

The following presentation was given at:

The SCAF 2016 Cost Estimating Challenge

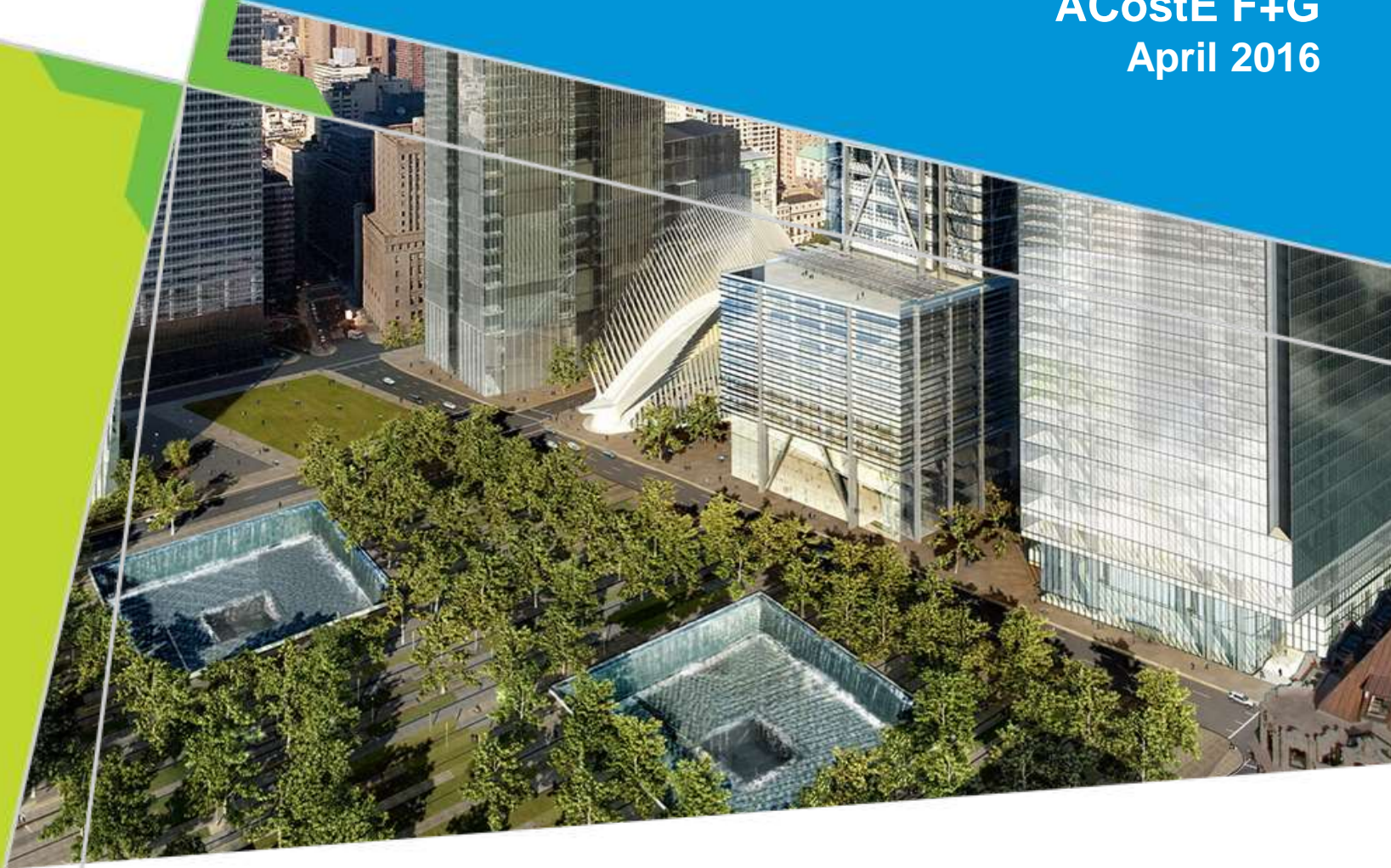
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SCAF Challenge

ACostE F+G

April 2016



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Our Strategy

Analyse the History

- Have vacuum cleaners become more powerful?
- Have vacuum cleaners become more efficient?
- Have vacuum cleaners become better at cleaning?

Forecast the Future

- Will the new regulations:
 - (a) Reduce the cost to the consumer
 - (b) Reduce energy consumption

I.e. 'Will consumers get better vacuum cleaners that are more energy efficient?'

