Building Regulations Part L 2013
Wales
Wider Engagement Event

Approach to Energy Modelling – New Build Non-Domestic – Part L2A

Sam Archer

Sustainable Development Group, AECOM

28 / 29th February 2012

AECOM

Recap on 5 criteria for Building Regulations Part L2A compliance

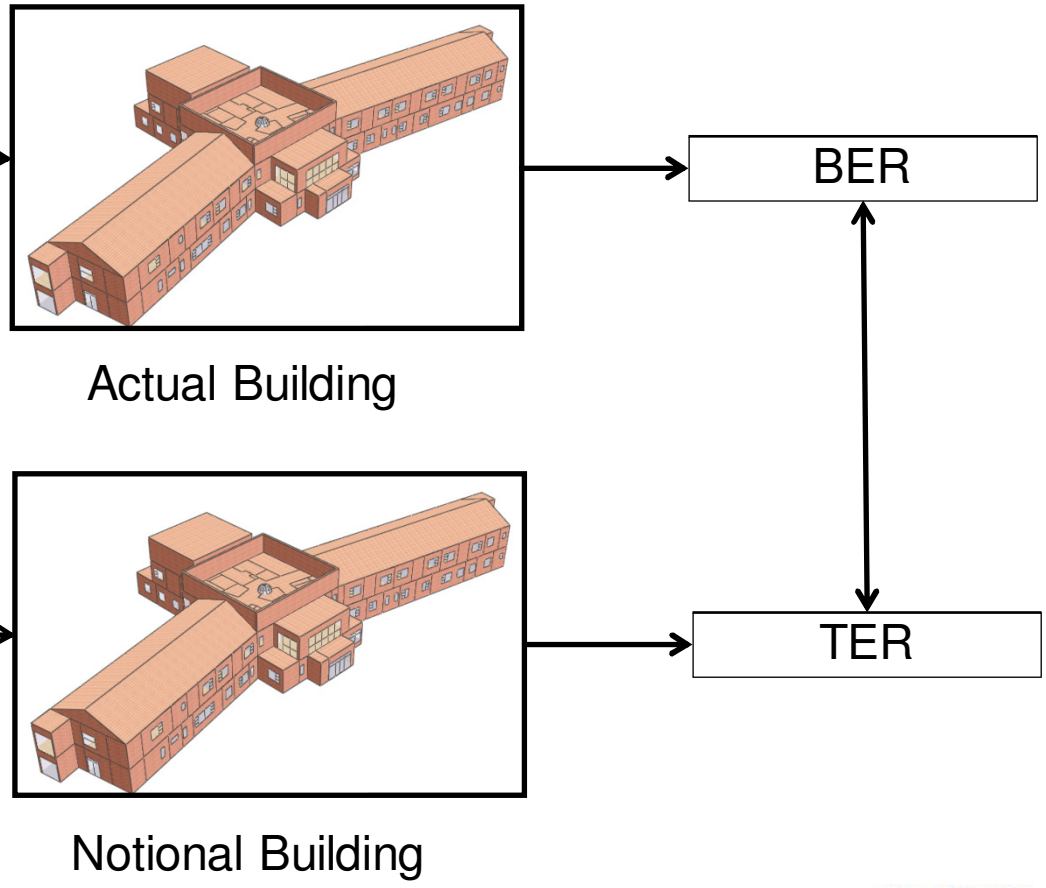
Criteria:

1. Building Emission Rate ≤ Target Emission Rate
2. Limits on design flexibility
3. Limiting the effects of solar gains in summer
4. Quality of construction & commissioning
5. Providing information / O&M instructions

AECOM

Criterion 1 – Target Emission Rate (TER)
Recipe / Aggregate approach in 2010

Concurrent Notional Recipe Approach



AECOM

Not to be confused with....
Criterion 2: Limits on design flexibility

- Non-domestic Building Services Compliance Guide
- Reasonable Provision…
- Values that should not be worse than
- Example:
- Notional Building, chiller SEER = 4.5
- Back stop, chiller SEER = 2.5
- Sufficient as Energy Efficiency limit?

AECOM

Aggregate reduction – different % targets for different buildings

- Each building type has different target reduction on Part L 2010
- Target attempts to fairly distribute costs of compliance across building types
- Aggregate made up of
  - Carbon reduction
  - Multiplied by build-rate

Target aggregate reduction	Target reduction
Warehouse (distribution)	20.1%
Office (Deep-plan, AN)	23.4%
Warehouse (Retail)	16.2%
Office (Shallow-plan, AN)	23.1%
Hotel (5-star)	15.0%
Secondary School	17.4%
Aggregate reduction	**20%**

AECOM

Aggregate reduction very much dependent on build mix

- Build mix:
- what buildings are built in Wales?
- and in what proportion / quantity?

Table 2.11: Build rate assumptions

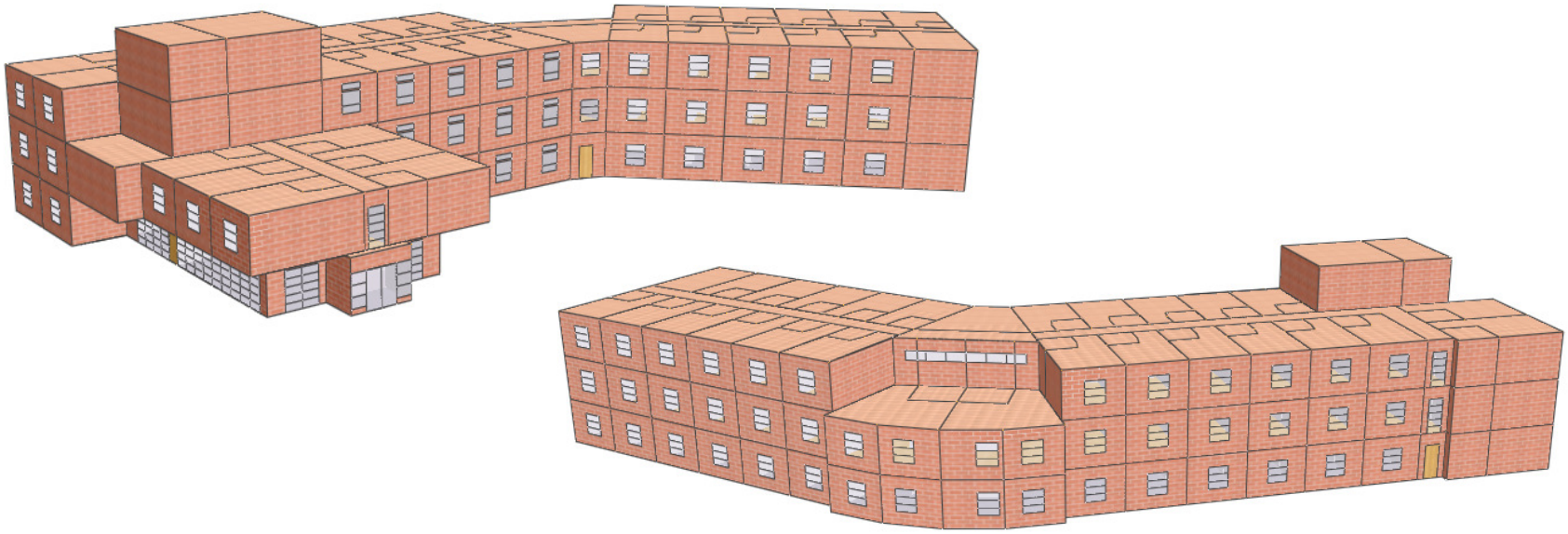
	Build rate in 2014 (m^2)	Build mix
Distribution warehouse	2,321,068	30%
Deep plan office AC	2,067,025	26%
Retail warehouse	993,544	13%
Shallow plan office AC	1,378,016	18%
5 star hotel	272,048	3%
Secondary school	830,874	11%

