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Whole Life Cost in Practice

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SHINE Conference

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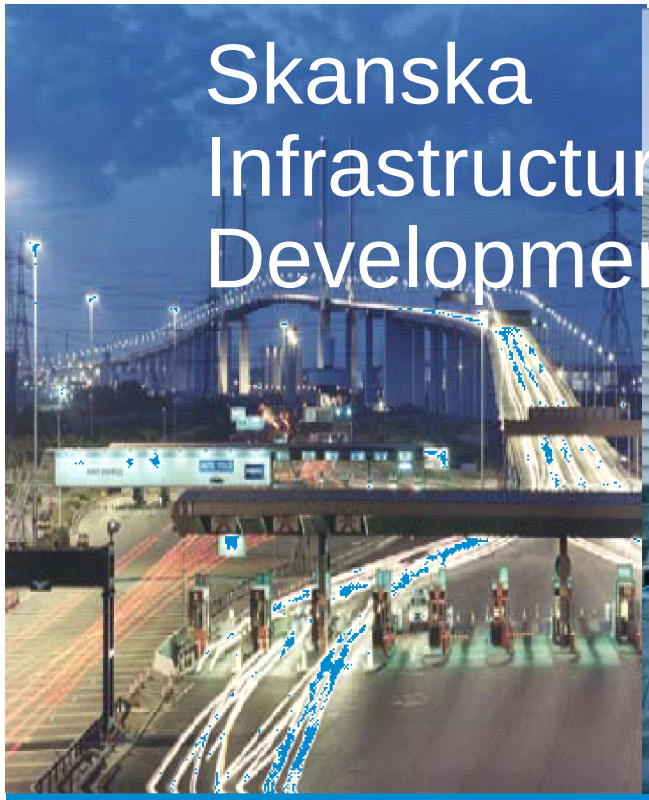

M25 Motorway

Barts and the Royal London Hospital

Brislington Enterprise College, Bristol

Skanska Infrastructure Development develops, invests in and operates privately financed infrastructure projects such as hospitals, schools and roads.

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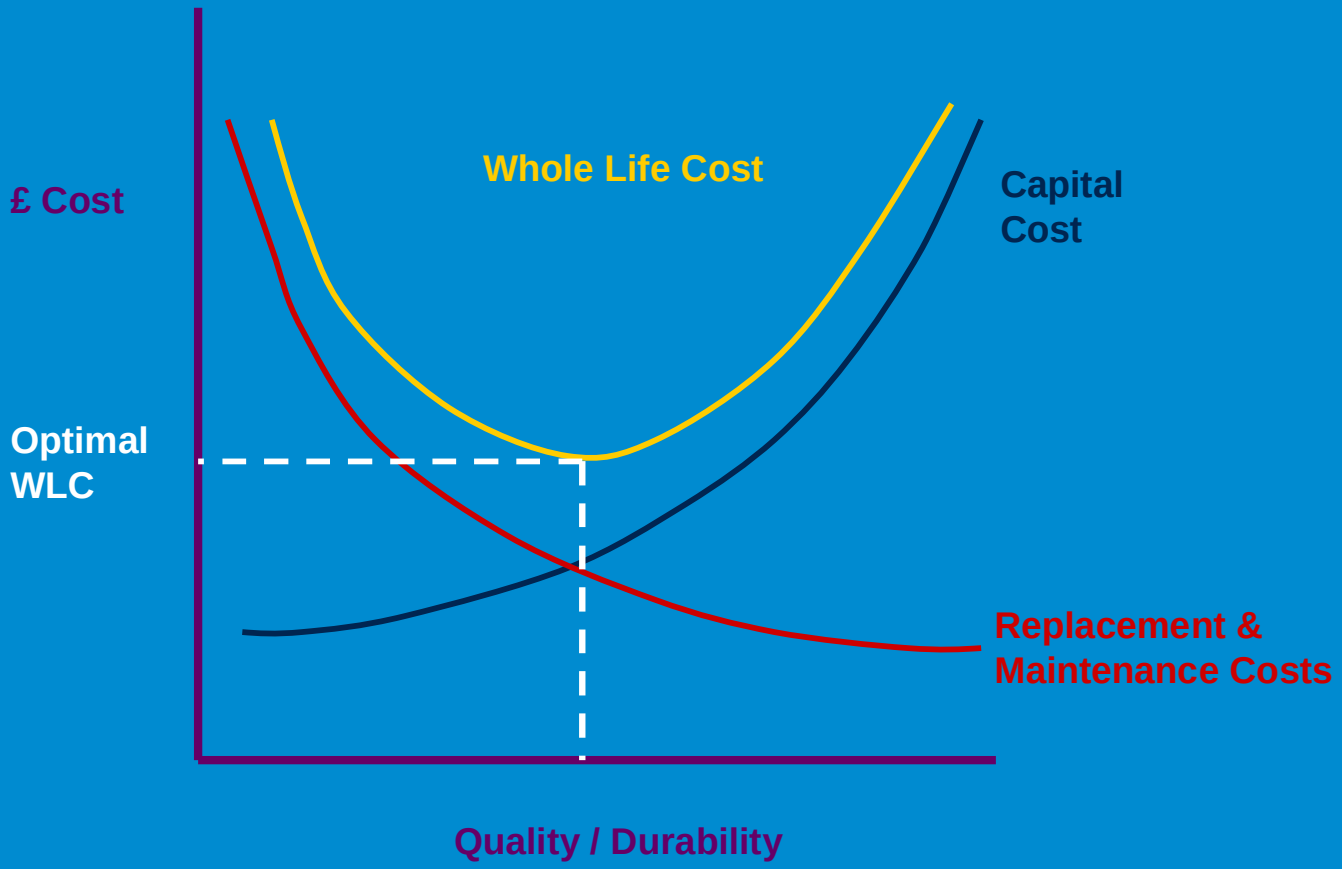
Whole Life Cost in Practice