EU Rules

"The whole point of the regulations is to go away from the idea that high power means better performance - which is not necessarily the case." (European Commission 2013)

Justification of the new rules

- Increasing energy efficiency and the level of protection of the environment
- Providing consumers with information that allows them to choose more efficient products

Implementation of Regulations

Stage 1 - From 1 September 2014

- Annual energy consumption shall be less than 62.0 kWh/year
- Rated input power shall be less than 1600W
- Dust pick up on carpet (dpuc) shall be greater than or equal to 0.703
- Dust pick up on hard floor (dpuhf) shall be greater than or equal to 0.95

Stage 2 - From 1 September 2017

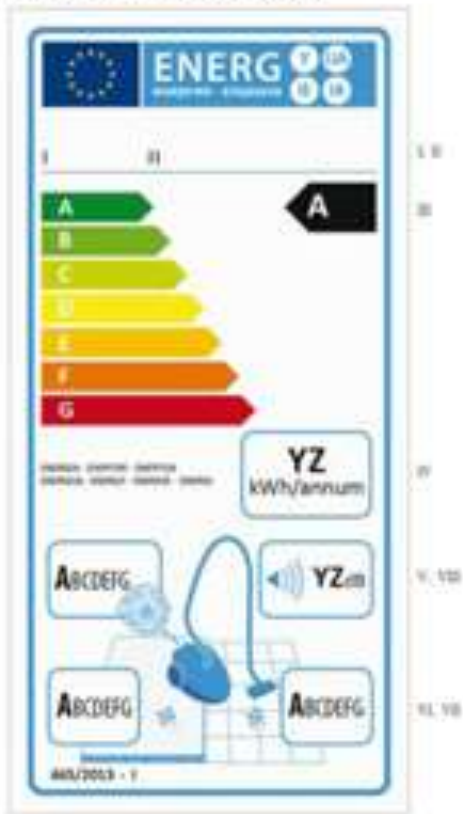
- Annual energy consumption shall be less than 43.0 kWh/year
- Rated input power shall be less than 900W
- Dust pick up on carpet (dpuc) shall be greater than or equal to 0.75
- Dust pick up on hard floor (dpuhf) shall be greater than or equal to 0.98

Efficiency and Protection

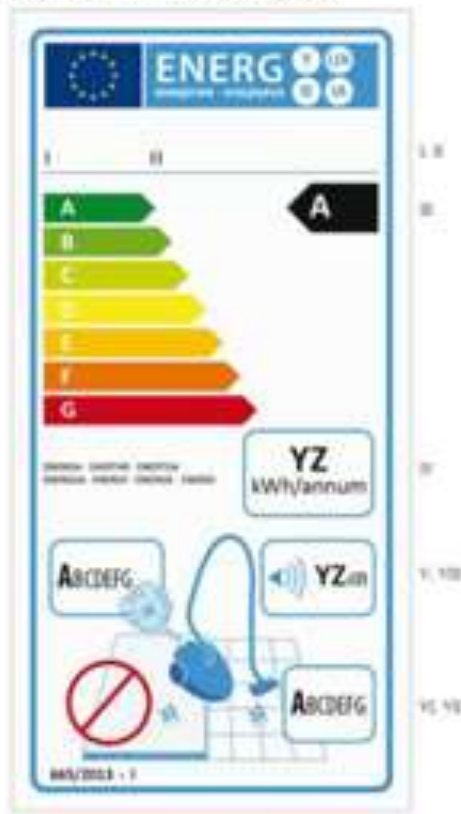
- By switching to one of the most energy efficient vacuum cleaners, you can save around £56 over the lifetime of the product.
- With more efficient vacuum cleaners, Europe can also save up to 20 TWh of electricity per year by 2020.
- This is equivalent to the annual household electricity consumption of Belgium.
- It also means over 6 million tonnes of CO₂ are avoided