	'000m^2	% build mix	What this represents *per year*
Education	41	16%	4 new secondary schools
Healthcare	8	3%	3 healthcare clinics
Hotels	10	4%	3 budget hotels
Offices	23	9%	10 offices for a staff of 150 people each
Retail	73	29%	36 supermarkets at 2000m^2 each
Warehouses	90	35%	18 distribution warehouses
Residential Care	11	4%	3 care homes
	255	100%	

AECOM

Hotel – Small budget 3*

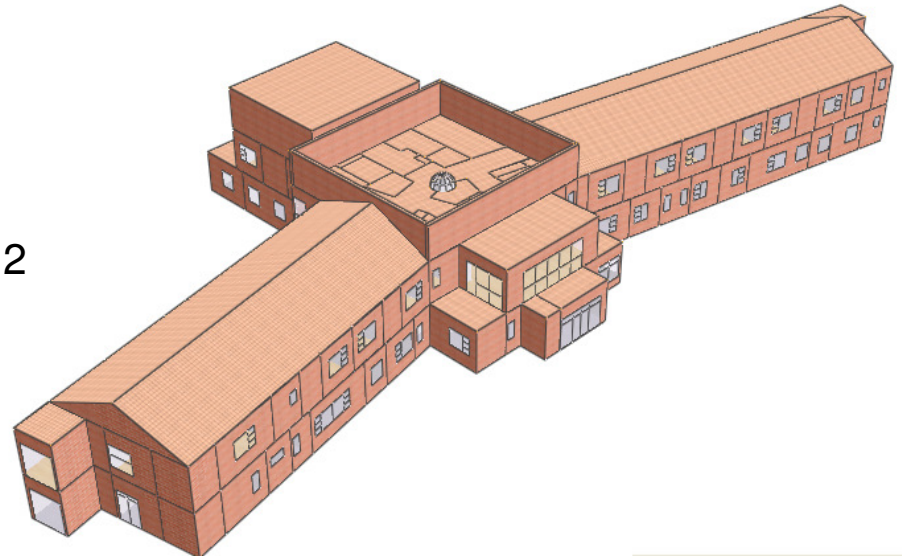
- Budget Hotel – Model supplied by Premier Inn
- Gross Internal Area: Approx 2,729m^2
- Location: Barry



AECOM

Health – Community Hospital

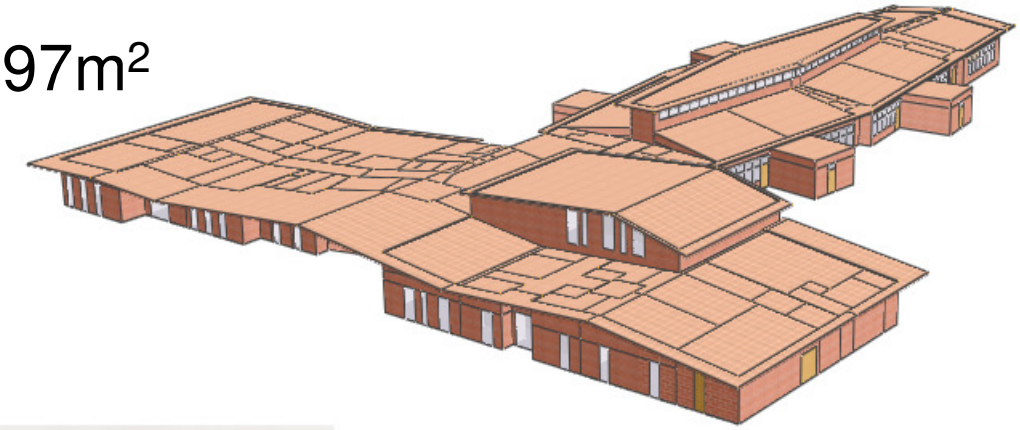
- Moreton-in-Marsh Community Hospital
- Gross Internal Area: 2,507m^2
- Location: Moreton-in-Marsh

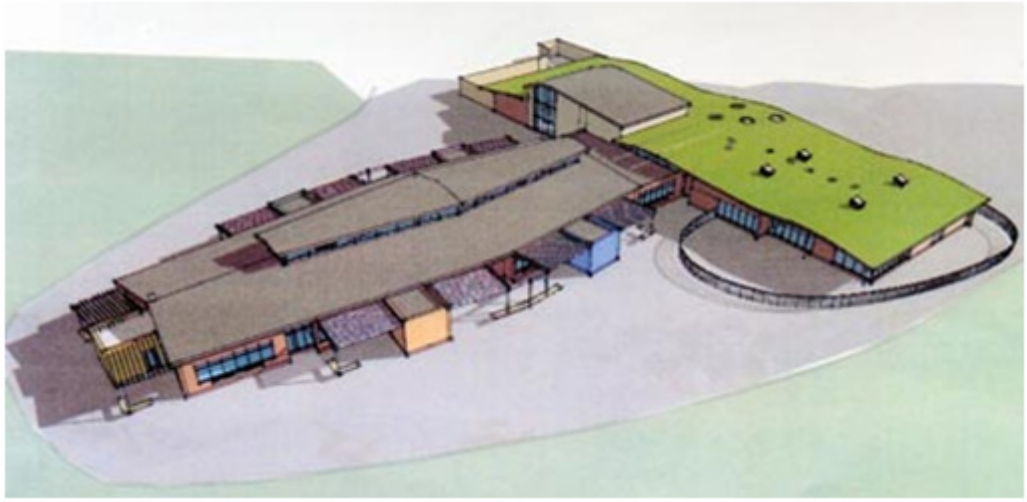


AECOM

Education – Primary School

- Williamstown Primary School
- Gross Internal Area: 2,297m²
- Location: Penrhiwfer

