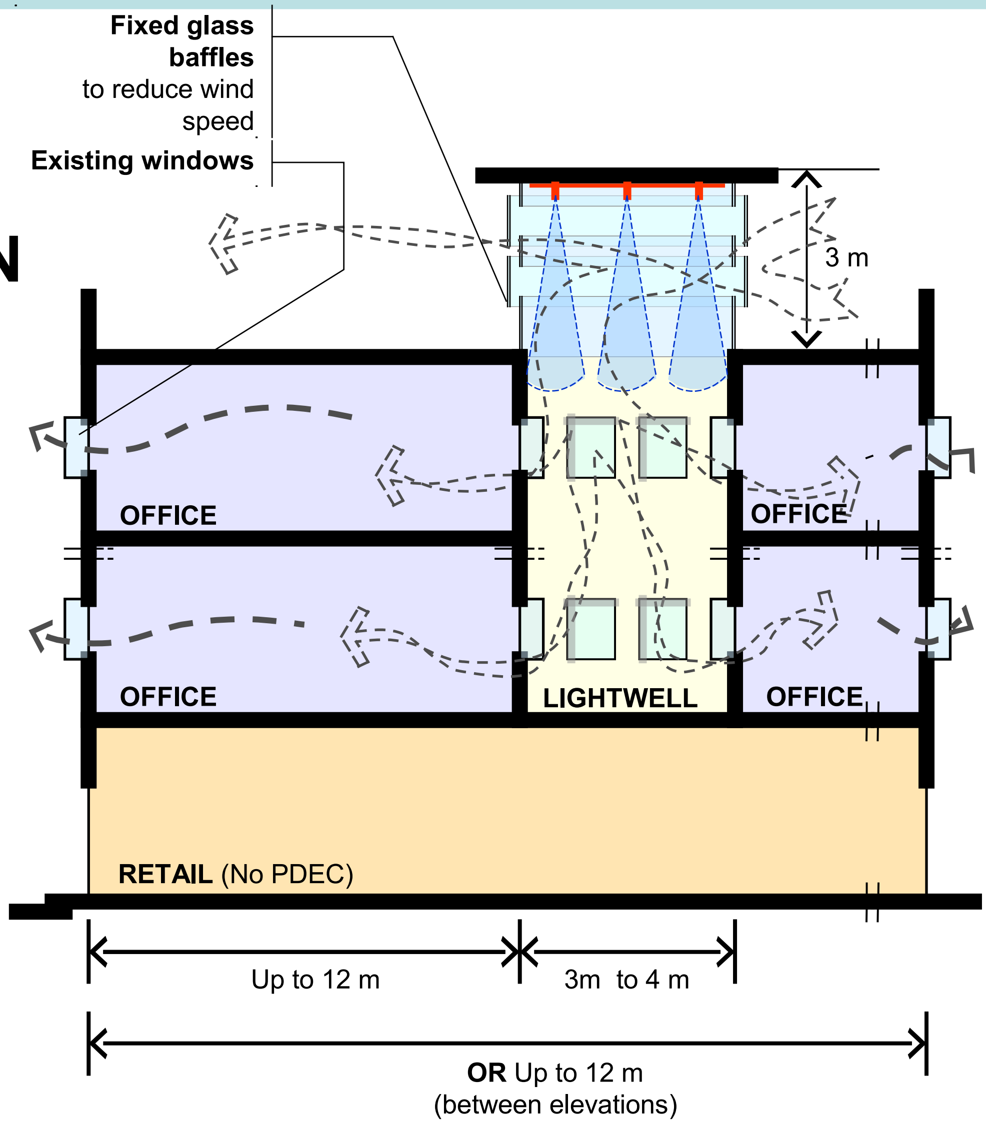
* Data available on building height

Impact of urban morphology on the applicability of PDEC

PDEC GENERIC
TOWER FOR
MINOR INTERVENTION



Before intervention



Urban Morphology

Assessment Technique

Served Area (m2)	Ratio Void / Floor	Prop of V/F Ratio Against Benchmark (%)	PDEC Applicability Rating (0 - 1)	Intervention appropriate 1 yes 0 no	Floor Area served by PDEC		
					Minor Intervention	Intermediate Intervention	Major Intervention
158.0	0.018	34.1	0.3	1		790	
169.5	0.053	100.4	1.0	1			678
212.1	0.034	63.8	0.6	1			848
204.5	0.056	106.5	1.0	1			1,023
604.8	0.109	207.1	1.0	1		3,024	
495.3	0.023	43.3	0.4	1			3,962
315.8	0.064	121.2	1.0	1	2,211		
305.4	0.071	135.2	1.0	1	2,138		

	PDEC Intervention				Property
	Minor	Intermediate	Major	Total	total area
Number of bldgs	94	70	227	391	
Area m2	193,027	129,141	406,772	728,939	919,543
Number of bldgs	24%	18%	58%	100%	
Area m2	26%	18%	56%	100%	
% of Total floor area	21%	14%	44%	79%	100%

Impact of urban morphology on the applicability of PDEC

	PDEC Intervention				Property total area
	Minor	Intermediate	Major	Total	

Seville summary

	Minor	Intermediate	Major	Total	Property total area
Number of bldgs	37	125	71	233	
Area m2	23,545	79,747	62,115	165,407	237,887
Number of bldgs	16%	54%	30%	100%	
Area m2	14%	48%	38%	100%	
% of Total floor area	10%	34%	26%	70%	100%

Madrid summary

	Minor	Intermediate	Major	Total	Property total area
Number of bldgs	17	111	51	179	
Area m2	28,610	394,551	241,916	665,077	922,654
Number of bldgs	9%	62%	28%	100%	
Area m2	4%	59%	36%	100%	
% of Total floor area	3%	43%	26%	72%	100%

Athens summary

	Minor	Intermediate	Major	Total	Property total area
Number of bldgs	27	313	459	799	
Area m2	23,096	264,257	575,071	862,425	1,061,545
Number of bldgs	3%	39%	57%	100%	
Area m2	3%	31%	67%	100%	
% of Total floor area	2%	25%	54%	81%	100%

Summary
Urbanisation, Energy Efficiency & Health

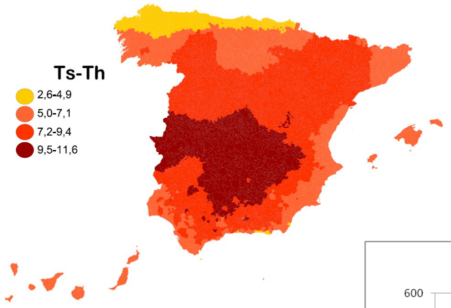
Support for research on

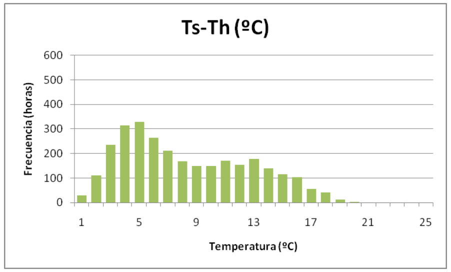
Mapping urban microclimate

And,

Analysis of urban morphology,

is very significant.





The results support planning policy and design guidance to promote energy efficiency, health & productivity in dense urban areas.

