CIBSE ASHRAE 40th Anniversary Seminar

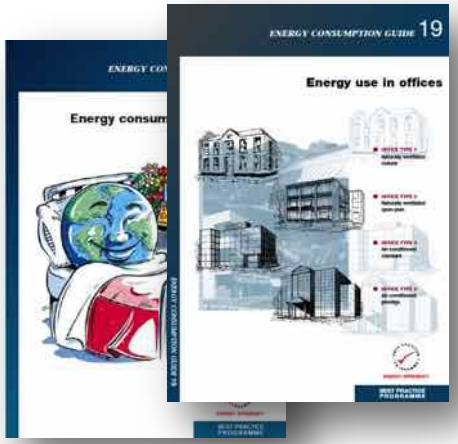
Delivering practically useful intelligence with building energy benchmarks

Dr Sung-Min Hong

CIBSE Research Associate
in Energy Benchmarking

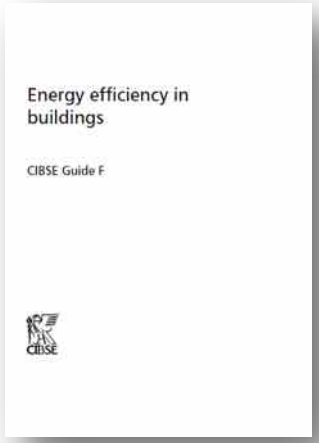
Benchmarking in the UK

EEO



1980's

1990's



2004
(2012)

Earlier Benchmarks

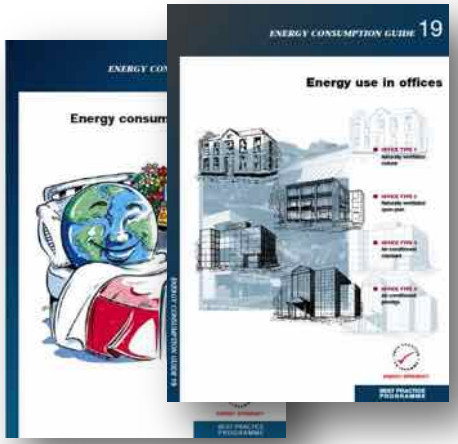
Table 20.6 Fossil and electric building benchmarks for various types of building[20]

Building type	Mixed fuel buildings					All-electric buildings			
	Electricity / kW·h·m^{-2} p.a.		Fossil fuel / kW·h·m^{-2} p.a.		Sample size	Electricity / kW·h·m^{-2} p.a.		Sample size	Floor area type
	Good	Typical	Good	Typical		Good	Typical		
Banks	70	95	74	105	835	97	144	623	Gross
Bingo halls	117	128	203	261	29	—	—	—	Gross
Cinemas	64	81	203	261	56	—	—	—	Gross
Department stores:									
— general	238	294	199	248	221	237	371	29	Sales
— specialist	225	269	219	319	863	333	447	204	Sales
Dry cleaners	197	247	622	828	26	350	400	14	Gross
Fast food outlets	818	889	480	669	48	—	—	—	Sales
Frozen food centres	—	—	—	—	—	858	1031	602	Sales
Further education	35	49	146	216	49	—	—	—	Gross
Night clubs	106	292	50	89	13	247	297	11	Gross
Offices (multi-tenanted)	25	53	131	181	57	—	—	—	Gross
Post offices (main)	45	69	142	214	323	80	142	56	Gross
Shops/stores:									
— butchers' shops	—	—	—	—	—	475	578	195	Sales
— DIY shops	128	160	151	192	94	—	—	—	Sales
— electrical goods (rental)	—	—	—	—	—	281	367	585	Sales
— electrical goods (retail)	—	—	—	—	—	172	231	299	Sales
— fashion shops	—	—	—	—	—	303	350	150	Sales
— non-food stores	224	258	82	127	59	238	307	1352	Sales
Warehouses:									
— distribution	53	67	114	175	71	—	—	—	Gross
— refrigerated	125	142	56	83	38	—	—	—	Gross

Note: the results from small samples, e.g. less than 50 buildings, may not be representative of the whole sector

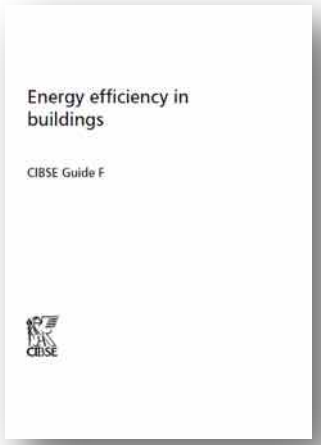
(CIBSE 2012)