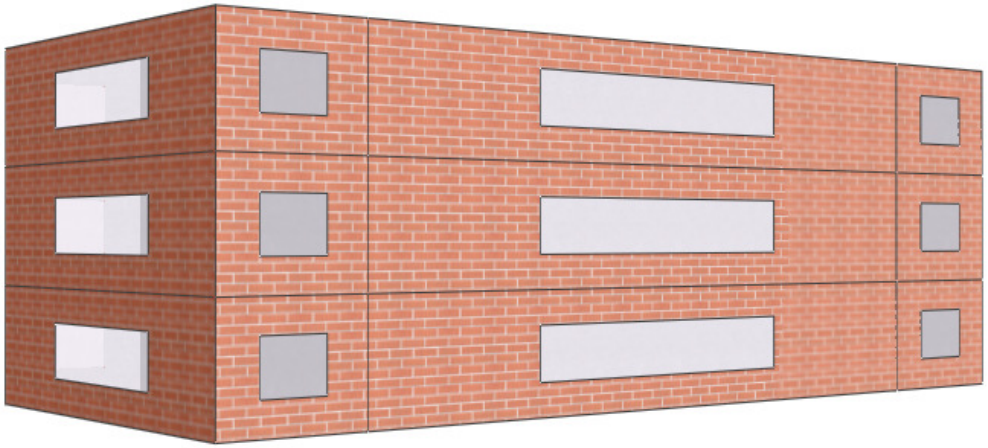




AECOM

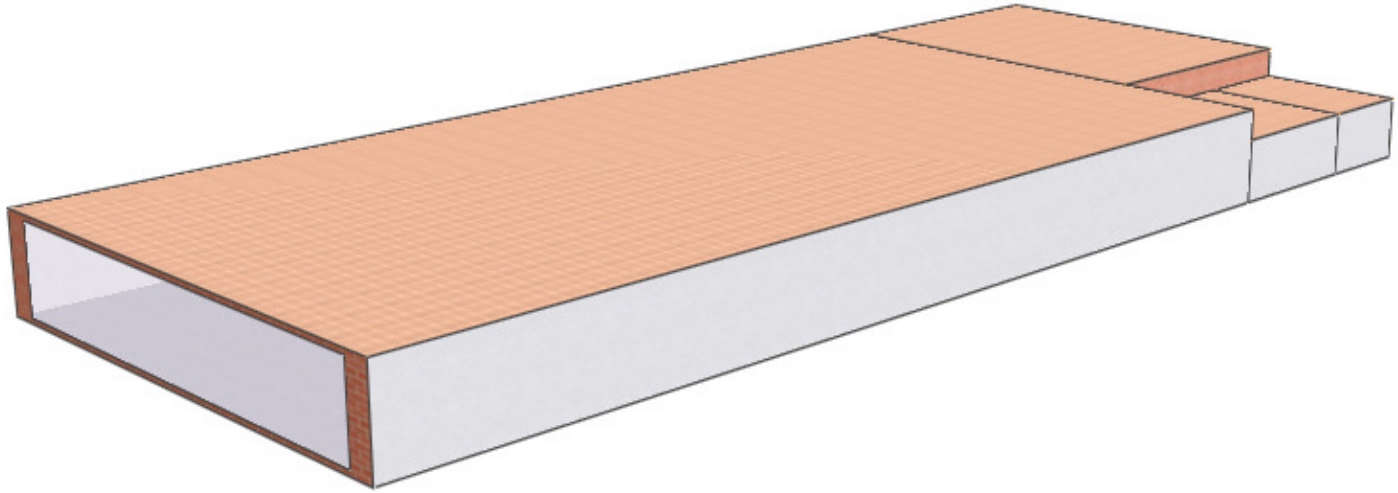
Offices – Naturally vented, heated only

- Naturally ventilated, heated only
- Gross Internal Area: Approx 1,120m^2
- Location: generic model not based on actual building



Retail Unit

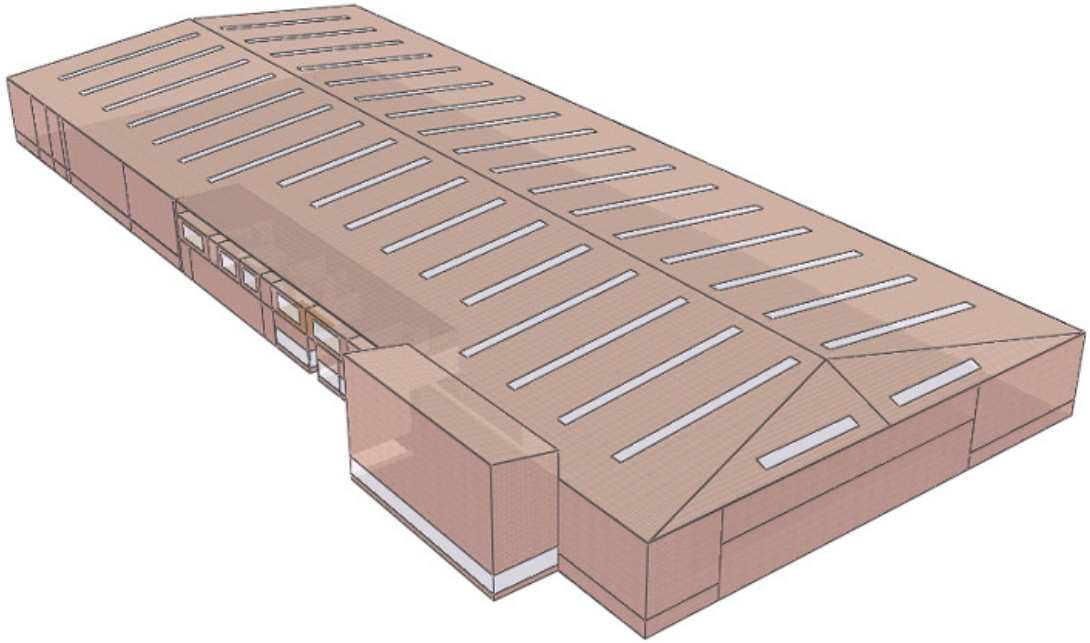
- Retail unit
- Gross Internal Area: Approx 1,210m^2
- Location: generic model not based on actual building



AECOM

Warehouse – distribution

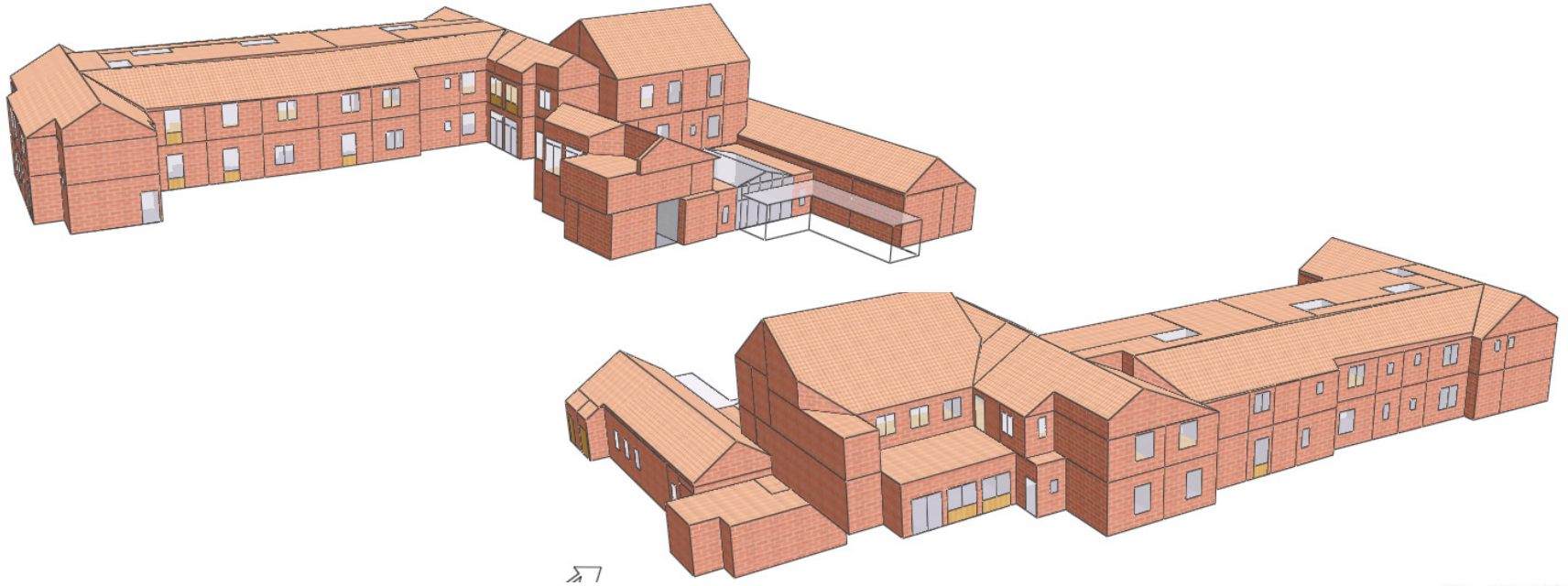
- Generic Warehouse
- Gross Internal Area: 5,262m^2
- Location: generic model not based on actual building



AECOM

Multi-residential

- Care Home
- Gross Internal Area: Approx 1,935m^2
- Location: Mynydd Mawr Care Home



Packages modelled - Fabric

Fabric					
Element	**Unit**	**Package A (2010 Notional)**	**Package B**	**Package C**	**Package D**
Roof	U-value ($W/m^2.K$)	0.18	0.18	0.16	0.10
Wall	U-value ($W/m^2.K$)	0.26	0.26	0.20	0.20
Floor	U-value ($W/m^2.K$)	0.22	0.22	0.20	0.15
Window	U-value ($W/m^2.K$)	1.8	1.8	1.6	1.4
Window	G-Value	40% (10% FF)	40% (10% FF)	40% (10% FF)	40% (10% FF)
Window	Light transmittance	71%	71%	71%	71%
Roof-light	U-value ($W/m^2.K$)	1.8 (15% FF)	1.8 (15% FF)	1.6 (15% FF)	1.4 (15% FF)
	G-Value	55%	52%	48%	45%
Roof-light	Light transmittance	60%	57%	53%	50%
Air-permeability	m^3/m^2/hour	5	3	3	3