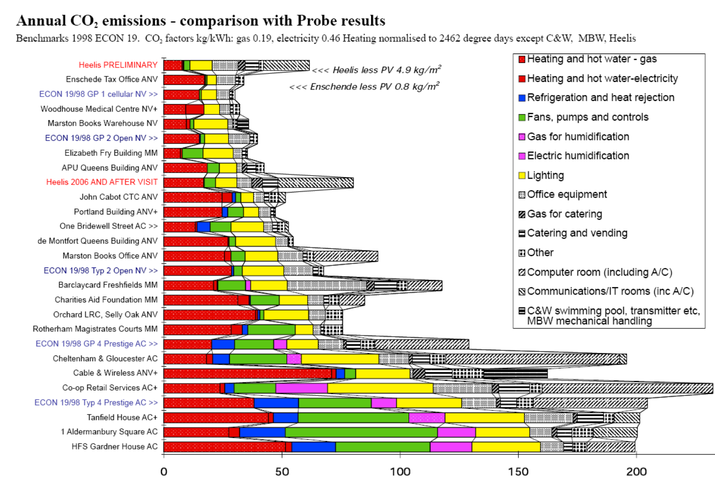
2. Assessing Building Performance in Use

Why ?

- Quality of internal environment influences productivity & health of occupants

- Energy use influenced by building design & occupant behaviour but relationship poorly understood

- Gap between predicted & actual energy use

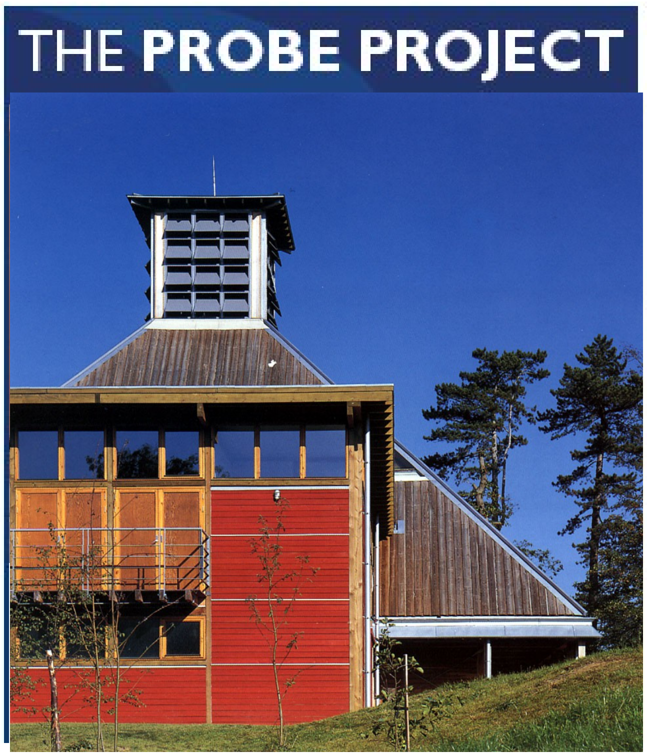


Service Sector Buildings in the UK - End use Carbon Emissions

SUBSECTOR	END USES / Annual Carbon Emissions	Catering	Computing	Cooling & Ventilation	Space Heating	Hot Water Heating	Lighting	'Other'	TOTALS
Commercial Offices	%	4	12	4	51	5	23	1	10
	M t C	0.09	0.28	0.09	1.17	0.12	0.53	0.02	2.3
Communication & Transport	%	5	3	6	19	3	62	4	3
	M t C	0.03	0.02	0.04	0.13	0.02	0.43	0.02	0.69
Education	%	9	3	3	53	7	23	2	12
	M t C	0.25	0.08	0.08	1.46	0.2	0.63	0.06	2.76
Government	%	8	13	2	60	6	10	1	7
	M t C	0.13	0.21	0.03	0.97	0.09	0.16	0.02	1.61
Health	%	6	2	1	54	11	25	1	8
	M t C	0.11	0.04	0.02	1.00	0.2	0.45	0.02	1.84
Hotel & Catering	%	28	1	4	37	17	12	1	15
	M t C	0.97	0.03	0.14	1.28	0.59	0.41	0.03	3.45
Retail	%	16	3	7	31	3	38	2	18
	M t C	0.67	0.12	0.29	1.28	0.12	1.58	0.08	4.14
Sports & Entertainment	%	10	2	7	41	12	25	3	4
	M t C	0.09	0.02	0.06	0.38	0.11	0.23	0.03	0.92
Warehousing	%	2	5	20	32	3	35	3	6
	M t C	0.03	0.07	0.28	0.44	0.04	0.48	0.04	1.38
Others	%	3	4	2	54	11	22	4	17
	M t C	0.12	0.16	0.08	2.1	0.43	0.86	0.16	3.91
TOTALS	%	12	5	5	46	9	22	1	100
	M t C	2.76	1.15	1.15	10.58	2.07	5.06	0.23	23MtC

Building Performance Evaluation.