EEO

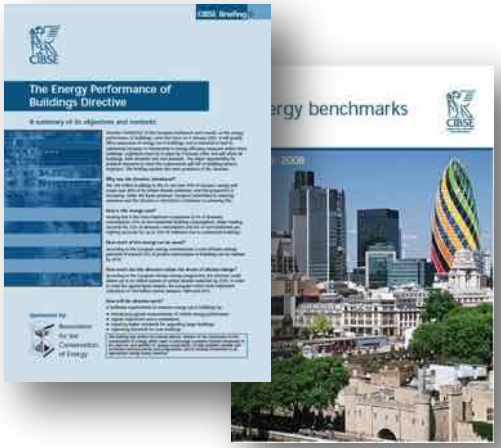


1980s

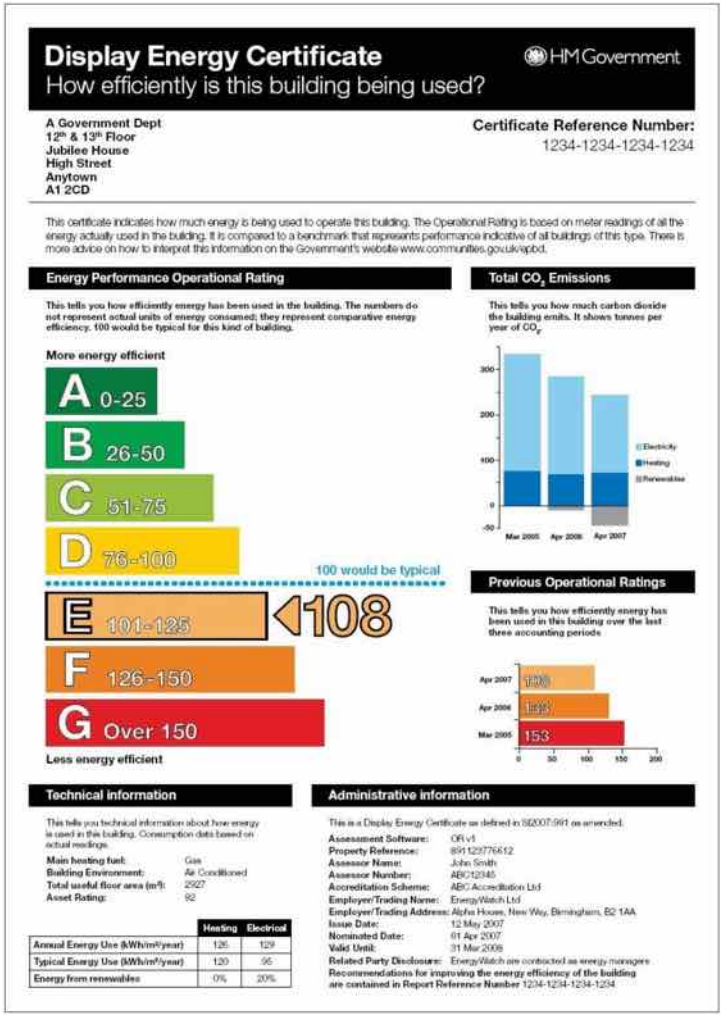
1990s



2004
(2012)



2008



Display Energy Certificate

How efficiently is this building being used?

HM Government

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Anytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The Operational Rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100
100 would be typical
E 101-125 ◀108
F 126-150
G Over 150

Less energy efficient

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods

Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel:	Gas
Building Environment:	Air Conditioned
Total useful floor area (m²):	2927
Asset Rating:	92

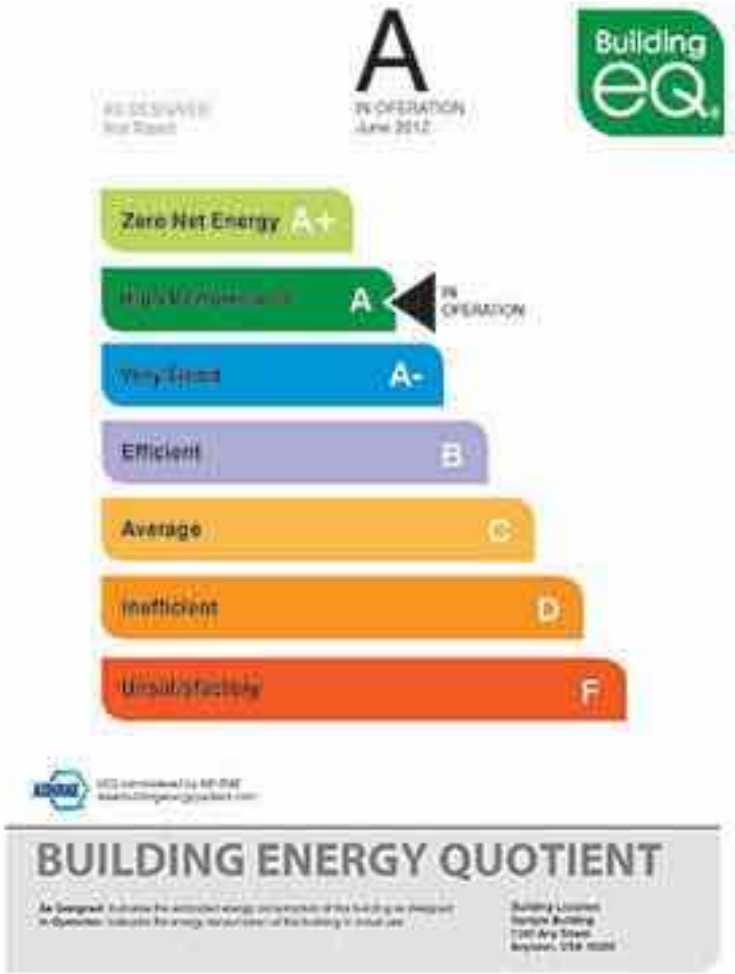
	Heating	Electrical
Annual Energy Use (kWh/m²/year)	126	129
Typical Energy Use (kWh/m²/year)	120	95
Energy from renewables	0%	20%

Administrative information

This is a Display Energy Certificate as defined in SI2007/991 as amended.