Energy Efficiency Labelling

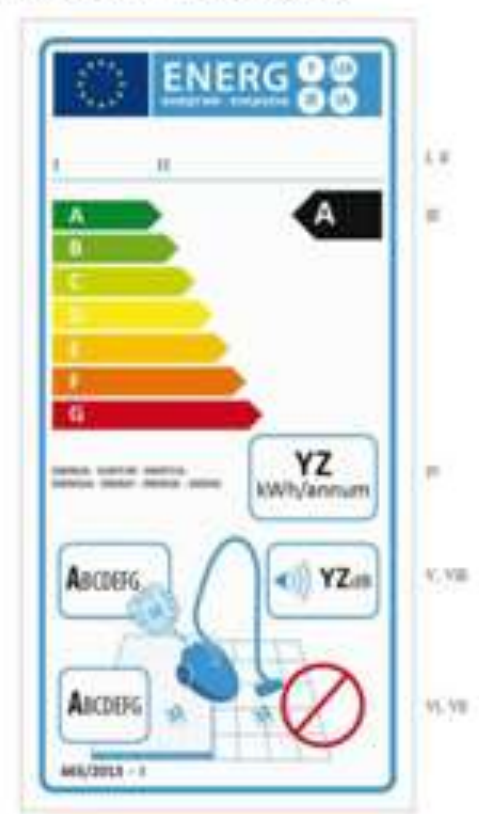
For general purpose vacuum cleaners



For hard floor vacuum cleaners

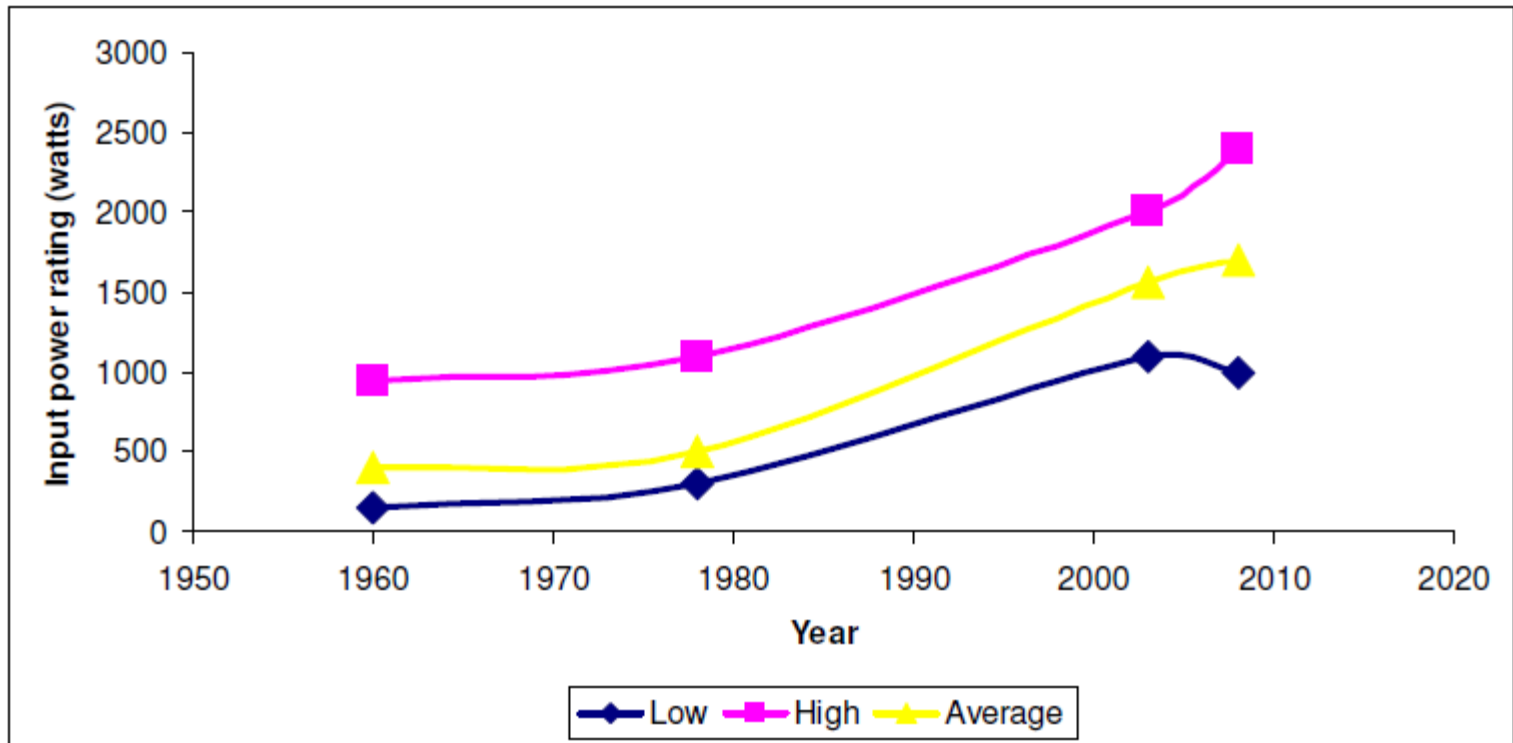


For carpet vacuum cleaners



Historical Trends

- Vacuums have become more powerful over time



Historical Trends (Cont.)