Example: the UK PROBE Studies

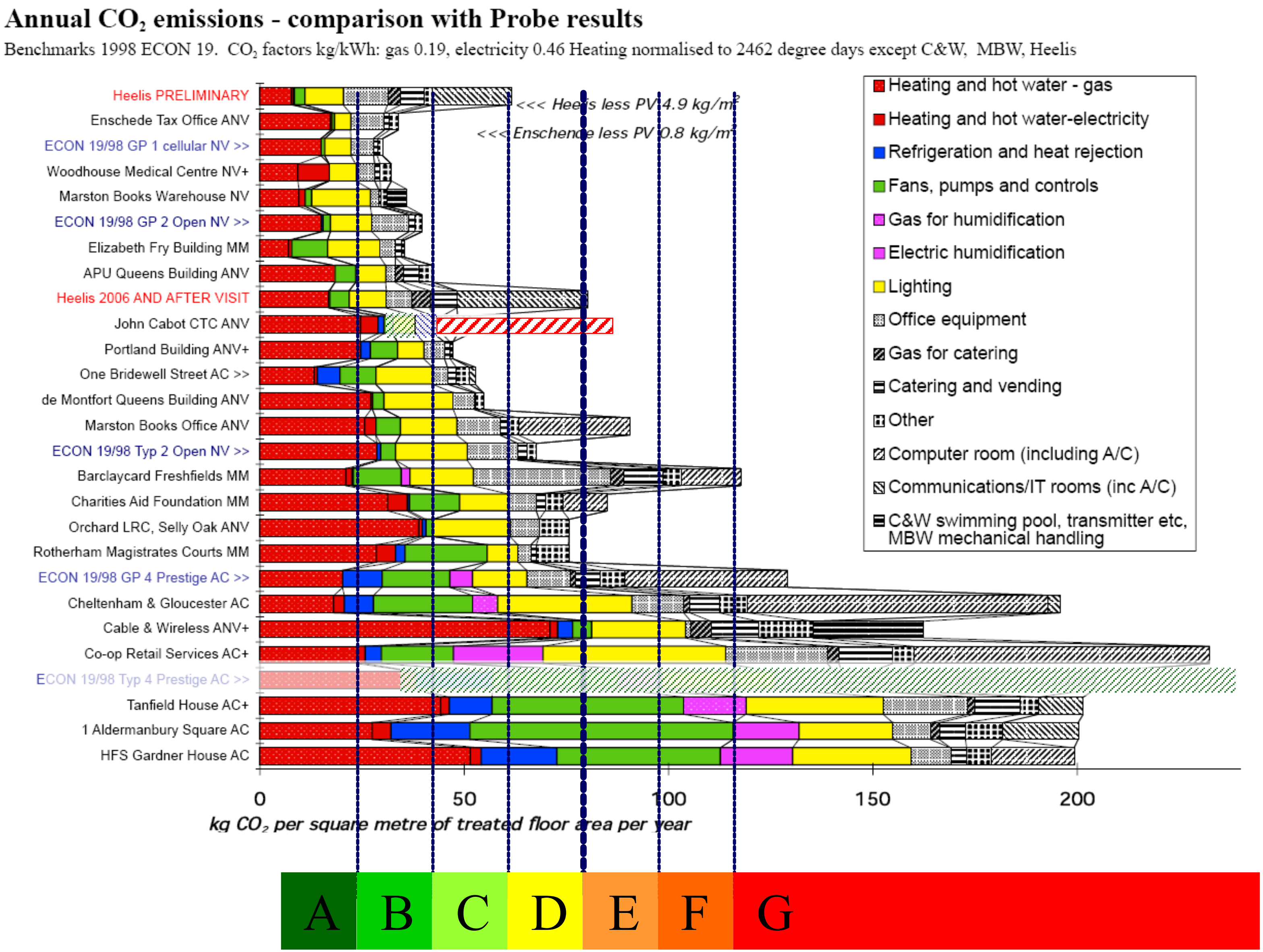


Post-occupancy
Review
Of
Buildings, and their
Engineering

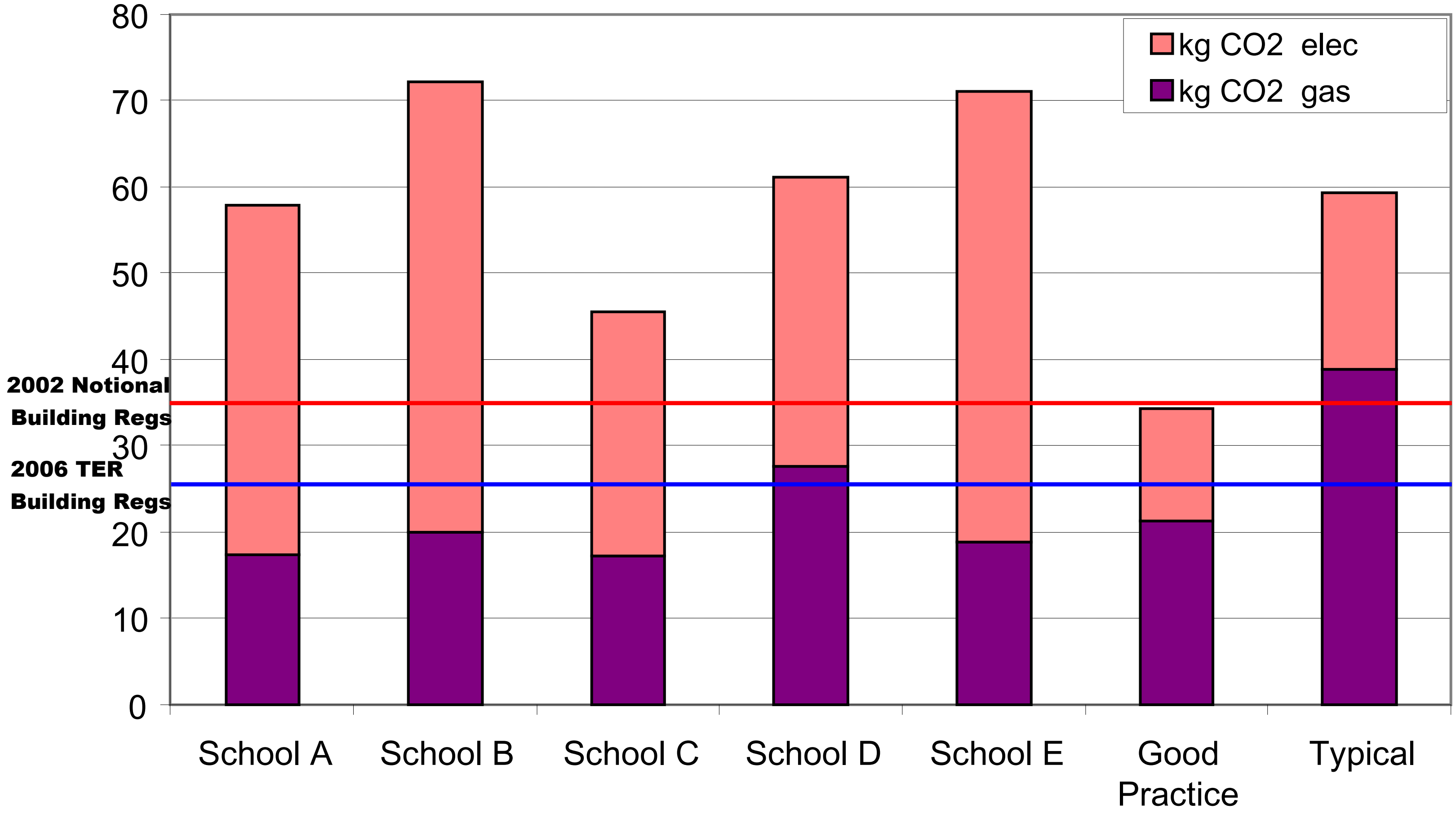
Original reports + many other
Relevant articles available from
The Usable Buildings Trust