Assessment Software:	OR v1
Property Reference:	891129776512
Assessor Name:	John Smith
Assessor Number:	ABC12345
Accreditation Scheme:	ABC Accreditation Ltd
Employer/Trading Name:	EnergyWatch Ltd
Employer/Trading Address:	Alpha House, New Way, Birmingham, B2 1AA
Issue Date:	12 May 2007
Nominated Date:	01 Apr 2007
Valid Until:	31 Mar 2008
Related Party Disclosure:	EnergyWatch are contracted as energy managers

Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234



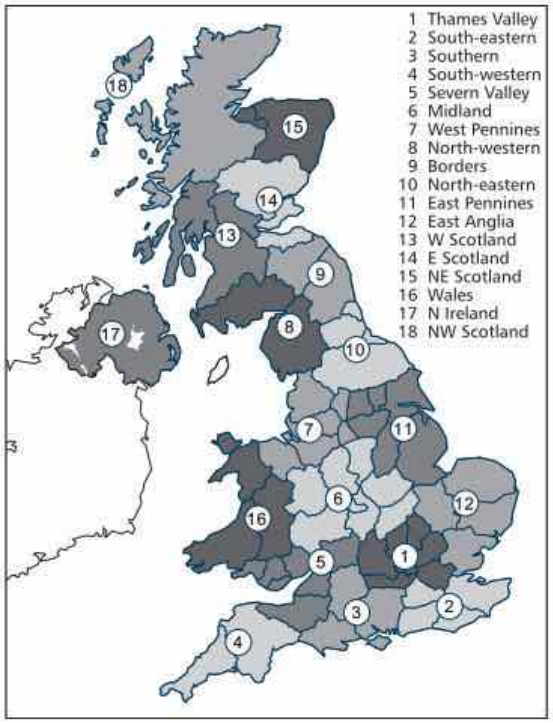
A
IN OPERATION
June 2012

Building eQ

Zero Net Energy A+
A
IN OPERATION
A-
Efficient B
Average C
Inefficient D
F

BUILDING ENERGY QUOTIENT

Extended Flexibility



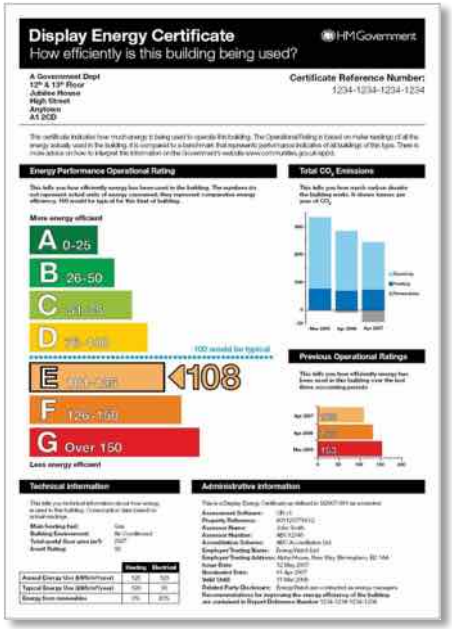
Weather adjustment

Extended occupancy

Separable energy uses

Opportunities

- Empirical data from a wide range of sources
- Unified database on English schools



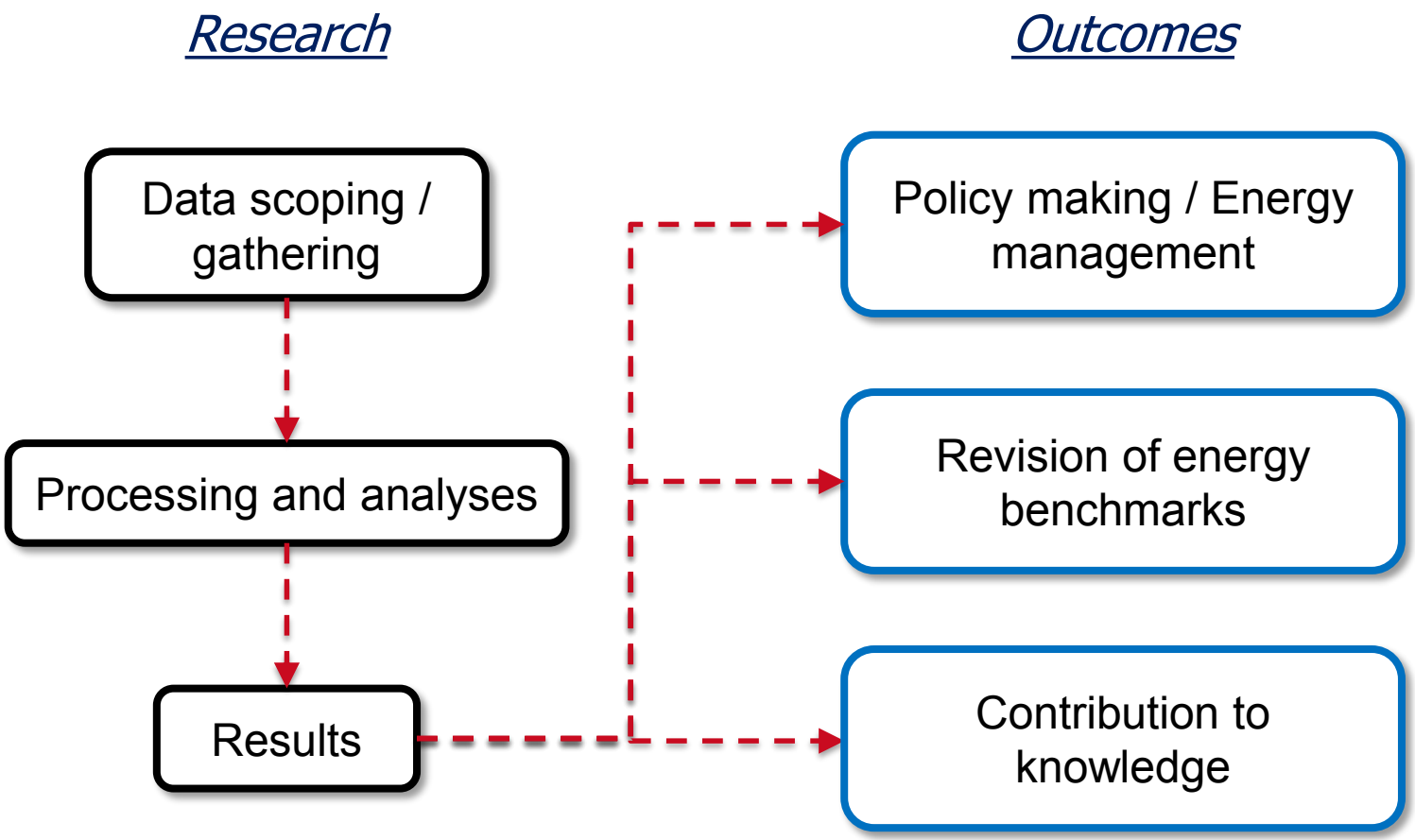
Department for Communities and Local Government