AECOM

Packages modelled – Building services

Building Services					
Element	**Unit**	**Package 1 (2010 Notional)**	**Package 2**	**Package 3**	
Lighting	Luminaire lm/ circuit watt	55	65	65	
Occupancy control	Yes/no	Yes	Yes	Yes	
Daylight control	Yes/no	Yes	Yes	Yes	
Heating efficiency	Heating and hot water (side lit)	88%	91%	91%	
Heating efficiency	Heating and hot water (top lit) – i.e. gas-radiant space heating	86%	91%	91%	
Central Ventilation	SFP (w/l/s)	1.8	1.8	1.8	
Terminal Unit	SFP (w/l/s)	0.5	0.4	0.3	
Cooling	SEER	4.5	4.5	4.5	
Heat recovery	%	70%	70%	70%	
Variable speed control of fans and pumps	Yes/no – multiple sensors	Yes	Yes	Yes	
Demand control (mech vent only)	Yes/no – CO2 sensing with variable speed	No	Yes	Yes	

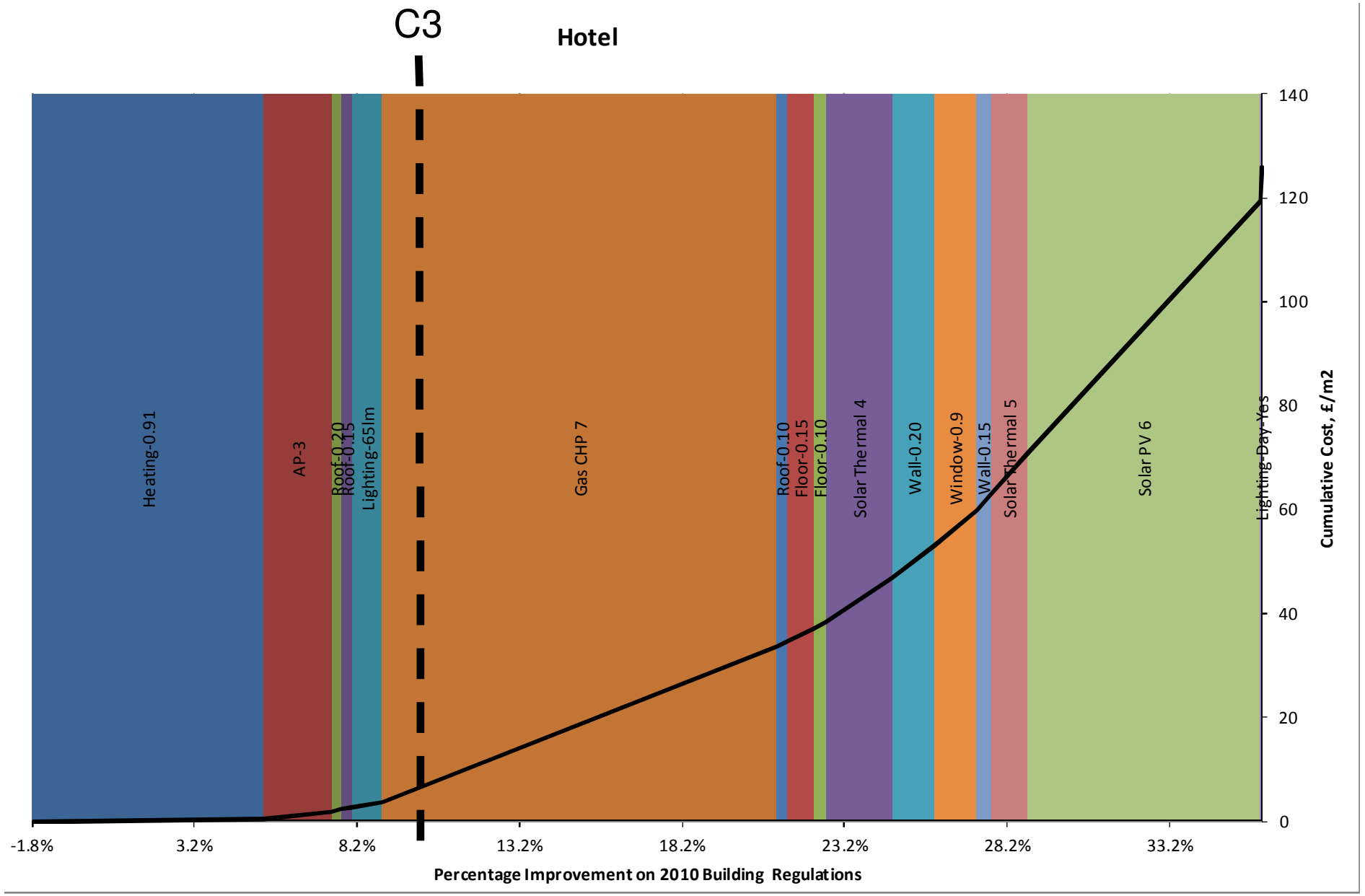
AECOM

Initial Results – Energy Efficiency Packages

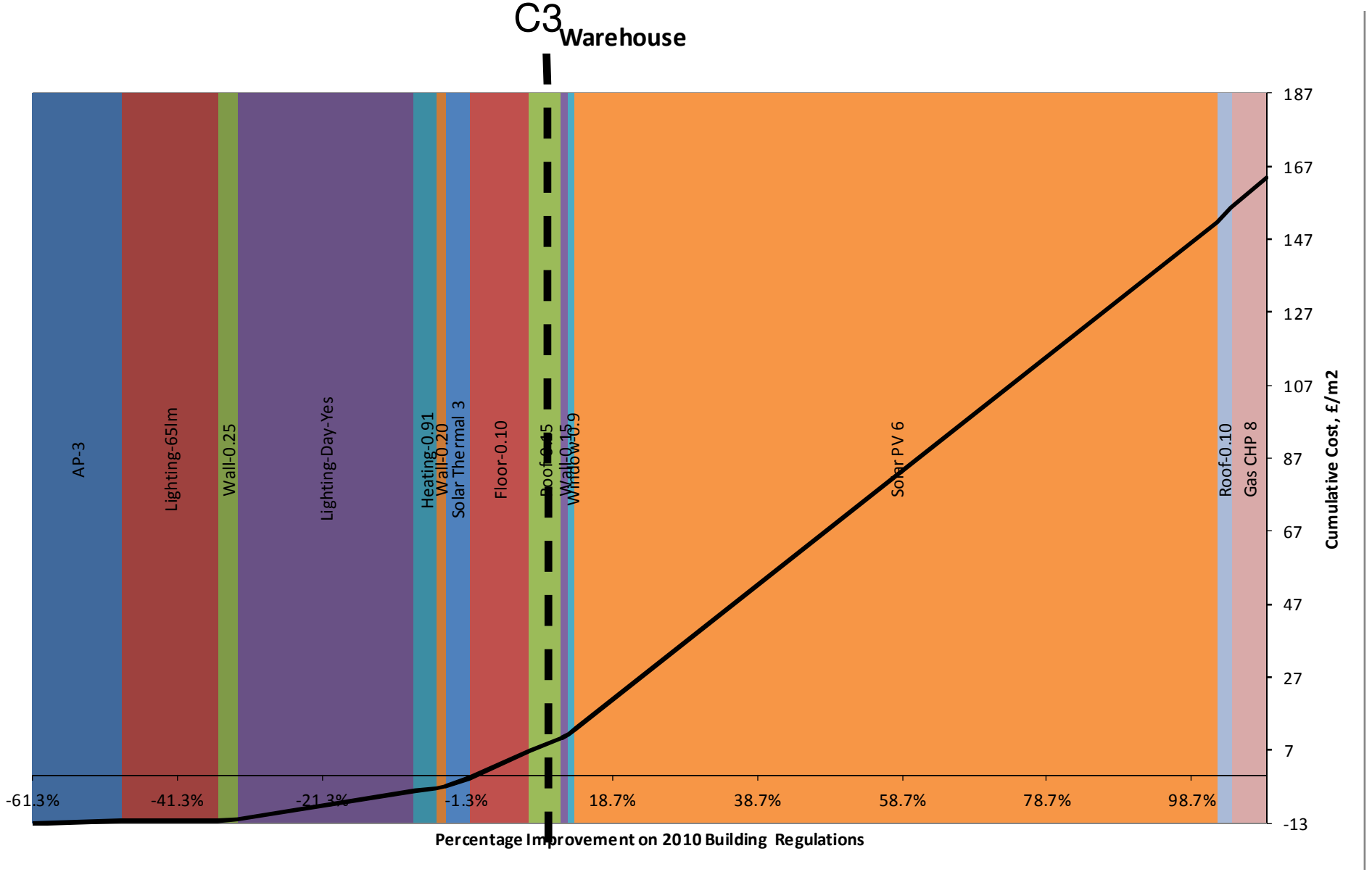
A1 0.0%	A2 9.2%	A3 10.0%
B1 3.1%	B2 11.1%	B3 11.8%
C1 4.8%	C2 12.7%	C3 13.4%
D1 6.7%	D2 14.5%	D3 15.2%