www.usablebuildings.co.uk

Measuring what happens in practice

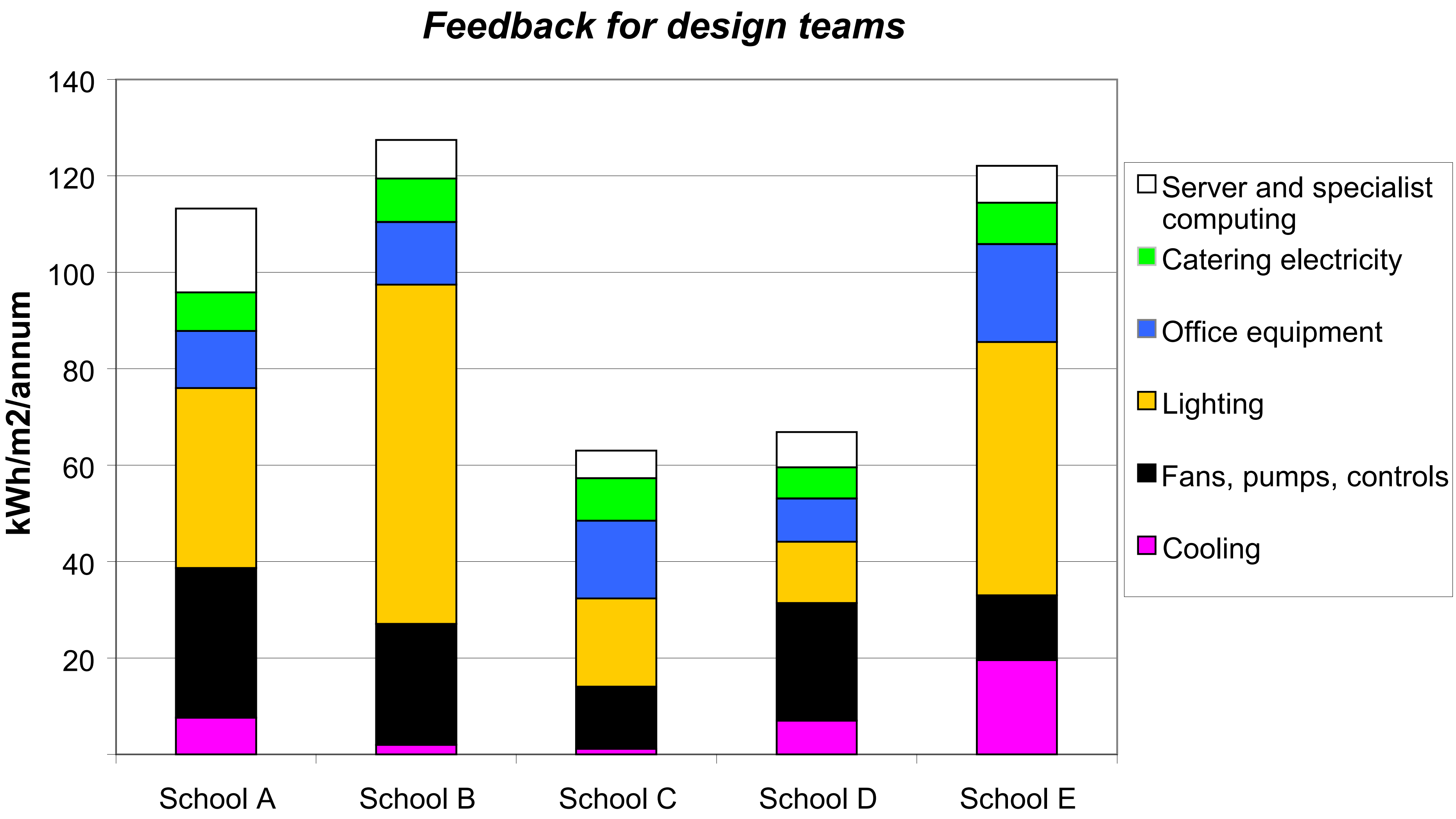


Benchmarking energy use in UK schools (since 2002)



Comparison of School Carbon Emissions

Breakdown of Electrical Consumption by End Usage



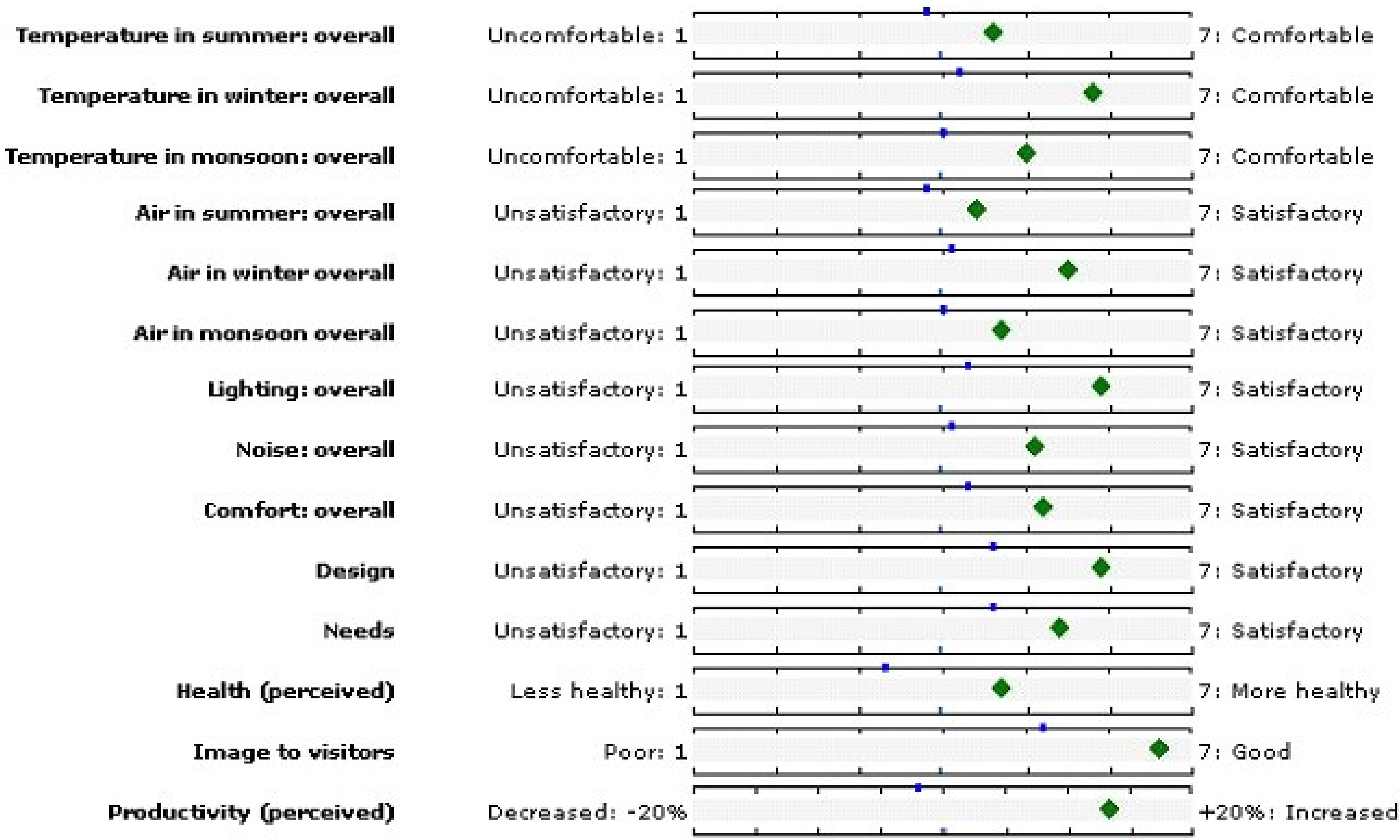
Surveys of user perceptions of the internal environment

- **Specific targeted issues** (eg thermal and visual comfort) – building oriented

- **General surveys of Occupant Perceptions**

  - benchmark oriented

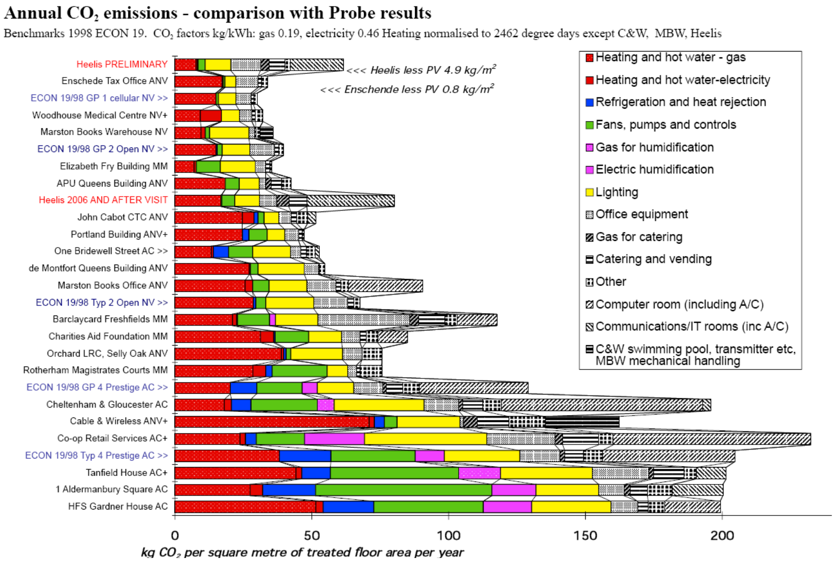
Torrent Research Laboratory, Gujarat, India
Post-Occupancy Evaluation



Summary Chart for PDEC Buildings at Torrent Research Centre (100 respondents) – December 2004. (Courtesy Thomas & Baird)

Assessing Building Performance in Use

- Data on actual energy use in buildings & occupant satisfaction surveys useful to identify design/management issues + areas for improvement.
- Feedback of detailed analysis raises design team knowledge & expertise.