- Drivers for WLC
- BS ISO 15686 Standardised Method
- Application of WLC in Practice
- Levels of Design Decisions

  Strategic / System / Component
- Whole Life Cycle Cost Model
- Examples

Drivers for Whole Life Cost Optioneering

- Value for Money
- Sustainability
  - Economic Benefit
  - Social Benefit
  - Environmental Benefit
- Client Requirement



Optimal Whole Life Cost = Value for Money

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SUSTAINABILITY

Optimising the building form and orientation can result in real sustainable environmental and social benefits without the need for major additional capital costs and in addition positively impact operational costs.

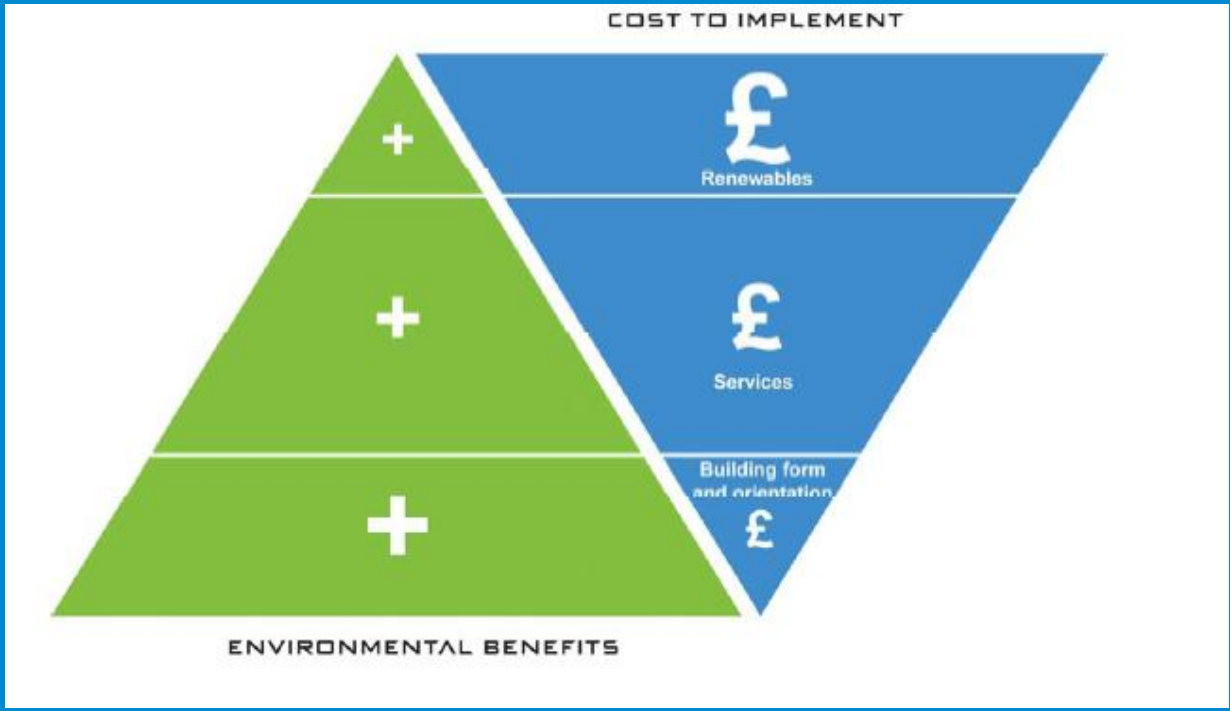

Image courtesy of F+G

Skanska's Green Initiative

Vision

We are determined to become the leading green project development and construction company

Goal

To develop economically attractive green solutions for our customers

Client Requirements