Vacuums become more efficient over time

- there is no-correlation between power and cleaning efficiency
- Design improvements create greater efficiency
- **The relationship between energy efficiency and cleaning efficiency**
 - There is no relationship between the two.
 - Overall energy conversion of vacuum cleaners has not dramatically improved and remains at a maximum of 33%

Cost Modelling

Problem statement: Were suppliers wasting energy with power hungry appliances?

Answers: Compare the 2014 'Unregulated' Market vs. the 2016 EU Intervention market

Variable	Methodology
Retail price	Develop test samples to represent the retail prices of the 2 markets and determine minimum, most likely and maximums. Incorporate an element of price adjustment to fit criteria of '2015 prices'.
Electricity Price	Consult a 2015 energy bill for price per Kilo Watt hour. Assume to be constant over 10 year period
R&M	Research repair charges for vacuum cleaners and frequency
Duration of clean	Proportionally adjust the EU assumed duration (based on 87m ²) to the specified area of 76m ²
Frequency of clean	Determine a minimum, most likely and maximum number for model
Watts	Develop test samples to represent wattage range of the 2 markets and determine minimum, most likely and maximums
Inflation	Use the Bank of England's CPI forecast to adjust future years energy costs into 2015 prices

Sample Retail Price / Wattage Test

Manufacturer	Model	Upright / Cylinder	Retail Price	Power (W)
Vax	Bagless Cylinder Vacuum	Cylinder	£250	1800
Russell Hobbs	Power Cyclonic	Cylinder	£70	1800
Hoover	Spirit SP2102	Upright	£80	2100
Dyson	DC41 Animal Ball	Upright	£390	700
Numatic	HVR200A Henry A1	Cylinder	£155	1200
Panasonic	Bagged Vacuum	Upright	£100	1900
Zanussi	AirSpeed Lite Multi-Cyclonic	Upright	£70	1600
Sebo	K1PRO Cylinder	Cylinder	£200	2100
VonHaus	Cyclonic Bagless Cylinder Vacuum	Cylinder	£100	2400
Bosch	Power Silence Bagless	Cylinder	£250	1200

Sample taken from a 2014 Telegraph Article that listed the 10 best sellers of Amazon.co.uk

Manufacturer	Model	Upright / Cylinder	Retail Price	Power (W)
Zanussi	ZAN2000A	Upright	£53	1100
Vax	U91-MA-P	Upright	£190	1200
Vax	U90-MA-R Air Reach	Upright	£130	1200
Gtech	AirRam	Upright	£230	100
Morphy	Richards 732000	Upright	£70	100
Bissell	2562E Featherweight	Upright	£40	140
Dyson	Dyson DC40	Upright	£265	700
NUMATIC	HVR200-12	Cylinder	£100	620
Miele Complete	C3 PowerLine Bagged	Cylinder	£140	1600
Zanussi	ZAN3002EL	Cylinder	£35	1400
Bosch	BGS5SIL2GB	Cylinder	£130	700
Vax	Air Compact - Pet C88-AM	Cylinder	£200	800

Sample taken from the current most popular vacuums on Amazon.co.uk

Repair & Maintenance

Fixed Price Repair Charges (Out of 12 month guarantee period): Products up to 10 years old £119 incl. vat inclusive of labour and free parts (Hoover 2016)

It is therefore suggested that for this project the figure of 20% is used for the number of cleaners ever taken for repair in their lifespan (Consumer Research 2006)

Model: 20% probability that during the lifetime of vacuum a £120 repair will be required (Discrete distribution)

Duration / frequency of Clean

a & b are known lab test conditions
 c & d are taken from an EU label of a Hoover
 e & f can be calculated using a, b, c and d

e is the number of kilowatts used per clean
 If a vacuum uses 700 Watts in an hour, then the duration of a household clean that uses 0.54 kWh can be calculated

$e = 27 \text{ kWh/annum} / 50 \text{ cleans}$
 $f = (540 \text{ W} / 700 \text{ W}) \times 60 \text{ minutes} = 46 \text{ minutes}$

	a	b	c	d	$e = c / a$	$f = (e / (d / 1000)) \times 60$
	Cleans per year	m ²	kWh / annum	Watts	kWh / Clean	Duration of clean
EU	50	87	27	700	0.54	46.29