AECOM

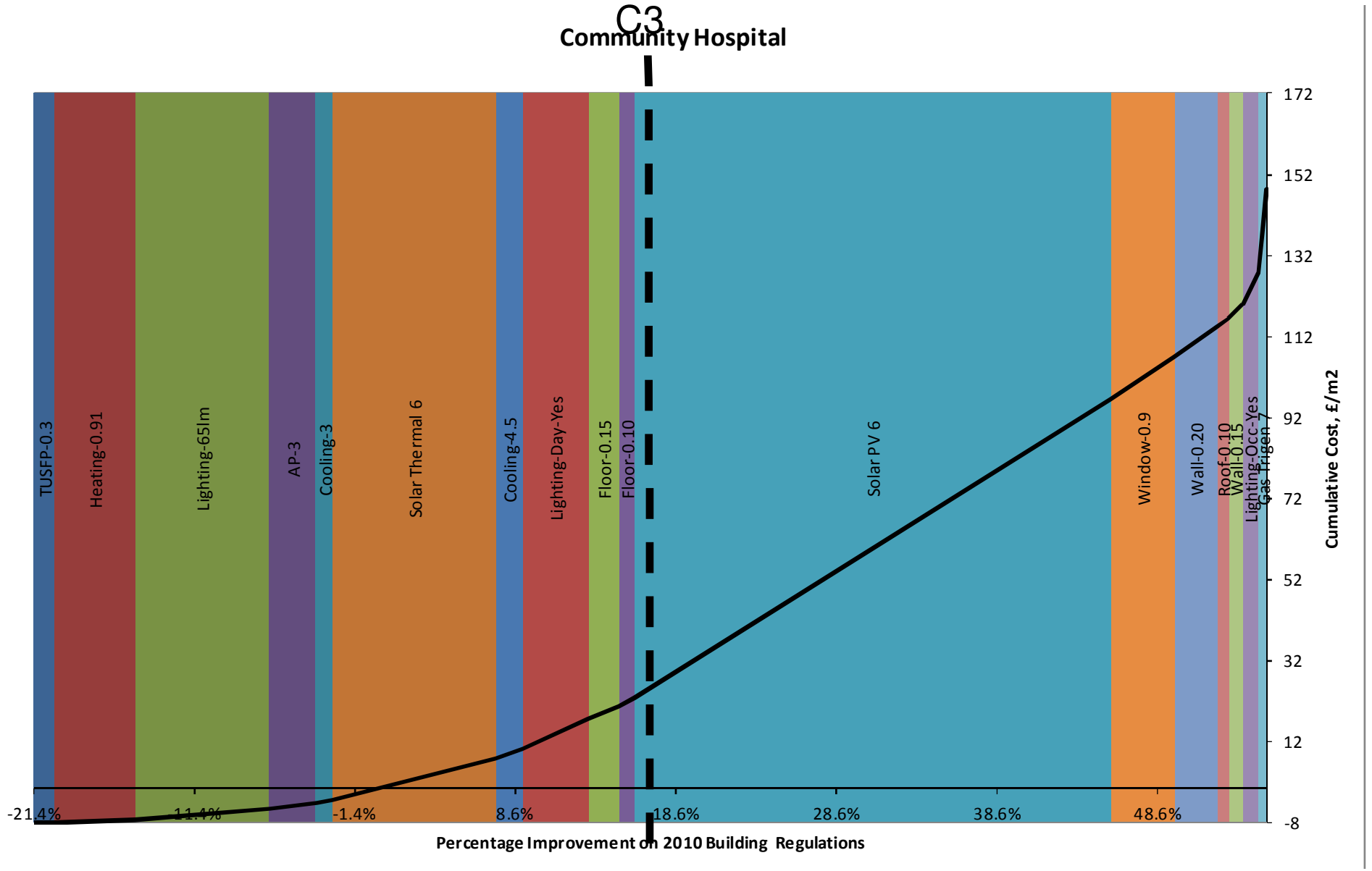
Initial Results – Carbon Abatement Curves



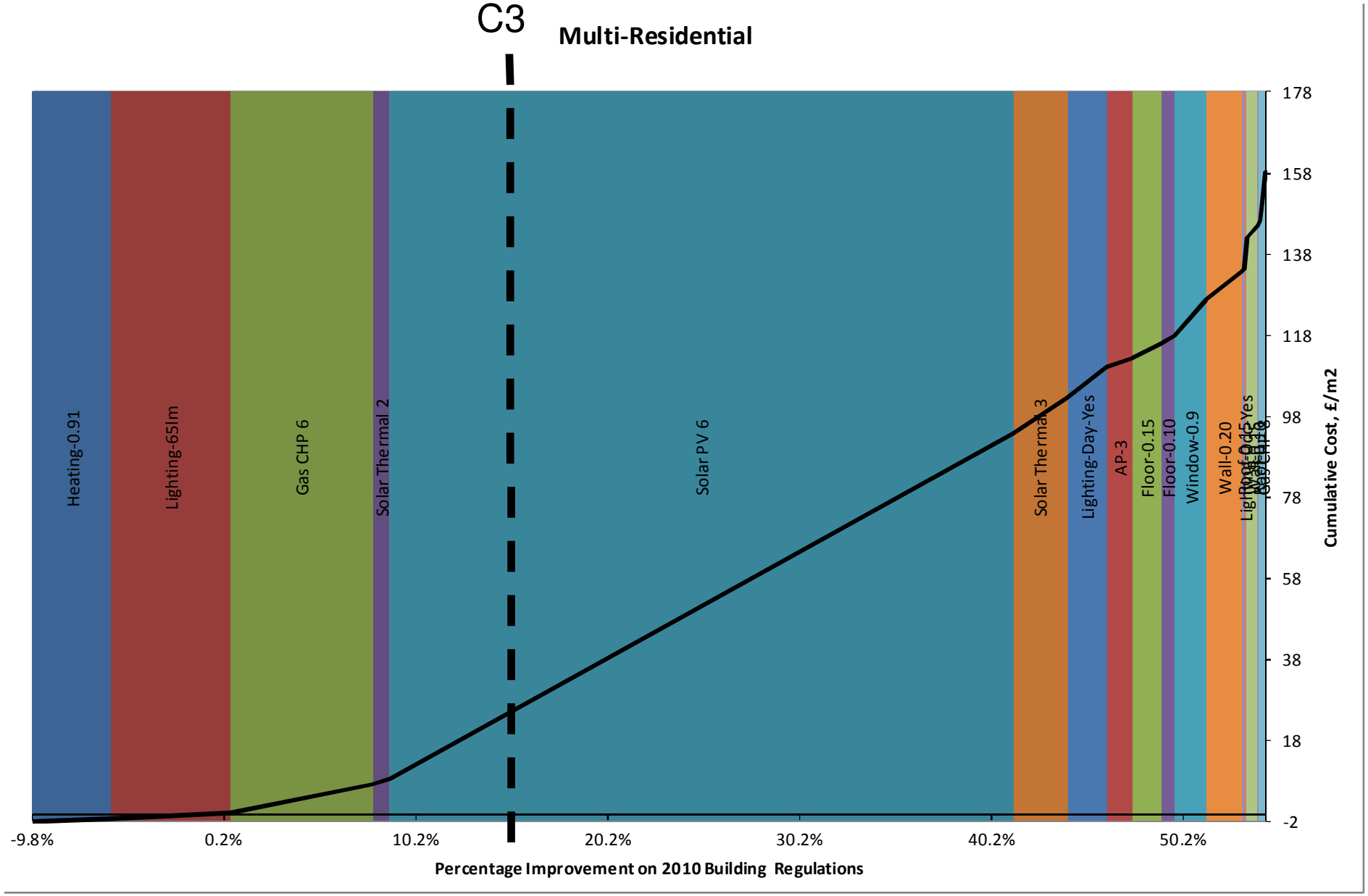
Initial Results – Carbon Abatement Curves