Karolinska Hospital, Sweden

Extract from Project Goals

‘As the basis of **all** systems and material choices a life-time cycle costs calculation (LCC) shall be produced. It is important to be able to make the best long-term choices when it comes to energy utilisation and resource consumption’

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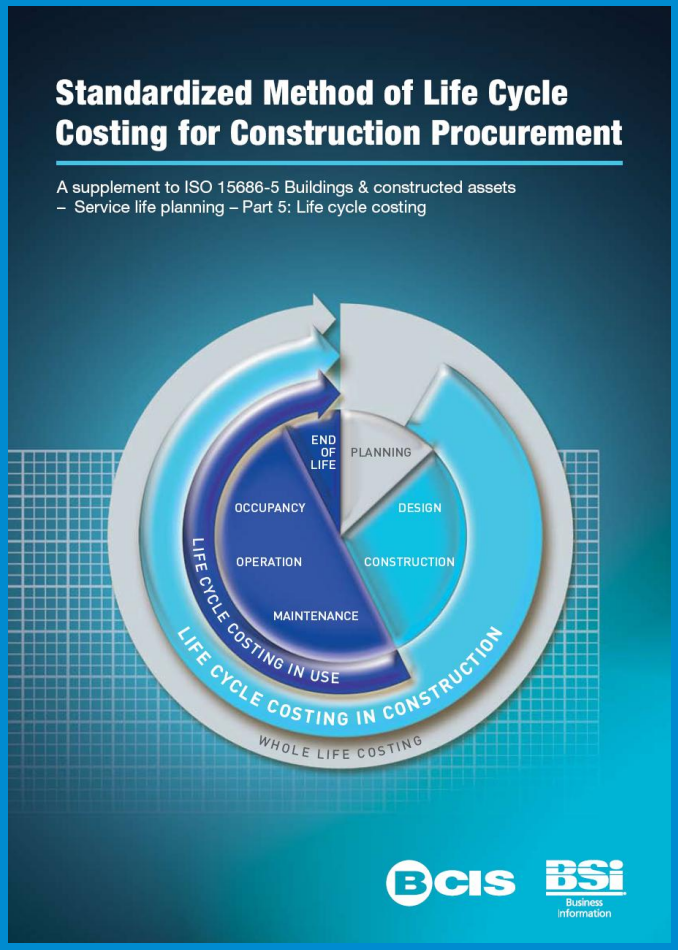
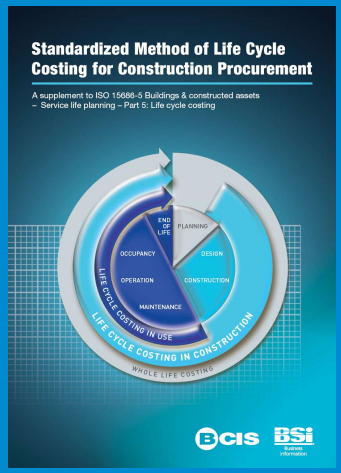
BS ISO 15686-5 Part 5 Life cycle costing



SMLCC - Objectives

- Definitions
- Standard Data Set
- Standardised method of application
- Like with Like Comparison
- Process mapping
- Simplification and demystification
- Industry accepted methodology



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Whole Life Cost in Practice

- Generate Ideas for optioneering studies

  Team Approach - Architects, Engineers, Designers, Cost Planners, Facilities Managers, Client, Energy Specialists, Procurement, Sustainability Experts, Logistics, Planners etc.