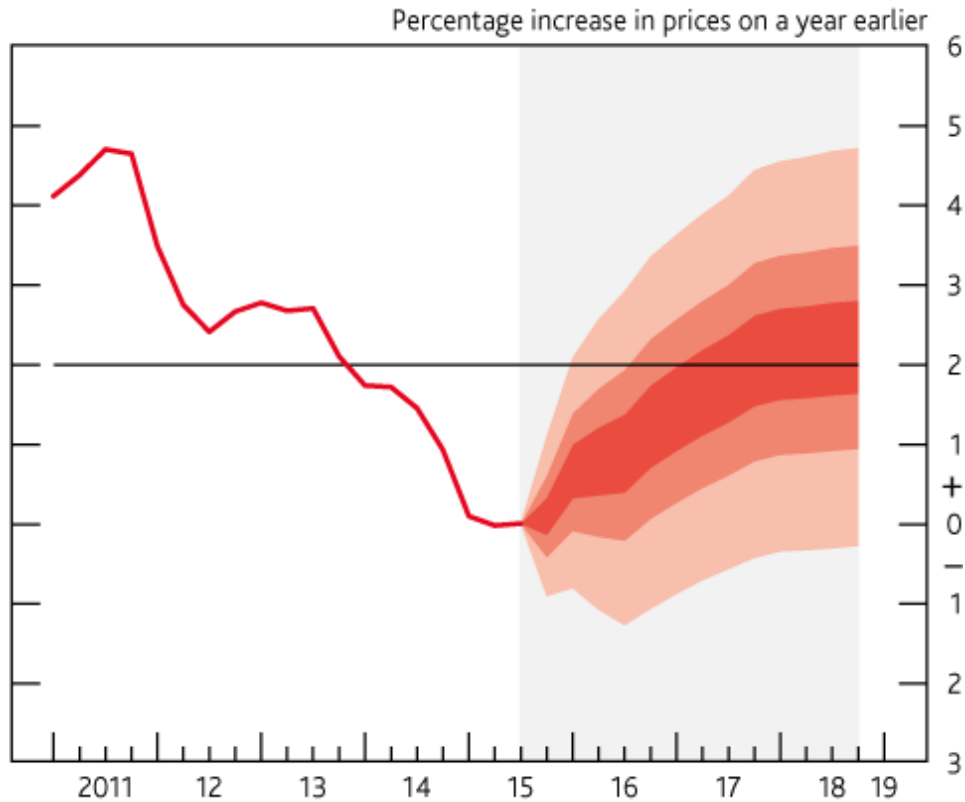
So knowing all that we can adjust the calculations proportional to the reduction in surface area

	a	g	$h = (g / b) \times c$	d	$i = h / a$	$j = (i / (d / 1000)) \times 60$
	Cleans per year	m ²	kWh / annum	Watts	kWh / Clean	Duration of clean
SCAF	50	76	23.59	700	0.47	40.43

Given the EU assumes 50 cleans per year as an average, model uses a minimum of 12, a maximum of 100 and 50 as a most likely.

'If people who had a poor vacuum cleaner replaced it with a much more effective one we have found no evidence that they would alter their habits greatly in terms of frequency or time spent on the activity, Information that exists for consumers in terms of vacuum cleaner performance is at best confusing and sometimes misleading' EU Report

Inflation



BoE CPI forecast used for initial years.

Assume BoE achieves it's objective of 2% inflation by 2018 and will continue to do so for the remaining years

(Bank of England 2016)