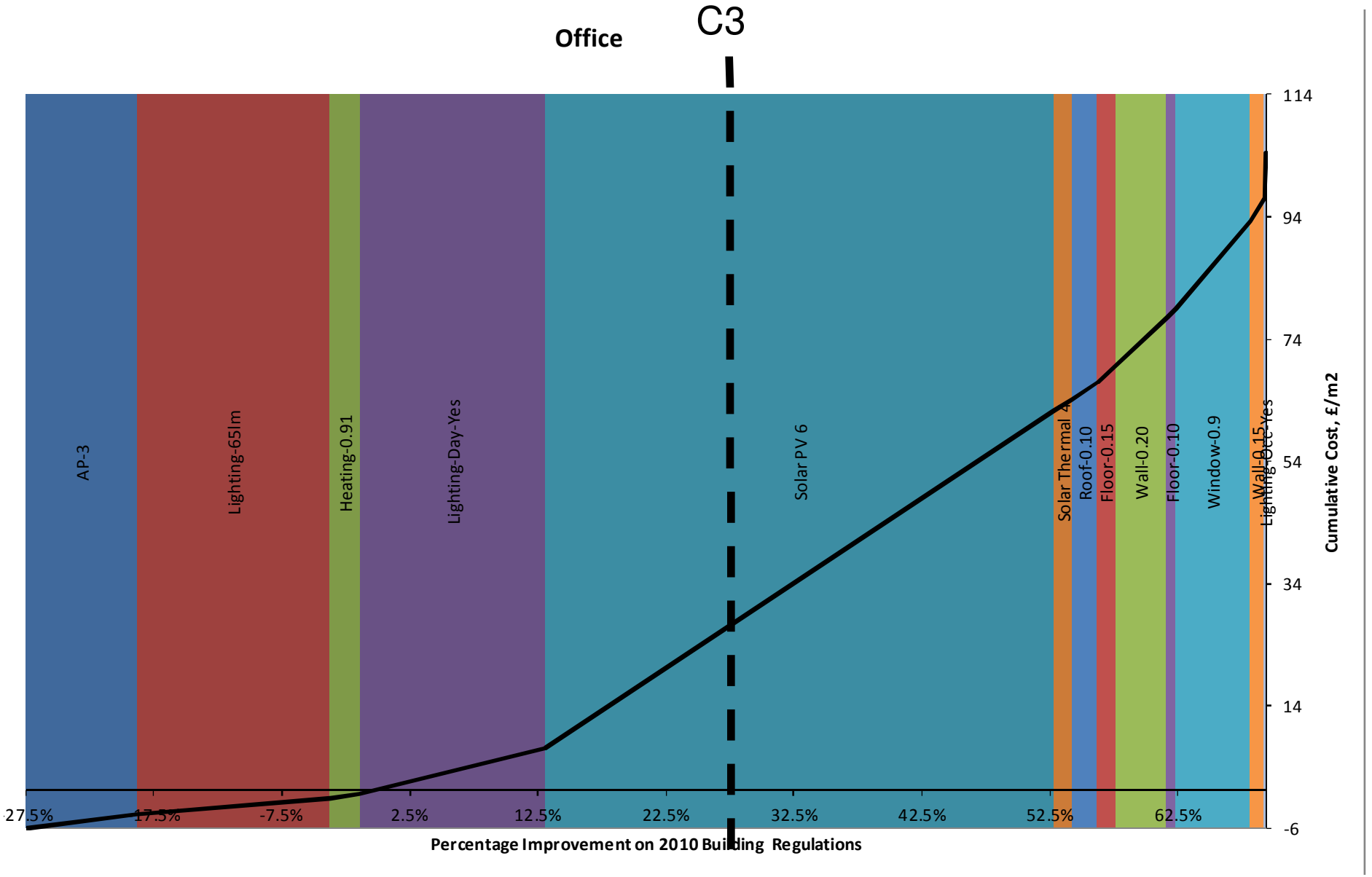
Initial Results – Carbon Abatement Curves



Initial Results – Carbon Abatement Curves

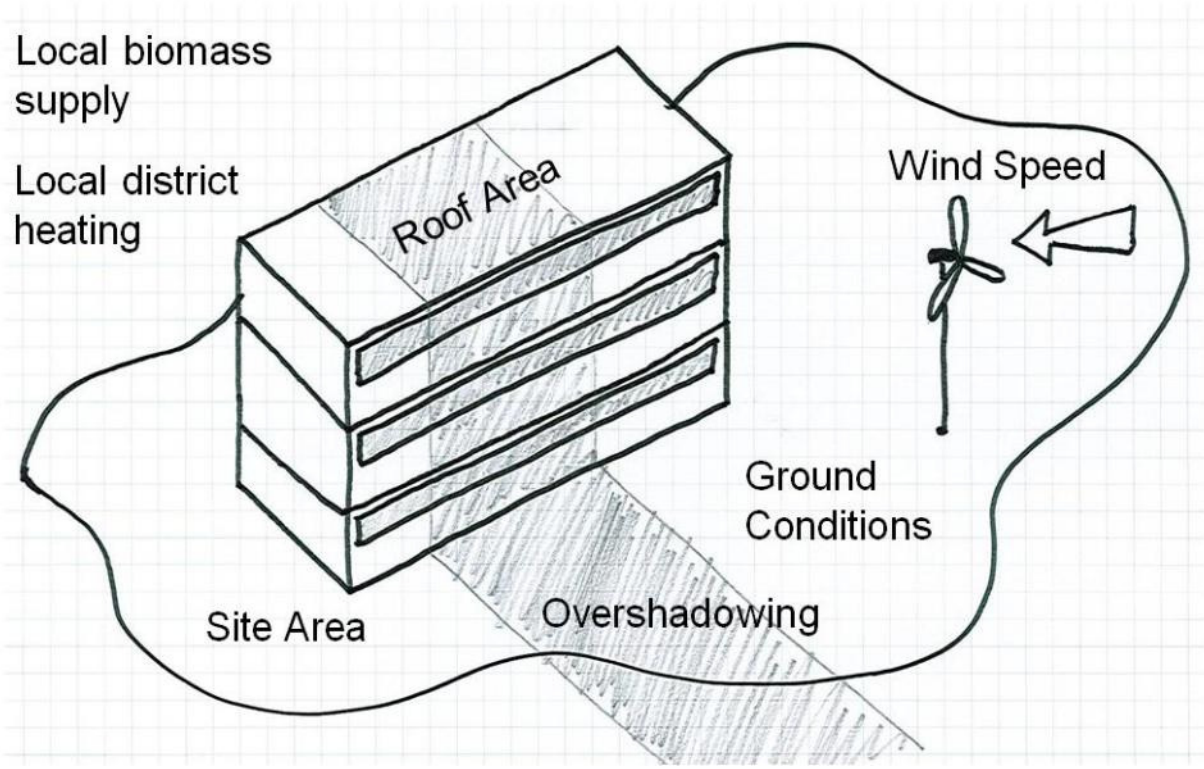


Initial Results – Carbon Abatement Curves



Need for Low and Zero Carbon Technologies in notional building?