Department for Education

Education Funding Agency

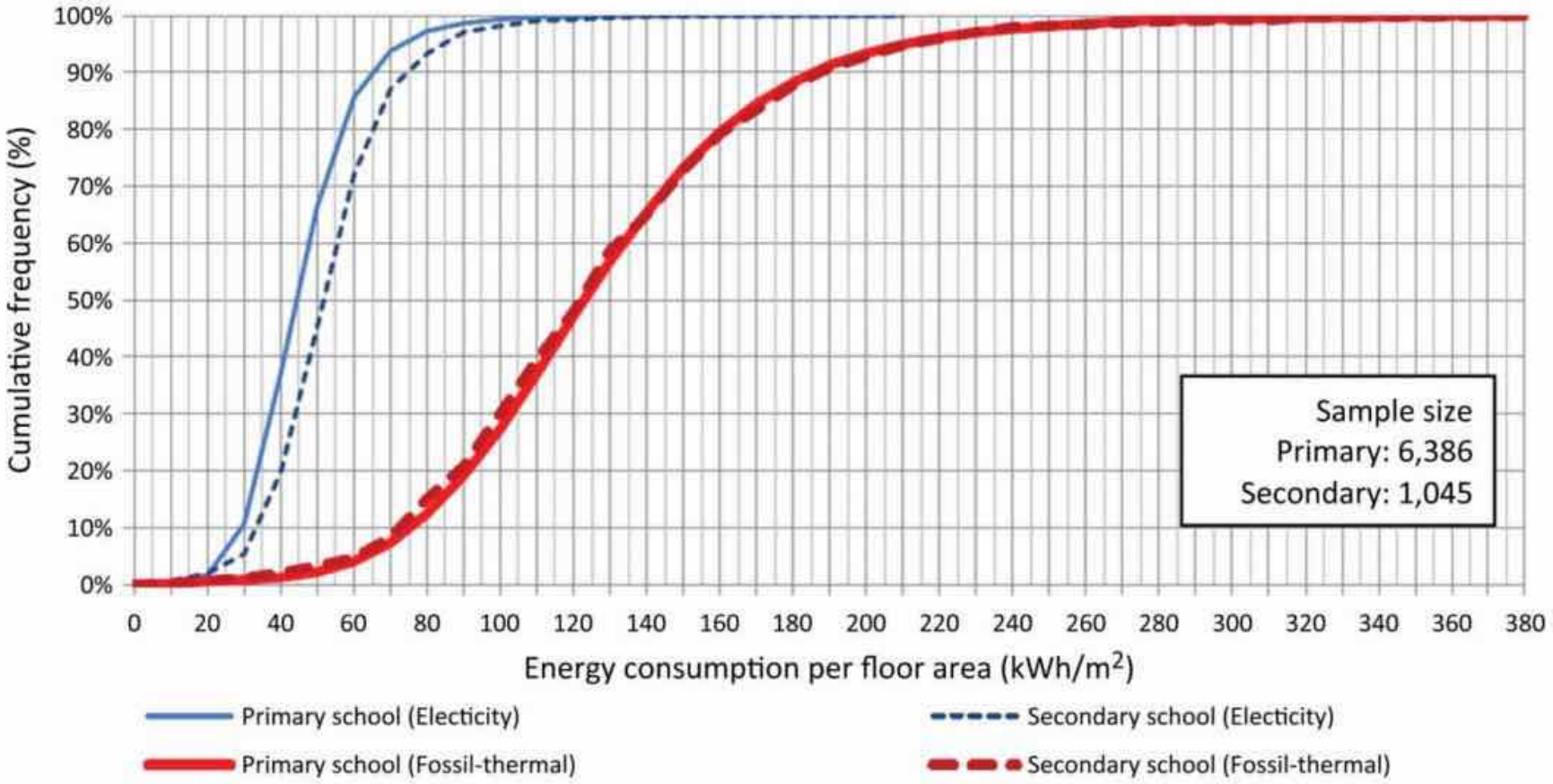
CIBSE / UCL Benchmarking Project

Evidence-based approach

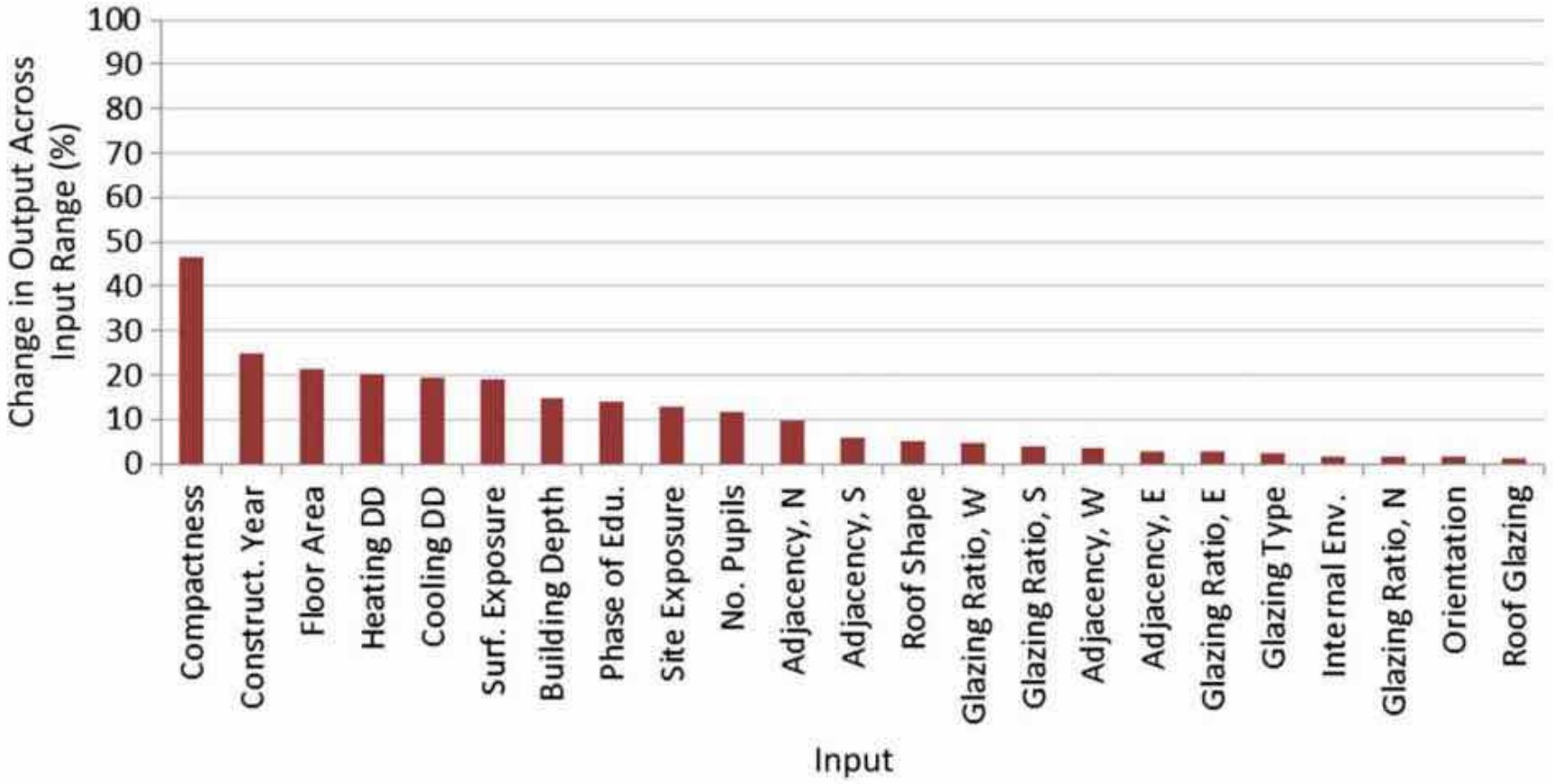


Making a Meaningful Comparison

Activity type + Weather + Occupancy + ?



(Hong et al. 2013)



(Hong et al. 2013)

Contextual Factors

Region	• Climate conditions • Socio-economic variation
Local Authority	• Policy (e.g. funding allocations, energy management)
Establishment	• Governance (e.g. priority on reducing CO_2) • Specialism (e.g. ICT, science) • Facilities (e.g. catering, swimming pool)
Building	• Building performance (e.g. age, services) • Occupant characteristics (e.g. pattern, density)