Cost Model - Deterministic

			2014 market conditions			2016 market conditions			Comments
			Min	Mean	Max	Min	Mean	Max	
Retail Price			£70	£167	£390	£35	£132	£265	Taken from Test Samples 10% adjustment
Depreciation/appreciation (2015 prices)			£63	£150	£351	£39	£147	£294	
Electricity	KW/hr		£0.15	£0.15	£0.15	£0.15	£0.15	£0.15	
Duration	mins		40.43	40.43	40.43	40.43	40.43	40.43	
Number	per year		12	50	100	12	50	100	
Watts			700	1,680	2,400	100	805	1,600	Taken from Test Samples
kW			5.66	56.61	161.73	0.81	27.12	107.82	Energy used per year
			£0.83	£8.29	£23.69	£0.12	£3.97	£15.80	Energy Cost per year (year 1)
	CPI								
2016	0.0%	0.0%	£0.83	£8.29	£23.69	£0.12	£3.97	£15.80	
2017	1.0%	1.0%	£0.84	£8.38	£23.93	£0.12	£4.01	£15.95	
2018	2.0%	3.0%	£0.85	£8.54	£24.41	£0.12	£4.09	£16.27	
2019	2.0%	5.1%	£0.87	£8.71	£24.90	£0.12	£4.18	£16.60	
2020	2.0%	7.2%	£0.89	£8.89	£25.40	£0.13	£4.26	£16.93	
2021	2.0%	9.3%	£0.91	£9.07	£25.90	£0.13	£4.34	£17.27	
2022	2.0%	11.5%	£0.92	£9.25	£26.42	£0.13	£4.43	£17.61	
2023	2.0%	13.7%	£0.94	£9.43	£26.95	£0.13	£4.52	£17.97	
2024	2.0%	16.0%	£0.96	£9.62	£27.49	£0.14	£4.61	£18.33	
2025	2.0%	18.3%	£0.98	£9.81	£28.04	£0.14	£4.70	£18.69	
			<u>£9.00</u>	<u>£90.00</u>	<u>£257.13</u>	<u>£1.29</u>	<u>£43.12</u>	<u>£171.42</u>	Energy cost x10 year life
			<u>£72.00</u>	<u>£239.85</u>	<u>£608.13</u>	<u>£40.17</u>	<u>£189.70</u>	<u>£465.87</u>	Plus Retail Price
			<u>£72.00</u>	<u>£263.85</u>	<u>£728.13</u>	<u>£40.17</u>	<u>£213.70</u>	<u>£585.87</u>	Plus R&M

kW savings		
Min	Mean	Max
49	295	539
% Reduction		
86%	52%	33%

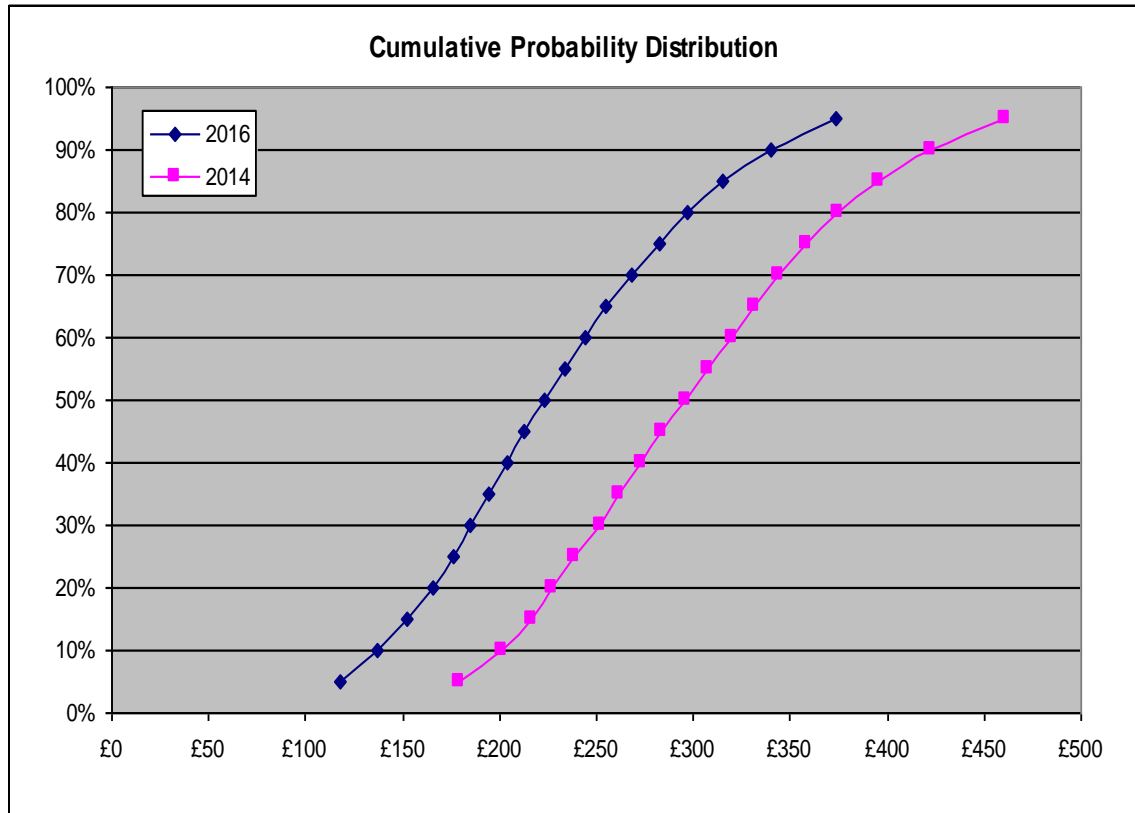
£ Savings		
Min	Mean	Max
£31.83	£50.15	£142.27
% Reduction		
44%	19%	20%