- Workshop to prioritise
- Define option specifications and evaluation criteria
- Scoring Matrix
- Life Cycle Cost Modelling
- Workshop to review, agree, document

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Design Decisions

Category	Examples	Approach
Strategic Level	Building layout, Building shape, Orientation, No. of storeys Storey height Energy source solution Ventilation strategy	Rationale behind decision will be a combination of factors including: optimum whole life cost, programme, sustainability, planning requirement, design flair.
Elemental / System Level	Frame: steel or reinforced concrete Façade: brick, cladding, etc Roof: flat, pitched, green etc. Internal Walls: block, plaster-board, etc Floor finish: carpet, lino, tiles, etc Paint: vinyl, matt, etc Windows: double / triple glazed,	Rationale behind decision likely to be a combination of factors including: optimum whole life cost, programme, sustainability, buildability, Client requirement.
Product / Component Level	Manufacturer and Specific Product Which paint Which carpet Which lino	Rationale behind decision likely to be based on optimum whole life cost.

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Evaluation Criteria

- Life Cycle Cost
- Client Requirement
- Planning Requirement
- Programme Implications
- Buildability
- Logistics
- Sustainability
- Environmental Impact – LCA
- FM Operational Impact
- Evidence Based Design Effects
- Aesthetics
- Clinical Requirements
- Infection Control Issues
- Etc.

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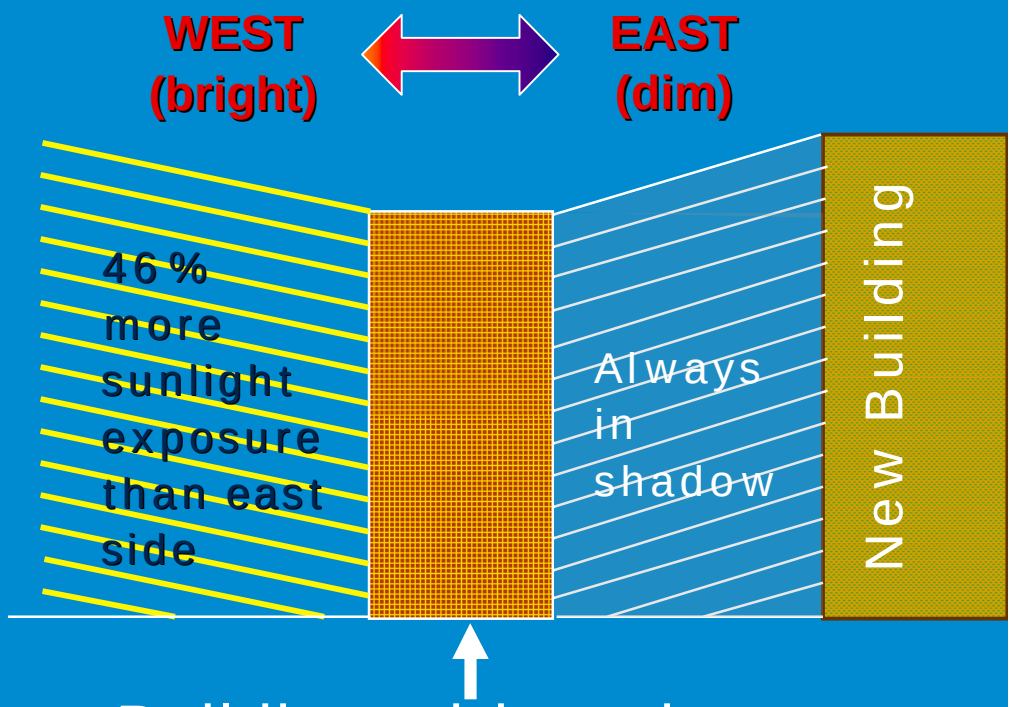
EBD STUDY: Natural light and pain

by Walch, Rabin et al., 2005, Slide Courtesy of Professor Roger Ulrich

Patients:
89 adults undergoing elective cervical and lumbar spinal surgery

Findings:
Patients with higher levels of sunlight were less stressed, reported less pain, took 22% less pain medication, and had 21% less pain medication costs