- Once Energy Efficiency measures exhausted target can only be moved forward by assuming LZC technologies
- But which ones?



AECOM

Need for Low and Zero Carbon Technologies in notional building?

- Conclusion: PV only technology applicable in all cases
- Notional building includes % roof area covered in PV

Example packages for % improvements

Target aggregate reduction	8%	Resultant target reduction	11%	Resultant target reduction	14%	Resultant target reduction	20%	Resultant target reduction
Warehouse (distribution)	A2	5.6%	B2	8.9%	C3	16.1%	C3+1.6%	20.1%
Office (Deep-plan, AN)	A2	11.9%	A2	11.9%	A2	11.9%	A3+1.6%	23.4%
Warehouse (Retail)	A2	6.8%	B2	8.0%	C3	13.6%	C3+1.6%	16.2%
Office (Shallow-plan, AN)	A2	12.2%	A2	12.2%	A2	12.2%	A3+1.6%	23.1%
Hotel (5-star)	A2	8.8%	C2	11.0%	C2	11.0%	C3+1.6%	15.0%
Secondary School	A2	8.3%	C2	11.0%	C2	11.0%	C3+1.6%	17.4%
PV required on notional building	None		None		None		Panel area equivalent to 1.6% of floor area applied to roof of each building	

AECOM

Differentiated notional building

- Different notional buildings for different building types:
  - Heated only (school, hotel)
  - Heated *and* cooled (retail warehouse, air-conditioned office)
  - Toplit (warehouse)
  - Residential
  - Others?

England 2013 Part L Consultation – New non-domestic buildings

Resultant Notional Building for 20% aggregate reduction

Element	Unit	Side lit (where HVAC specification is heating only)	Sidelit (where HVAC specification includes cooling)	Toplit
Roof	U-value ($W/m^2.K$)	0.16	0.18	0.16
Wall	U-value ($W/m^2.K$)	0.20	0.26	0.20
Floor	U-value ($W/m^2.K$)	0.20	0.22	0.20
Window	U-value ($W/m^2.K$)	1.6 (10% FF)	1.8 (10% FF)	N/A
	G-Value	40%	40%	N/A
	Light transmittance	71%	71%	N/A
Roof-light	U-value ($W/m^2.K$)	N/A	N/A	1.6 (15% Frame Factor)
	G-Value	N/A	N/A	48%
	Light transmittance	N/A	N/A	53%
Air-permeability	$m^3/m^2/hour$	3	5	3

AECOM

Element	Unit	Side lit (where HVAC specification is heating only)	Sidelit (where HVAC specification includes cooling)	Toplit
Lighting	Luminaire lm / circuit watt	65	65	65
Occupancy control	Yes (MAN ON/AUTO OFF) / No	Yes	Yes	Yes
Daylight control	Yes / No	Yes	Yes	Yes
Heating efficiency	Heating and hot water	91%	91%	91%
Central ventilation	SFP (W/l/s)	1.8	1.8	1.8
Terminal unit	SFP (W/l/s)	0.3	0.3	0.3
Cooling (air-conditioned)	SSEER	N/A	3.6	3.6
Cooling (mixed-mode)	SSEER	N/A	2.7	2.7
Heat recovery efficiency	%	70%	70%	70%
Variable speed control of fans and pumps, controlled via multiple sensors	Yes / No	Yes	Yes	Yes
Demand control (mechanical ventilation only). Variable speed control of fans via CO_2 sensors	Yes / No	Yes	Yes	Yes
Renewable energy contribution	Monocrystalline PV with an efficiency of 15%.	1.6%	1.6%	1.6%

Treatment of Renewable Heat

Biomass and Heat Pumps

- 2010
  - If biomass or heat pumps used in Actual building also used in Notional building
  - Little carbon benefit therefore from biomass boilers or heat pumps
- 2013
  - Retained above approach
  - Biomass and heat pumps not modelled in Cost Benefit Analysis

Other Minor Changes to AD L2A

Treatment of Lighting

- 2010
  - Actual design lux level irrelevant – rebased to
  - So supermarket designed to 2000 lux, rebased to notional building 800 lux
- 2013
  - Actual installed lighting wattage used so penalising overlit spaces.

Other Minor Changes to AD L2A

Treatment of District Heating

- 2010
  - Notional CO_2 emission factor for heat supplied from district heating same as in actual.
  - Little carbon benefit from connection to district heating.
- 2013
  - Notional CO_2 emission factor always 0.15 kg.CO2/kWh regardless of actual emission factor
  - Allows carbon benefit where efficient district heating is employed

Other Minor Changes to AD L2A

Removal of Accredited Construction Details (ACDs)

- No quality assured accredited construction details schemes have been approved by the Secretary of State. The confidence factor of 0.02 W/mKor 25 per cent is disapplied from Part L 2010.

Questions for discussion

1. Does the Build-Mix seem reasonable for Wales?
2. Are the notional building packages equally applicable across all building types? i.e. Are there any buildings that would struggle to meet higher standards? Any buildings where the standard could be pushed harder?
3. Carbon Abatement Cost Curves. Initial impressions. Any measures that seem impractical for a particular building type?
4. Minor amendments proposed in England. Any comments on these minor amendments and their applicability in Wales?