Benchmarking Approaches

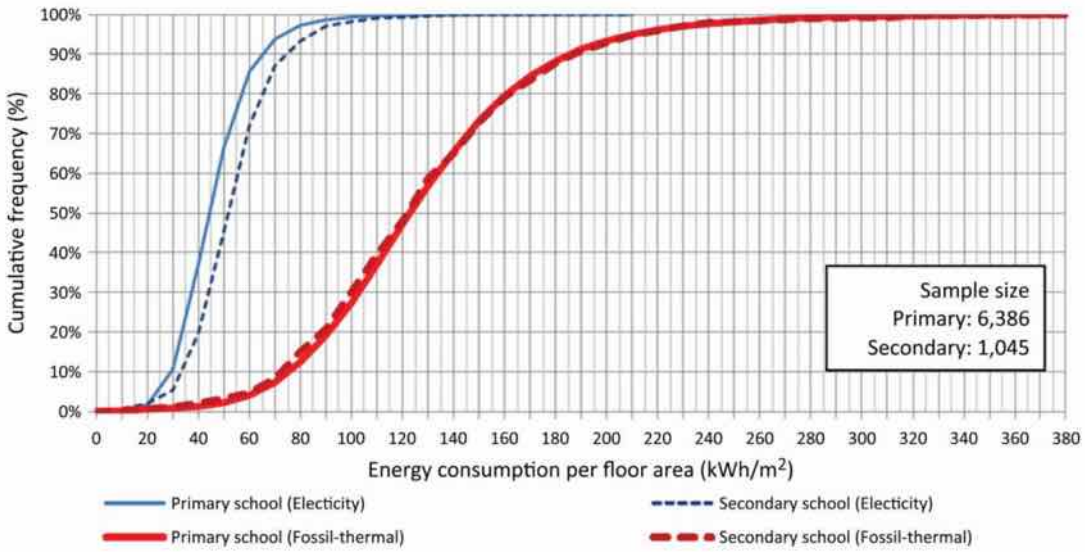
Top-down

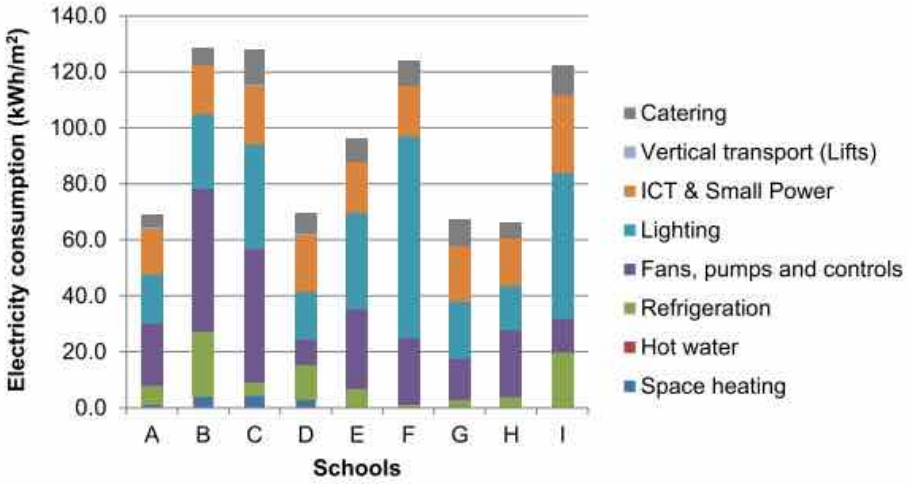
Stock-level insights

Building-level insights

Bottom-up

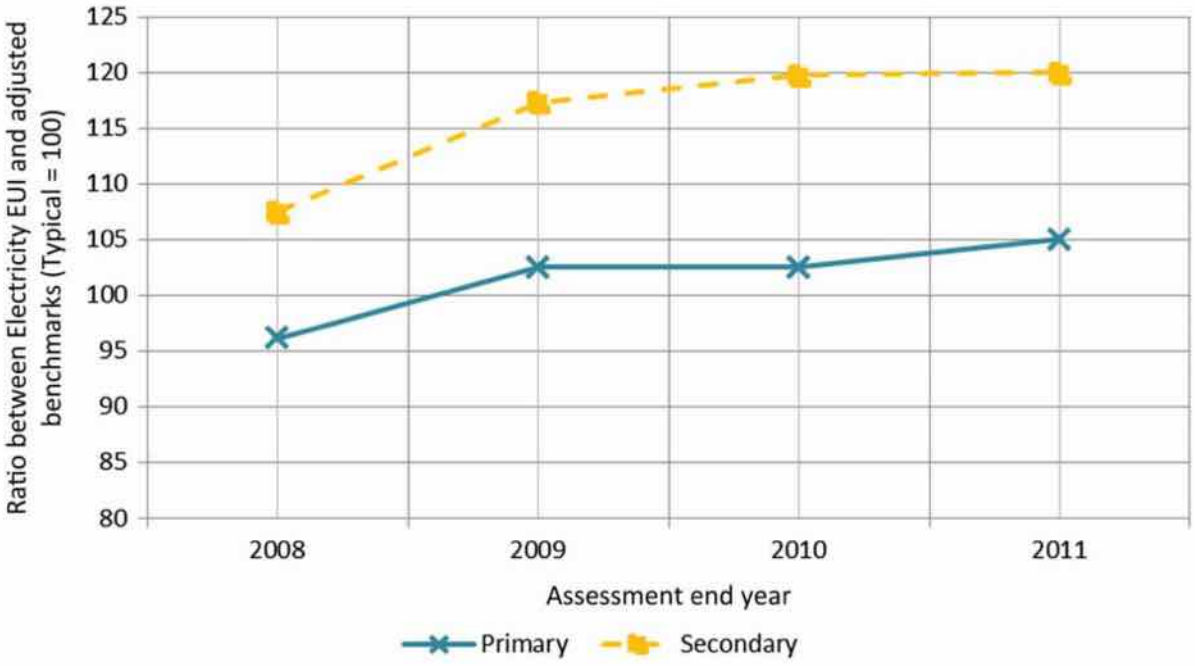
(Hong et al. 2013)