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Whole Life Cost Modelling

- Simple Example:
- Product / Component Studies Vinyl Flooring or Carpet
- Limited scope of variables
  - Costs of Procurement, Installation, Cleaning, Maintenance, Replacement.
- Indexation
- Discount Rate
- Net Present Value

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Whole Life Cost Optioneering Example

UK PFI Hospital – Natural Ventilation v Cooling

Comparison of Whole Life Cost of a naturally ventilated solution for single ward rooms with a cooled alternative.

The naturally ventilated solution required external solar protection and a number of alternatives were evaluated

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PFI Hospital – Natural Ventilation v Cooling

Activity	Tools Used
Option Selection: Fifteen Options initially identified Short list six based on evaluation criteria	Scoring Matrix – jointly populated by Design Team
Cost Estimates: Capital Costs Facilities Management Costs Energy Life Cycle Replacement Costs	
Solar Control Performance:	Thermodynamic Energy Model
Payment Mechanism:	Paymech Mechanism Model
WLC Modelling & Co-ordination:	WLC Comparator Model

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Natural Ventilation v Cooling

External Retractable Awnings

External Retractable Venetian Blinds

External Sliding Shutters

Brise Soleil

Interstitial Venetian Blind

Passive Chilled Beam

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Extract from Scoring Matrix

OPTION		REQUIREMENTS															TOTAL POINTS
		Performance			Patients wellness						Device management					Commercial/ Costs	Design	
		Solar Control	Glare Control	Daylight Availability	Blackout	Privacy	View out	Infection control	Patients controllability	Need for additional blind	Durability (material)	Cleaning / Maintenance	Replacement—disruption/frequency	Reliability (mechanism, motor)	Wind / climate impact / noise	Buildability	Aesthetic / Visuals	
6a	Triple glazed unit with interstitial blinds in ventilated outer cavity (double skin)	5	5	5	5	5	5	5	5	no	4	2	4	3	5	4	no?	62
6b	Interstitial blinds (in inner cavity, openable from inside) with solar control glass	3	5	5	5	5	5	1	5	no	4	4	2	3	5	4	no?	56
7a	Awning	5	5	5	4	5	5	5	5	yes?	3	3	4	4	4	4	yes	61
8	Solar control glass (reflective coating or body-tinted glass)	3	1	4	1	1	5	5	1	yes	5	5	5	5	5	5	no	51
8b	Solar control glass with internal disposable blind	3	3	4	3	5	5	3	4	?	5	5	5	5	5	5	no	60

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Extract from Comparator Model – External Sliding Shutters

Capex Calculation

			£ 500	/m2	Ref Tom Thoma 210208
	width	height			
Single Window Blind Area	2.1	2.2	4.62	m2	Ref: Architecture NGM 070308
Power supply cabling =	£ 225	per window			Ref: Ian Taylor
Control cabling =	£ 500	per window			Ref: Ian Taylor
Hardware =	£ 50	per window			Ref: JKD assumption (10% of Control Cabling
Uplift for access and cranage =	10%				Ref: JKD assumption
Total Cost of each shutter =	£ 5,905				Includes uplift
Total Cost of shutters=	£ **3,247,580**				

FM Calculation (Based on SID/SRW advice)

Annual Maintenance =	£ 31,625	Annual @ £25/hour 1 hour, and 2 Technician (add OHP)
Reactive Maintenance		Included in Lifecycle
Hard FM	£ 31,625	
Annual Cleaning =	£ 9,488	Say 2 Ops 30 mins per shutter @ £15 / hour (add OHP)

Lifecycle Calculation (SID/SRW assumptions)