AECOM

Thank You

sam.archer@aecom.com

28 / 29th February 2012

Building Regulations Part L 2013 Wales
Wider Engagement Event

Approach to cost modelling

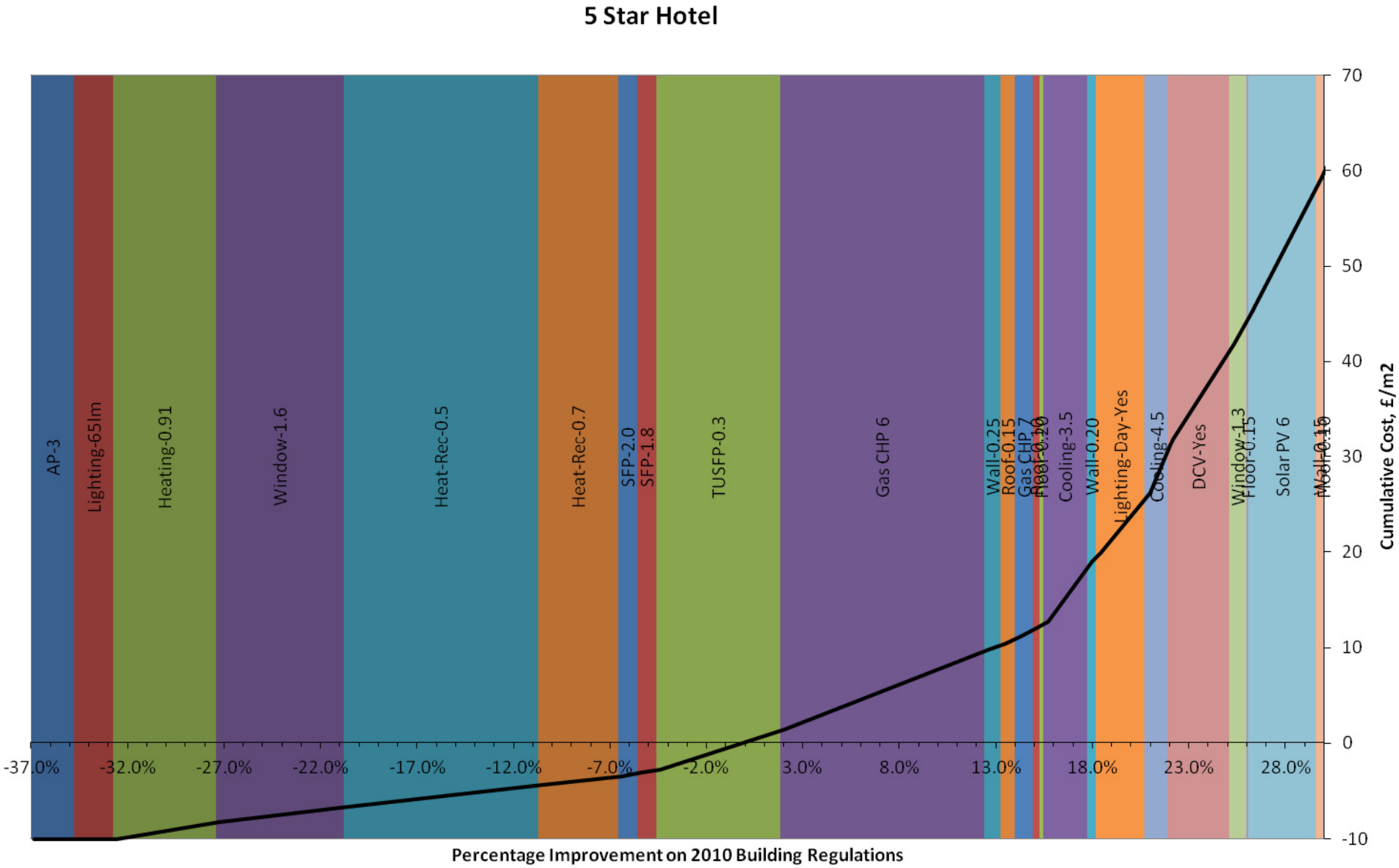
Sam Archer

Sustainable Development Group, AECOM

6th and 8th December 2011

AECOM

Reminder of Carbon Abatement Cost Curve
Built up element by element



Extra over costs – Office
Fabric Measures

		Capital	Maintenance	Lifespan
	Element	£/m2	£	Year
Floor U-value W/m2.K	Floor-0.25	0.0	0	60
	Floor-0.20	0.2	0	60
	Floor-0.15	0.7	0	60
	Floor-0.10	1.5	0	60
Roof U-value W/m2.K	Roof-0.25	0.0	0	60
	Roof-0.20	0.5	0	60
	Roof-0.15	0.8	0	60
	Roof-0.10	1.3	0	60
Wall U-value W/m2.K	Wall-0.35	0.0	0	60
	Wall-0.25	0.4	0	60
	Wall-0.20	1.0	0	60
	Wall-0.15	2.0	0	60
Thermal Bridges according to BR 497	Thermal-Bridging-No	0.0	0	60
	Thermal-Bridging-Yes	0.8	0	60
Window U-value W/m2.K	Window-2.0	0.0	0	60
	Window-1.6	1.0	0	60
	Window-1.3	3.2	0	60
	Window-0.9	8.5	0	60
Air permeability m3/m2/hour	AP-10	0.0	0	60
	AP-7.5	1.7	0	60
	AP-5	3.3	0	60
	AP-3	6.5	0	60

AECOM

Extra over costs – Office
Building Services Measures

		Capital	Maintenance	Lifespan
	Element	£/m2	£	Years
Luminaire efficiency Luminaire lumens / watt	Lighting-55lm	0.0	0	20
	Lighting-65lm	12.5	0	20
Lighting Occupancy Control	Lighting-Occ-No	0.0	0	20
	Lighting-Occ-Yes	6.2	0	20
Lighting Daylight Control	Lighting-Day-No	0.0	0	20
	Lighting-Day-Yes	6.2	0	20
Boiler Efficiency	Heating-0.84	0.0	0	15
	Heating-0.86	0.0	0	15
	Heating-0.88	1.8	0	15
	Heating-0.91	1.8	0	15
Heat recovery Yes (70%) / No	Heat-Rec-0	0.0	0	15
	Heat-Rec-0.7	1.5	0	15
Cooling SEER	Cooling-2.5	0.0	0	15
	Cooling-3	4.2	0	15
	Cooling-3.5	6.3	0	15
	Cooling-4.5	12.0	0	15
Central AHU Specific Fan Power w/l/s	SFP-2.2	0.0	0	15
	SFP-2.0	0.4	0	15
	SFP-1.8	0.7	0	15
Terminal Unit Specific Fan Power w/l/s	TUSFP-0.8	0.0	0	15
	TUSFP-0.5	3.0	0	15
	TUSFP-0.3	6.0	0	15
Luminaire efficiency Luminaire watts / lumen	Lighting-55lm	0.0	0	20
	Lighting-65lm	12.5	0	20

AECOM

Low and Zero Carbon Technologies

- Biomass and Heat Pumps not included
- If Biomass heating or Heat Pump in *actual* building...
- ...also in *notional* building so little incentive to use
- Leaves:
  - Solar PV
  - Solar Thermal
  - Gas CHP
  - Gas Trigeneration
  - Wind Power

AECOM

Low and Zero Carbon Technologies
Base costs (£/unit varies), 2010 and Learning Rates

Size	per kW(e) Gas CHP	per kW(e) Gas Trigen	per m2 Solar Thermal	per m2 Solar PV	per kW Wind
0.6	3289	3299	1505	689	13542
2.5	3289	3299	744	552	5573
5	3289	3299	583	552	4792
6	3289	3299	513	534	4010
10	3289	3299	513	534	3490
15	3289	3299	513	517	2917
20	3289	3299	513	517	2917
30	3289	3299	513	517	2917
40	2741	2784	507	517	2917
50	2193	2268	507	448	2917
60	1974	2062	507	448	2917
70	1645	1753	507	431	2917
80	1425	1546	507	431	2917
90	1316	1443	507	431	2917
100	1206	1340	507	431	2917
110	1206	1340	507	431	2917
120	1096	1237	507	431	2917
130	1096	1237	507	431	2917
140	987	1237	507	431	2917
150	987	1237	507	431	2396
160	987	1134	507	431	2396
170	987	1031	507	396	2396
180	987	1031	507	396	2396
190	877	979	507	396	2396
200	877	928	507	396	2396

	Gas CHP	Gas Trigen	Solar Thermal	Solar PV	Wind
2008	100%	100%	100%	100%	100%
2009	100%	99%	100%	100%	99%
2010	100%	98%	100%	100%	97%
2011	91%	97%	100%	83%	96%
2012	87%	96%	100%	75%	95%
2013	83%	95%	98%	69%	94%
2014	80%	94%	93%	63%	93%
2015	78%	93%	91%	60%	92%
2016	76%	92%	89%	57%	91%
2017	75%	91%	87%	56%	90%
2018	73%	90%	86%	53%	89%
2019	72%	89%	85%	51%	89%
2020	70%	88%	84%	50%	88%
2021	69%	87%	84%	49%	87%
2022	68%	86%	83%	48%	86%
2023	67%	85%	82%	47%	86%
2024	65%	84%	82%	45%	85%
2025	64%	83%	81%	44%	84%

AECOM

Possible items for discussion

- General build costs (£/m2)
- Inclusion of biomass and heat pumps?
- Welsh specific costs for LZC technologies or are these similar to England?

Possible items for discussion

- Are the building types we have selected representative of those built in Wales?
- Is the approach to target setting right?
- Is PV the right choice for the notional building?
- Are there building types with specific issues that we should take into account?
- Are we being ambitious enough with the performance specifications of elements?
- Is our approach to costing correct?

AECOM