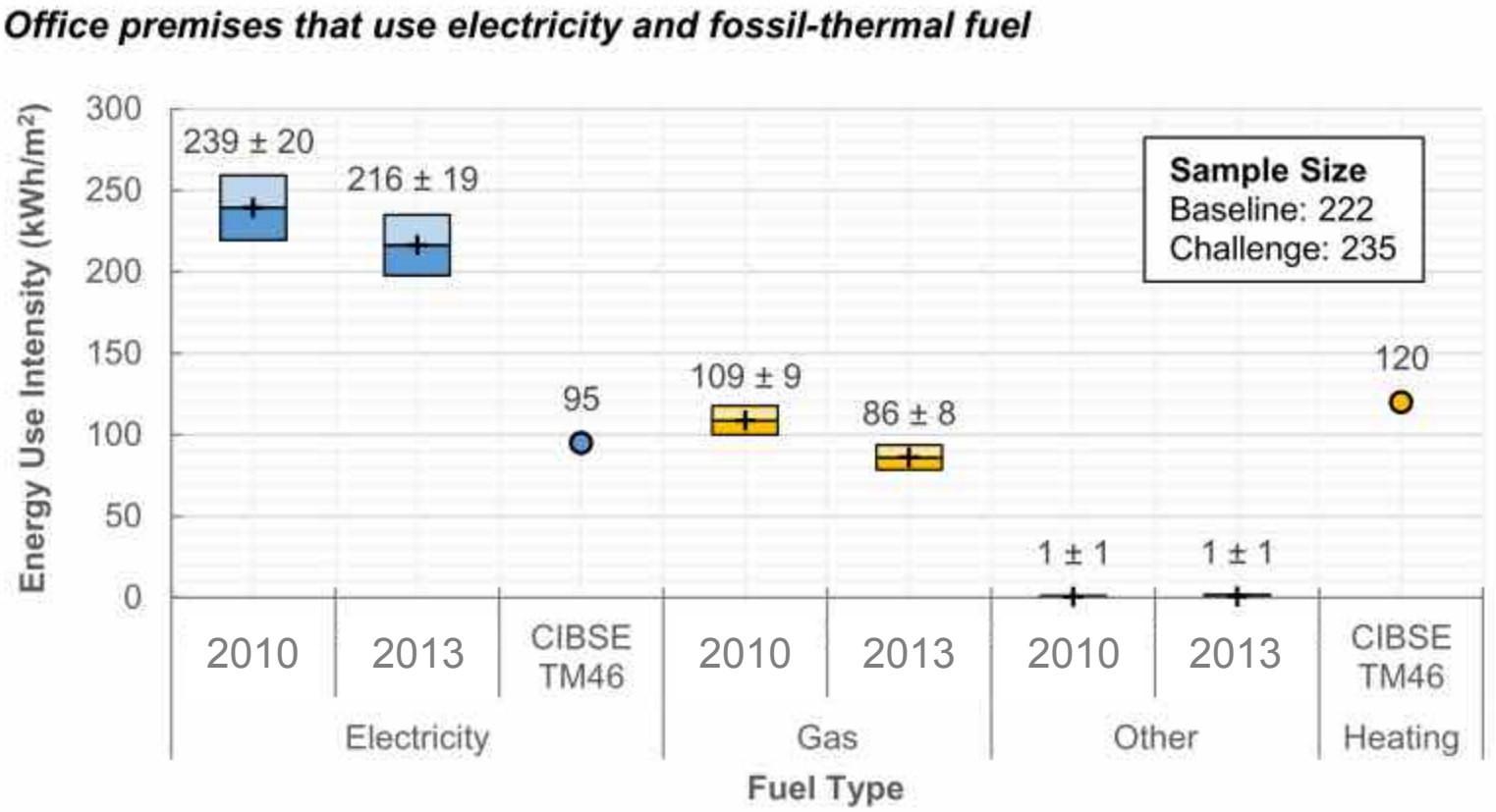


(Hong 2015)

Changes Over Time



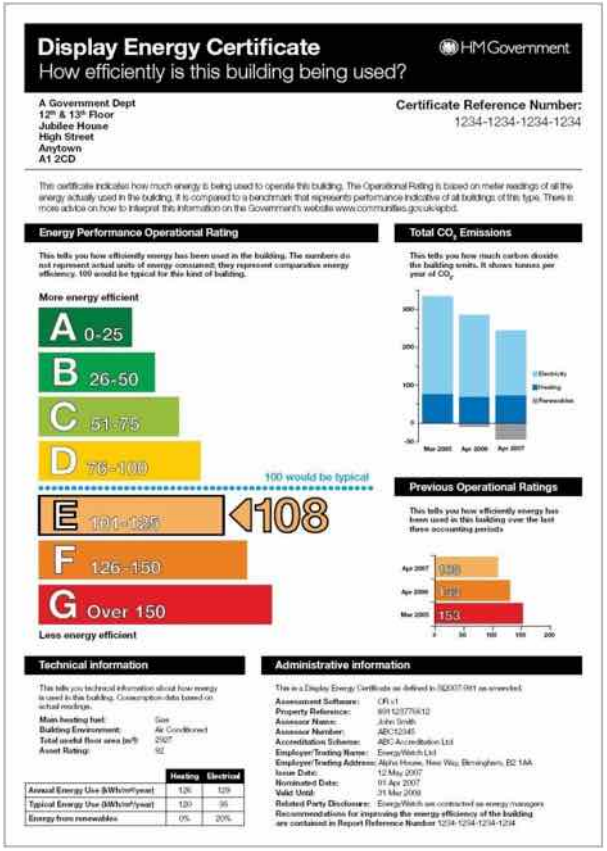
(Hong & Steadman 2013)



(Ruyssevelt & Hong 2015)