Cost Model - Probabilistic

Retail Price	@risk		£188	£160	RiskTriag
R&M	@risk		£24	£24	RiskDiscrete : ({0.8,0.2},{0,120})
Number	@risk		54	54	RiskTriag
Watts	@risk		1,593	835	RiskTriag
kWhr			58	30	
Electricity		KWhr	£0.15	£0.15	
			<u>£8.49</u>	<u>£4.45</u>	Energy Cost per year (year 1)
	CPI				
2016	0.0%	0.0%	£8.49	£4.45	
2017	1.0%	1.0%	£8.58	£4.50	
2018	2.0%	3.0%	£8.75	£4.59	
2019	2.0%	5.1%	£8.93	£4.68	
2020	2.0%	7.2%	£9.10	£4.77	
2021	2.0%	9.3%	£9.29	£4.87	
2022	2.0%	11.5%	£9.47	£4.96	
2023	2.0%	13.7%	£9.66	£5.06	
2024	2.0%	16.0%	£9.85	£5.16	
2025	2.0%	18.3%	£10.05	£5.27	
			<u>£92.18</u>	<u>£48.31</u>	Energy cost x10 year life
			<u>£280.13</u>	<u>£208.28</u>	Plus Retail Price
			<u>£304.13</u>	<u>£232.28</u>	Plus R&M

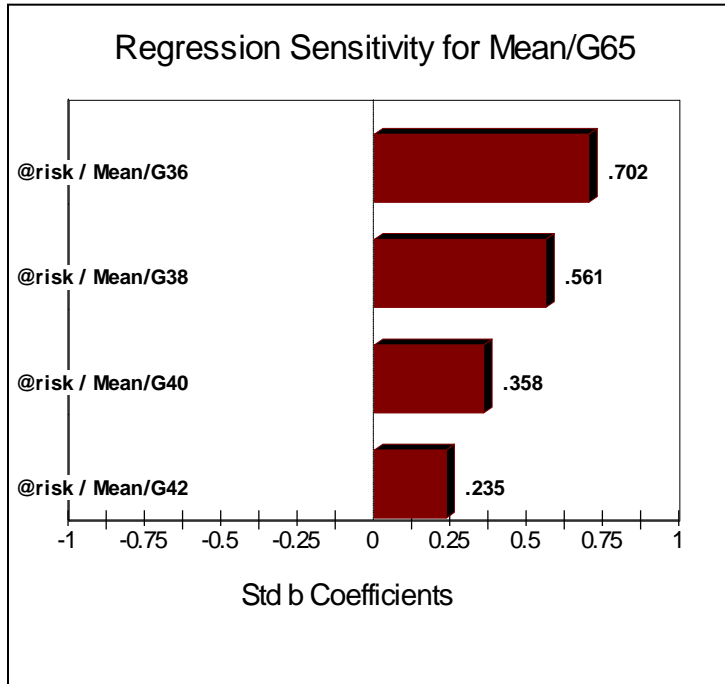
Cost Model - Probabilistic

%tile	2016	2014
5%	£118.22	£178.81
10%	£137.41	£200.72
15%	£152.53	£216.52
20%	£165.33	£226.78
25%	£176.21	£238.86
30%	£185.04	£251.50
35%	£194.29	£261.92
40%	£203.97	£272.66
45%	£213.12	£283.70
50%	£223.66	£295.52
55%	£233.75	£307.69
60%	£244.21	£319.53
65%	£255.11	£331.71
70%	£268.58	£343.70
75%	£282.76	£357.90
80%	£296.75	£374.47
85%	£314.99	£396.02
90%	£340.29	£421.96
95%	£373.32	£460.56