Moving Parts	£ 345	Assume replace 100% in year 10
Installation of moving parts	£ 75	Assume 3 hours @ £25 / hour
Total cost of replacement =	£ 231,000	
Rails	£ 874	Assume replace 50% in year 20
Installation of rails	£ 100	Assume 4 hours @ £25 / hour
Total cost of replacement =	£ 267,850	
Shutters	£ 2,310	Assume replace 5% every year
Total cost of replacement =	£ 63,525	Includes reactive maitenance

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Extract from Comparator Model – External Venetian Blind

Capex Calculation

Assume Option A Control System (individual) =	£ 165	/m2			
	width	height			
Single Window Blind Area	2.1	2.2	4.62	m2	Ref: Architecture NGM 070308
Power supply cabling =	£ 225	per window			Ref: Ian Taylor
Control cabling =	£ 500	per window			Ref: Ian Taylor
Hardware =	£ 50	per window			Ref: JKD assumption (10% of Control Cabling)
Uplift for access and cranage =	10%				Ref: JKD assumption
Total Cost of each blind =	£ 2,942				Includes uplift
Total Cost of blinds=	**£ 1,618,316**				

FM Calculation (Based on Levolux advice)

Annual Maintenance =	£ 10,734	Add OHP (and scale for actual no. of blinds)
Annual Cleaning =	£ 12,524	Say 2 Ops 40 mins per blind @ £15 / hour (add OHP)
Reactive Maintenance		Allowed for in assumption for Lifecycle of blinds

Lifecycle Calculation (Based on Levolux advice)

Supply Lift tapes per blind	£ 25	Assume replace 100% in year 15 Ref: Levolux	
Installation of Lift tapes per blind	£ 50	Assume 2 hours @ £25 / hour Ref: JKD	
Total cost of replacement =	£ 41,250		
Supply Motor per blind	£ 315	Assume replace 100% in year 15 Ref Levolux	
Installation of Motor per blind	£ 50	Assume 2 hours @ £25 / hour Ref:JKD	
Total cost of replacement =	£ 200,750		
Supply Blinds	£ 762	Assume replace 5% per year	Includes allowance for reactive maintenance
Total cost per year =	£ 20,963		

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Extract from Comparator Model

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Whole Life Cost
Design Option Comparator Model
Naturally Ventilated v Passive Chilled Beam

	Capex	Lifecycle	Hard FM	Soft FM	Energy
Indexation Assumption =	2.5%	2.5%	3.5%	3.5%	5.0%
Discount Rate =	6.0%	6.0%	6.0%	6.0%	6.0%

Option 2 - External Venetian Blind

	Area (m2)	Capex Rate (£/m2)	Capex (£)	Hard FM Annual Gross Cost (Maintenance)	Soft FM Annual Gross Cost (Cleaning)	Energy Costs
			£ 1,618,316	£ 10,734	£ 12,524	
Lifecycle	Replacement Period (Years)	Replacement Cost	Disposal / Removal Cost (%)	Lifecycle OHP (%)	Total Lifecycle Cost per Period (£)	
Blind	1	£ 20,963	%	%	£ 28,929	
Motor	15	£ 200,750	%	%	£ 230,863	If applicable
Lift Tapes	15	£ 41,250	%	%	£ 47,438	If applicable

	NPV	Construction Period (Year)			Concession Period (Year)				
		1	2	3	1	2	3	4	30
Capex	£1,513,210	£ -	£ 1,700,243	£ -					
Lifecycle	£730,238				£ 31,933	£ 32,731	£ 33,549	£ 34,388	£ 693,985
Hard FM	£211,509				£ 12,317	£ 12,748	£ 13,194	£ 13,656	£ 33,402
Soft FM	£246,782				£ 14,371	£ 14,874	£ 15,395	£ 15,933	£ 38,972
Other	£0				£ -	£ -	£ -	£ -	£ -
Total	£2,701,739	£ -	£ 1,700,243	£ -	£ 58,620	£ 60,353	£ 62,138	£ 63,977	£ 766,360