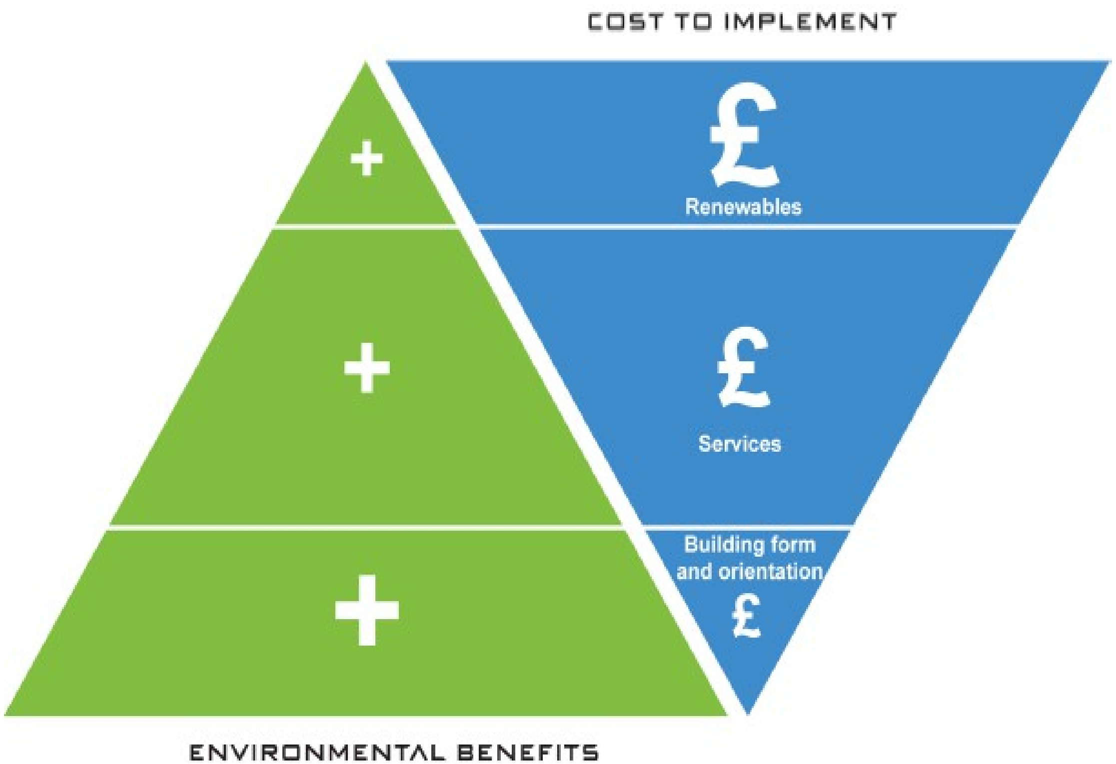


But,

Post-occupancy performance evaluation is still uncommon

3. Passive Design / Fabric First

Cost /benefit of different measures



Renewable Energy Devices,

Building services, heating, cooling and ventilation

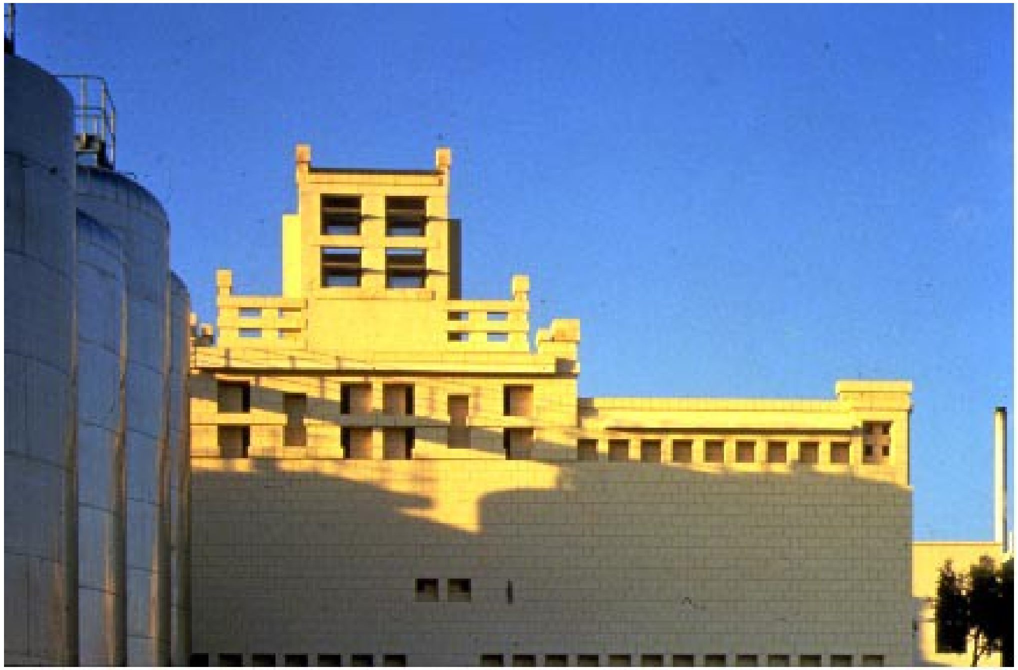
Building form and orientation, Fabric performance, shading, daylight penetration

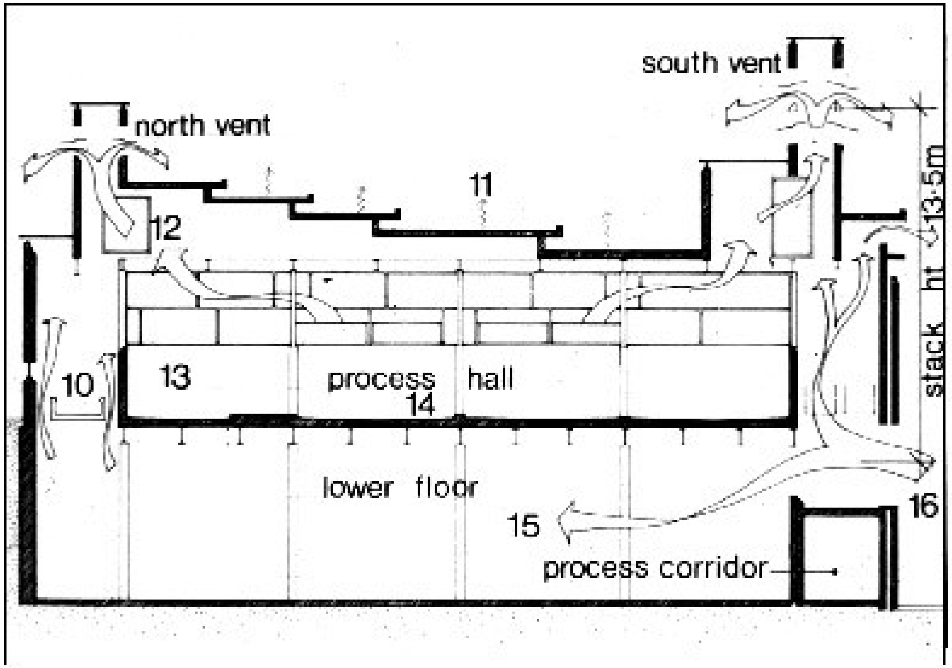
Fabric First
- examples

Brewery in Malta

40°C + outside
27°C max inside

Without mechanical cooling !