Updating & Understanding

Data



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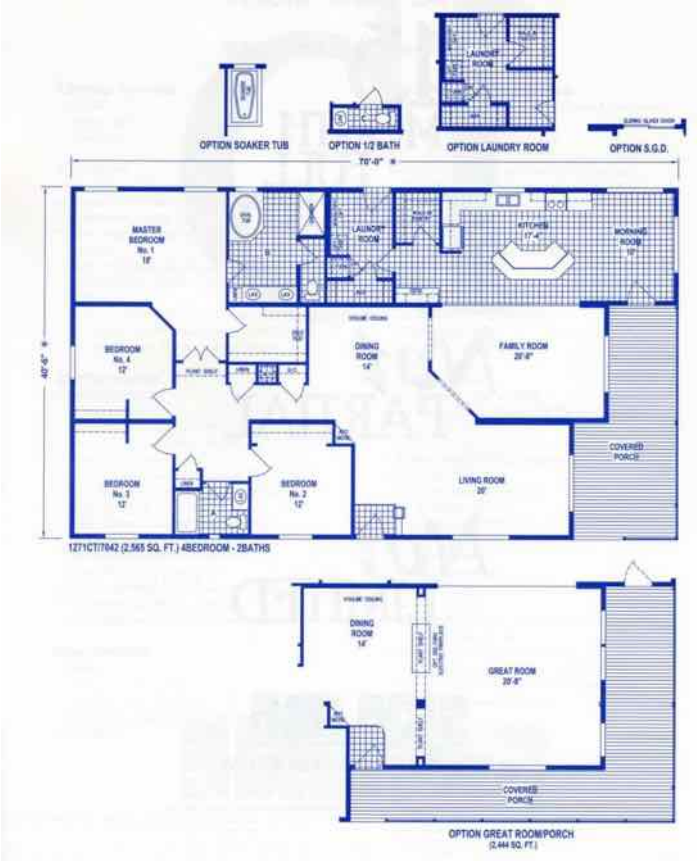
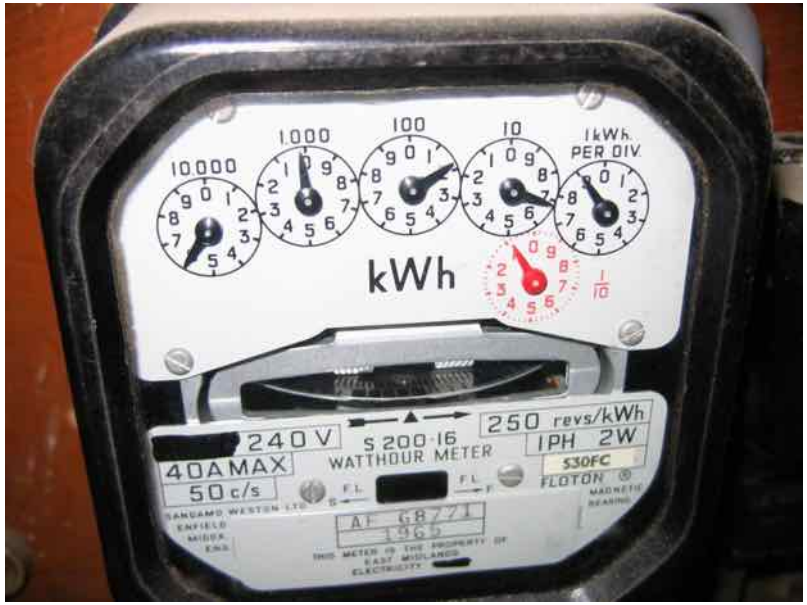
Energy