Unitary Charge	£162,104

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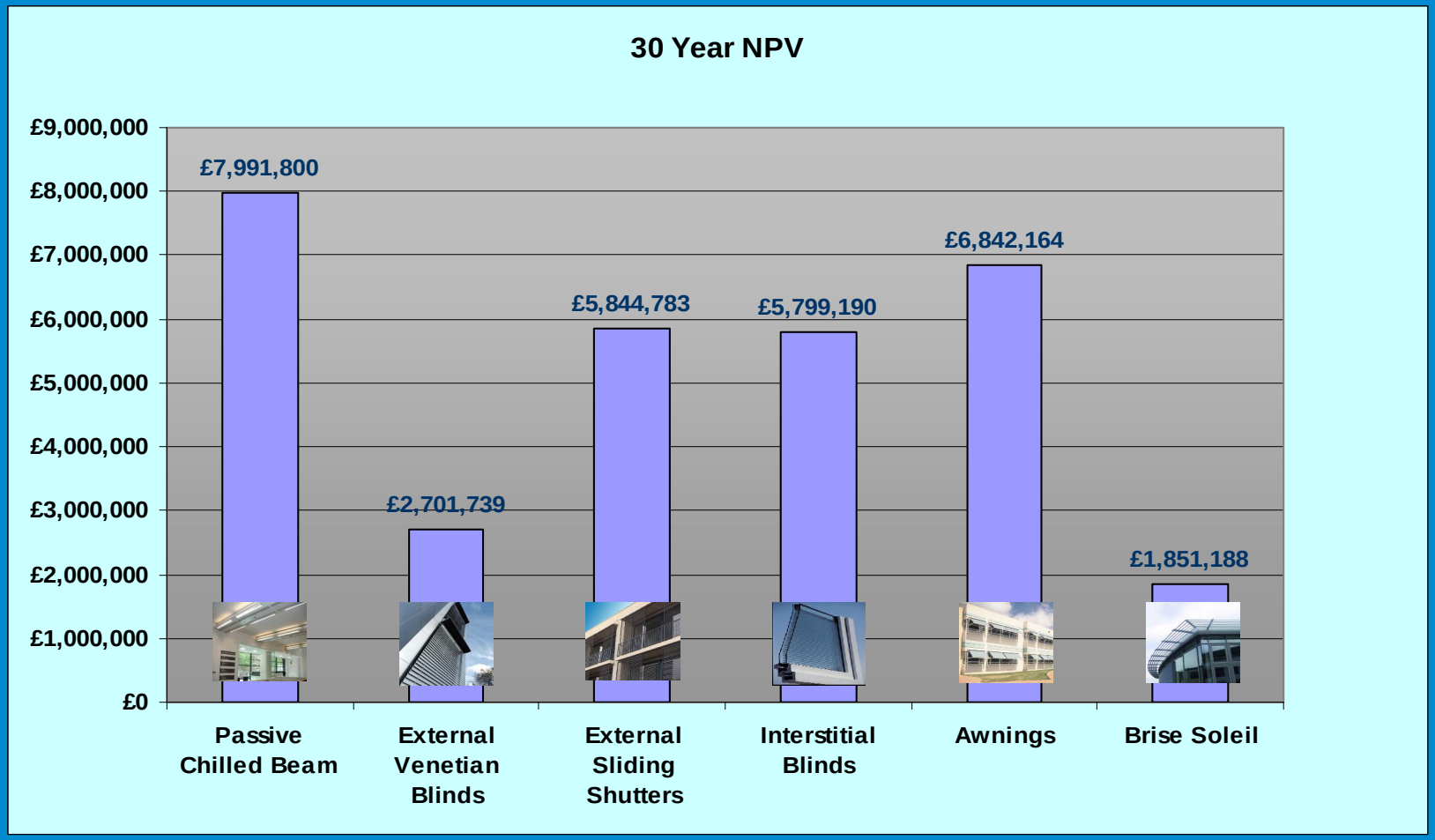
PFI Hospital – Natural Vent v Cooling