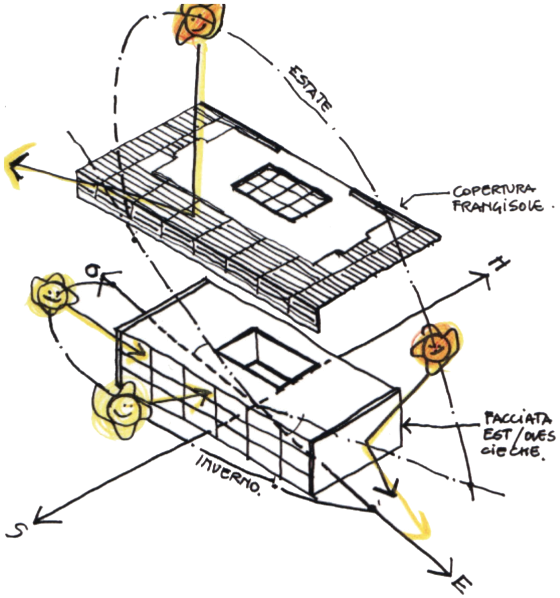


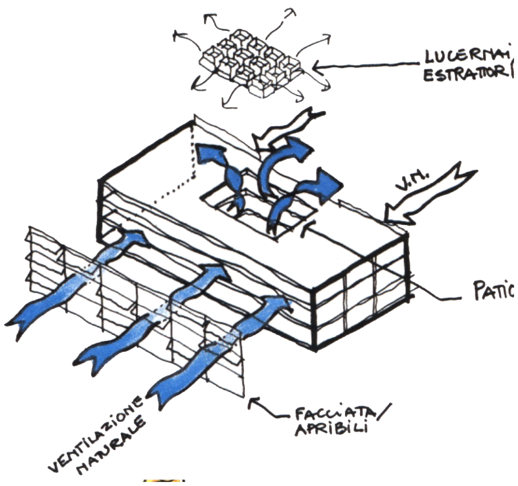
Fabric First

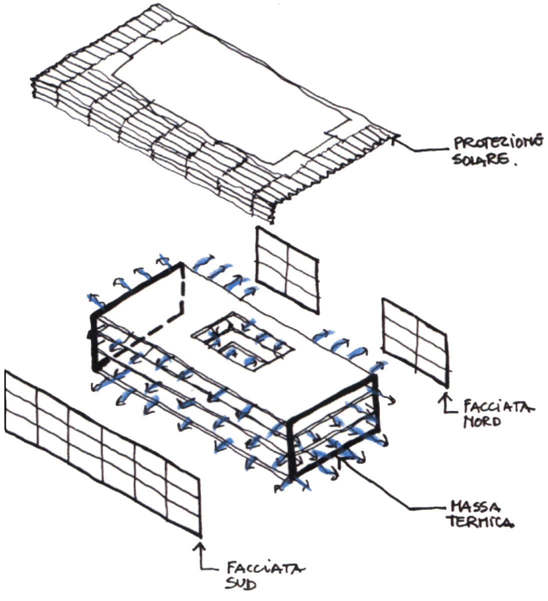
Office HQ for I Guzzini,Italy

Design minimises need for cooling

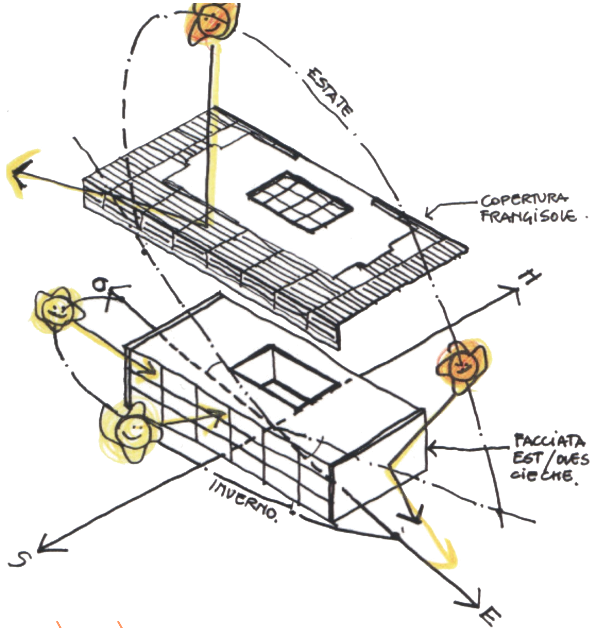
Mario Cucinella Architects

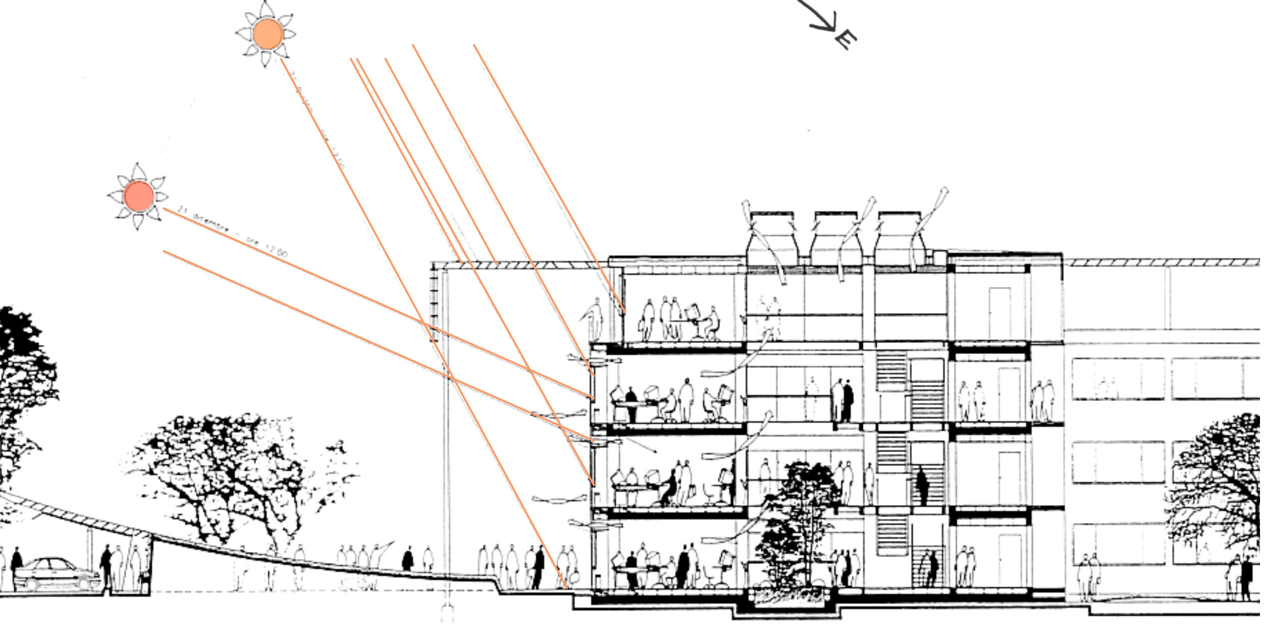






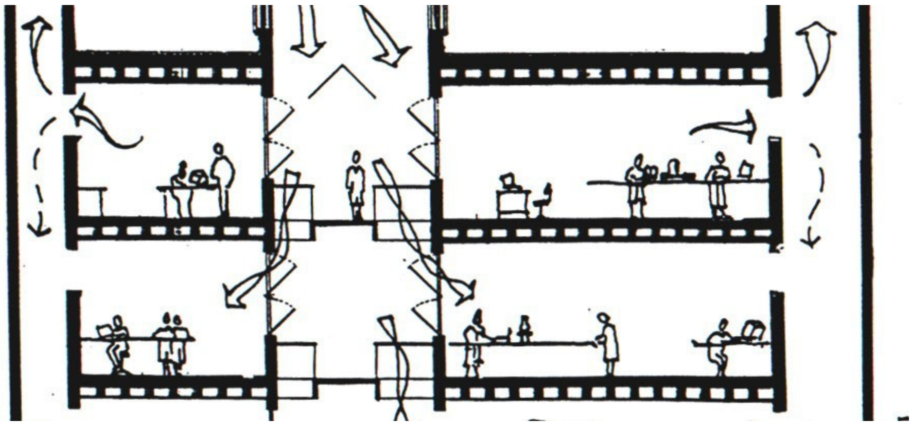
Fabric First – I Guzzini HQ Italy





Fabric First

Torrent Research Laboratory, India
Abhikram Architects



Measured Performance

- **10 -12°C Temp Difference**
- **6 - 9 air changes / hour**
- **65% + energy reduction**
- **High occupant satisfaction**

Designed for 175 occupants in 1997, - more than 600 users in 2005

Fabric First - Torrent Research Laboratory (TRC), Gujarat, India

Abhikram Architects

Energy Consumption minimised by passive design measures

Measured total energy consumption at T R C = 54 kWh/m^2 (Thomas & Baird, 2005)

Compared with:

Average Office Building = 280-500 kWh/m^2 (Singh & Michaelowa)

Passive Design / Fabric First

'Fabric First' design approach can deliver significant **cost effective** energy efficiency savings + occupant satisfaction.

But,

Gap in knowledge & skills among architects & engineers.

Therefore,

Need for improvements in education & training

4. The Knowledge & Skills Gap: Improving Knowledge Transfer

"There is a clear lack of appropriate training (e.g. for architects, engineers, auditors, craftsmen, technicians and installers)."

Source: 'European Buildings under the microscope' BPIE Oct 2011

Today (in Europe), about 1.1 million qualified workers are available, while 2.5 million will be needed by 2015 in order to improve the energy efficiency of buildings and better integrate renewable energy technologies.