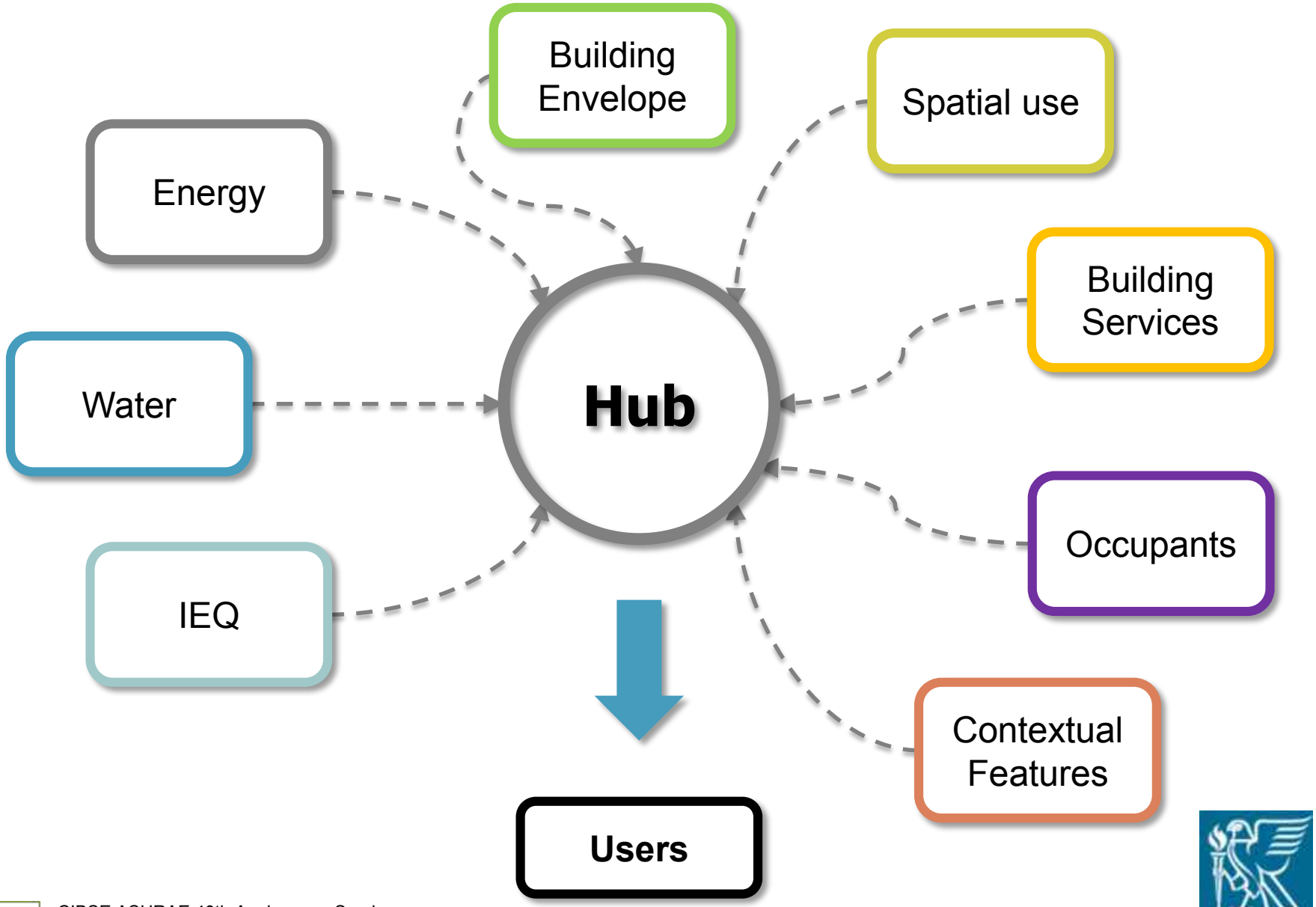
IEQ

Data Quality





Future Aspirations


Building Envelope
Spatial use
Energy
Building Services
Water
Hub
Occupants
IEQ
Contextual Features
Users

Thank you

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References

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- Hong, S., 2015. Benchmarking the energy performance of the UK non-domestic stock : a schools case study. PhD Thesis. University College London.
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