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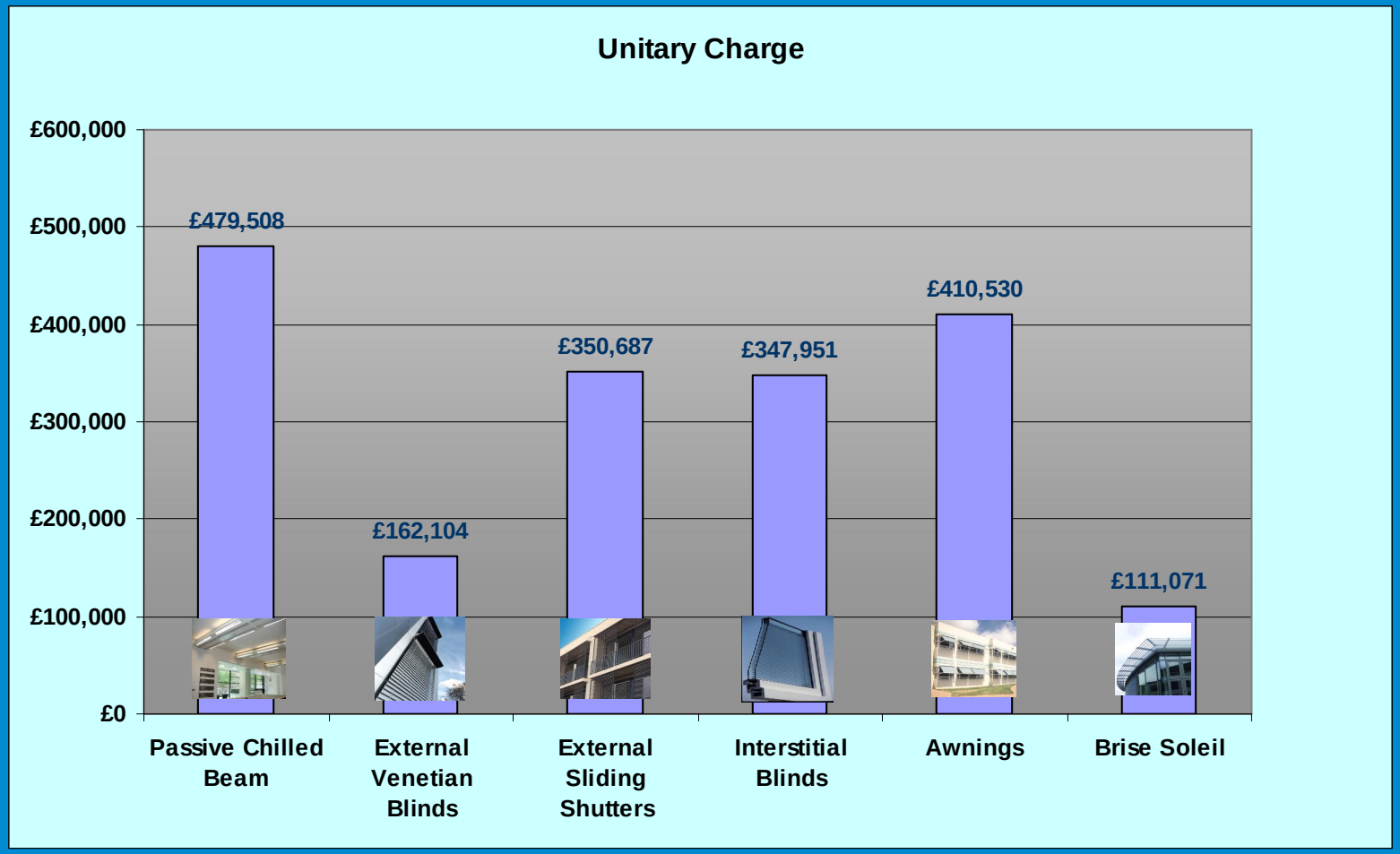

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Whole Life Cycle Cost Optioneering Example

Natural Ventilation v Cooling

Chilled Beam solution fully compliant with internal temperature requirements in Payment Mechanism had highest Whole Life Cost

Naturally Ventilated solutions preferred as ‘greener’ than chilled beam solution and lower Whole Life Cost

Brise Soleil solution unacceptable due to significant overheating

External Venetian Blind selected. Client accepted slight amendment to maximum internal temperature threshold in return for £300,000 saving on Unitary Charge.

Value from WLC Optioneering

- Helps to identify optimum VFM
- Promotes detailed review and analysis of options
- Demonstrates technical ability and expertise
- Promotes sustainable options / identify ‘green premium’
- Provides basis for informed dialogue with the Client
- Builds open relationship and trust with Client
- Provides basis for informed decisions
- Helps justify design decisions
- Aids Value Engineering
- Promotes documentation of decisions