The Knowledge & Skills Gap: Improving Knowledge Transfer

Promote:

- Professional & technical training.
- Links between the Professions, Industry & Academia
- Public awareness & behavioural change

The EDUCATE Action (EC Intelligent Energy Europe 2008 -2012)

EDUCATE seeks to:

- Address the **pedagogical** and **professional barriers** to the integration of **sustainability** - in architectural education and practice
- **create a communication platform** for dissemination of **technical principles and creative applications**
- develop an interactive **intelligent Portal** on sustainable environmental design that facilitates such communication to students, staff and professionals
- explore the **harmonisation of qualification criteria** in collaboration with Chambers of Architects in Europe

What do staff & students of Architecture Need ?

- **A commitment to *rigorously*** and ***creatively*** address the challenges of sustainability in design.

- **Theoretical** and **empirical understanding** of **sustainability**;

- Knowledge of environmental design principles and skill in the manipulation of **tools** and **techniques.**

- The **ability**, acquired in the studio, **to embed sustainability within design** projects.

Source: www.notttingham.ac.uk/abe

State of the Art of Professional Practice

EDUCATE has completed more than 400 surveys with building professionals in 40 EU and non-EU countries, in four main sections:

A. Sustainable environmental design in the **architectural curriculum**;

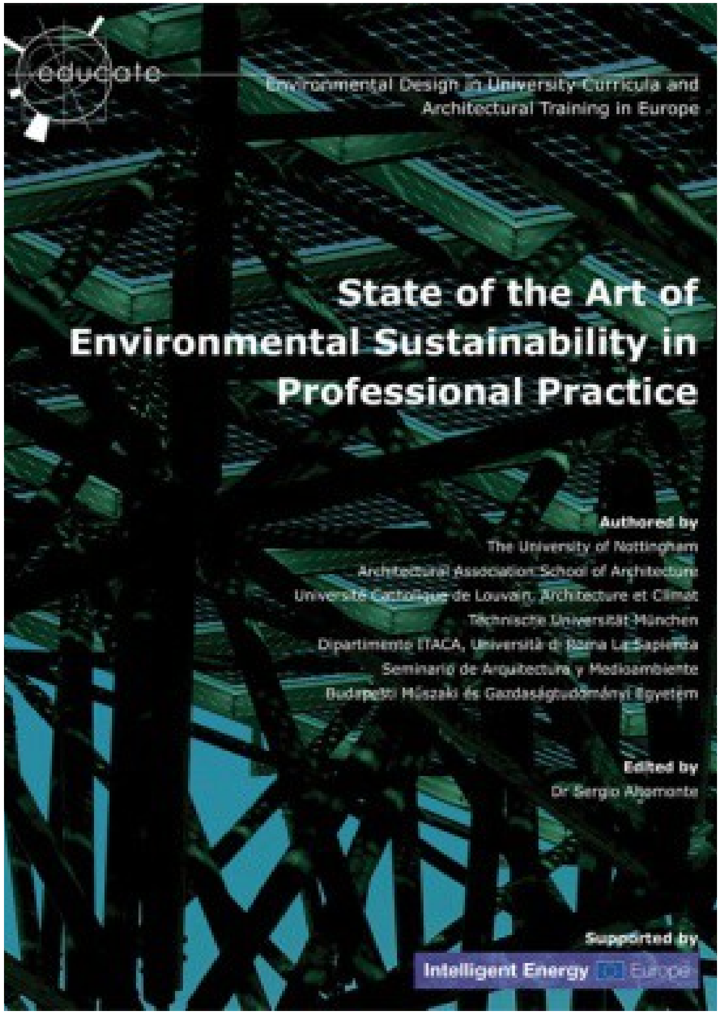
B. Sustainable environmental design in **continuing professional development**;

C. Sustainable environmental design in **regulation** and clients **requirements**.

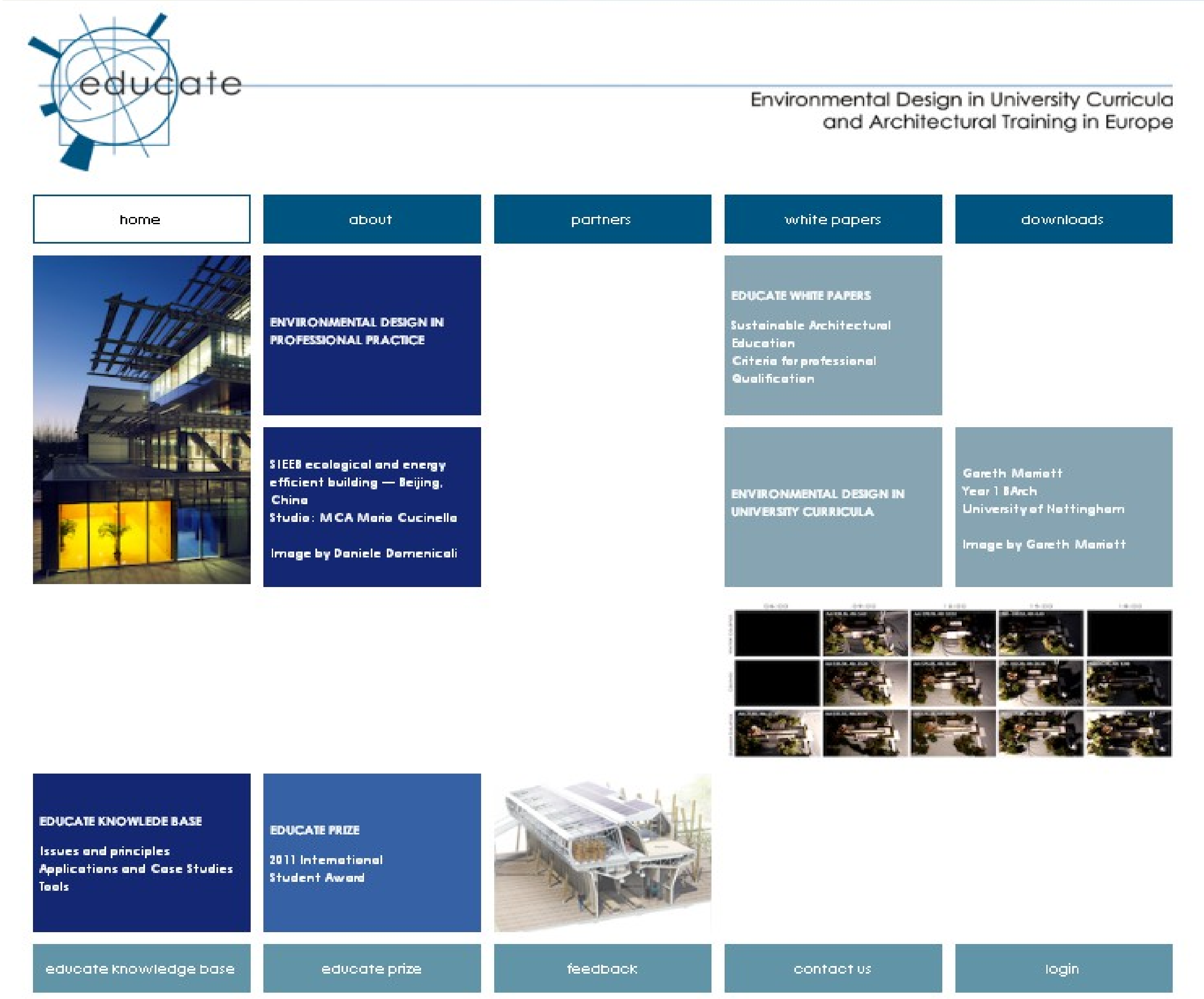
D. Personal **feedback**

The results

- emphasize **pros and cons** of different educational methodologies,
- benchmark the **needs** and **demands** of the market.



EDUCATE Knowledge Base – www.educate sustainability.eu



Education & Training in Energy Efficiency

The need to improve the education and training of professionals with regard to energy efficiency is now widely recognised,

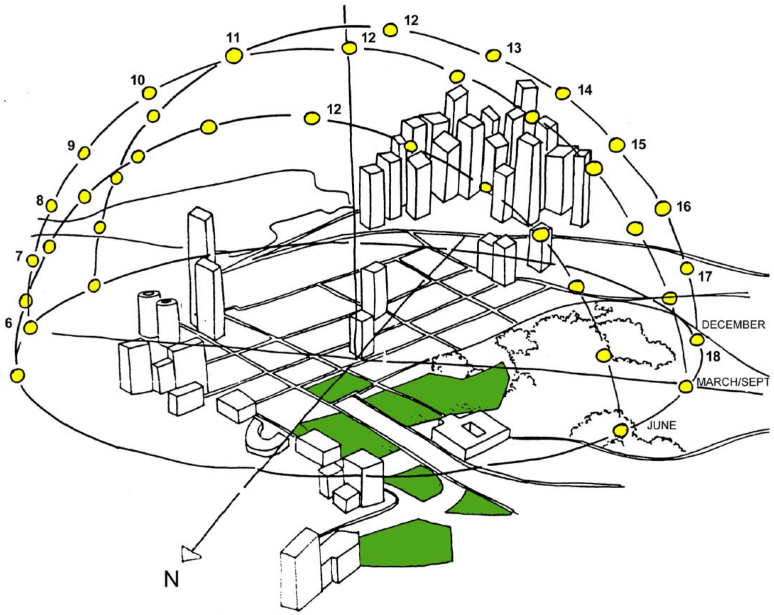
But, we need to:

- Review University curricula & professional CPD provision
- Promote improved knowledge & skills through specialist courses/workshops/training.
- Promote ‘Research by Design’ demonstration projects

In SUMMARY…

What have we learnt that is relevant to Brazil ?

1. ***Urban microclimate & urban morphology***
2. ***Building Performance in Use***
3. ***Fabric First, is the design priority***
4. ***Professional Education & Training is vital***



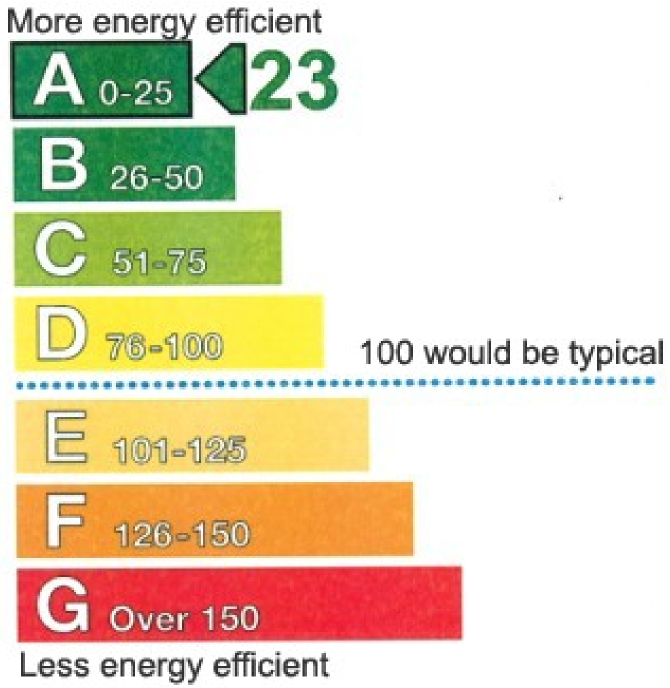

Obrigado !

Recommendations:

1. Improve understanding of urban micro-climate & morphology + influence urban design guidance.

2. Improve understanding of building performance (energy use + occupant satisfaction) for different building types.

3. Raise knowledge & skills through specialist courses at Universities & CPD for Professionals.



An EDUCATE Network ?