Cost Model - Probabilistic

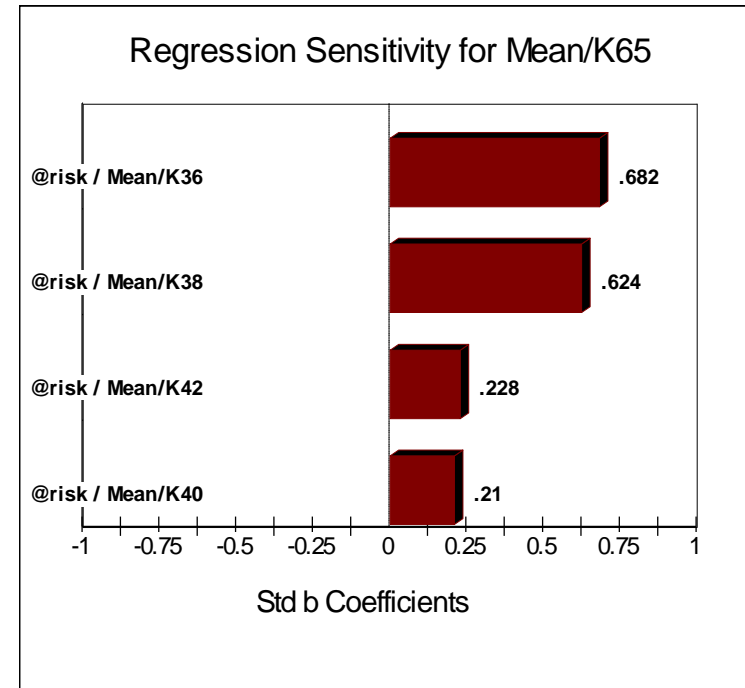
2014



Line 36 : Retail Price

Line 38: R&M

2016



Line 40 : Number of cleans

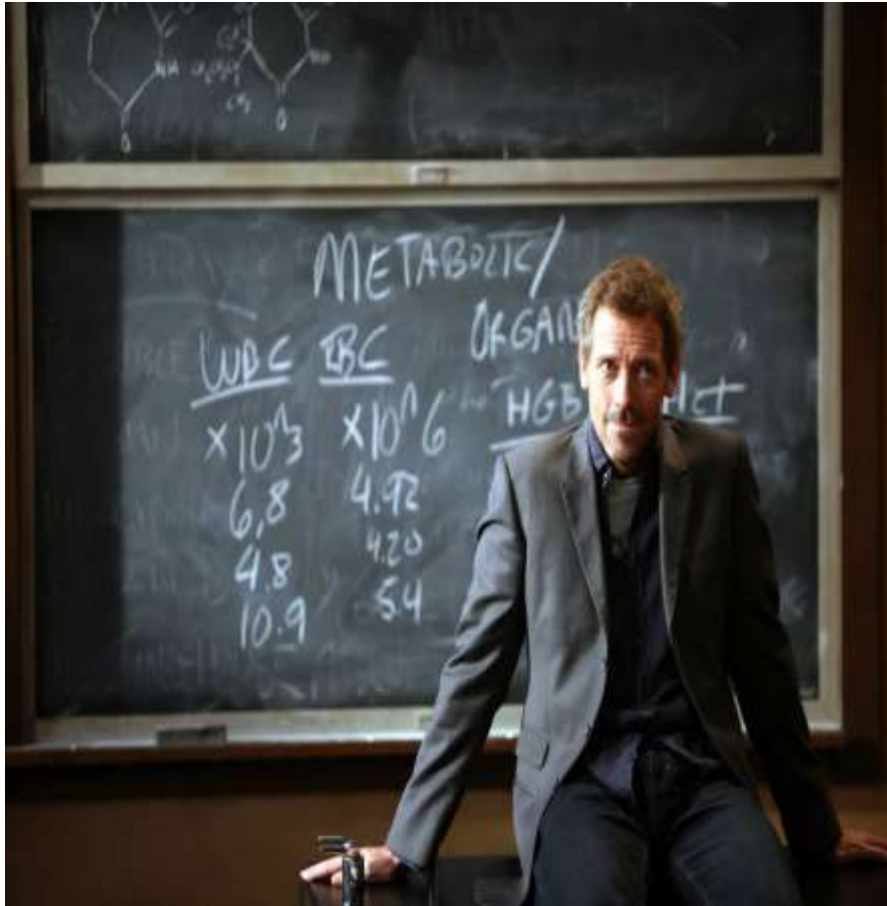
Line 42: Watts

Summary

The 2016 vacuum cleaner market is cheaper and more efficient than the 2014 market!

- Consumers will on average save around £50 due to reductions in power consumption
- The most important factor in the lifetime cost of a vacuum is the retail price, which in terms of the min/max of the market has fallen since 2014.
- This may not be a direct result of EU market intervention and could be a result of other supply-side (e.g. reduced cost of materials) or demand-side factors (e.g. reduction in real wages).
- It is not possible to tell if vacuum cleaners have improved (in terms of cleaning performance) as no consistent performance metrics were available prior to the introduction of the reforms.

Lessons Learned



In the words of Dr House
**‘Work smart - not
long’**

References

1. Consumer Research Associates (2006) Work on Preparatory Studies for Eco-Design Requirements of Eups – Vacuum Cleaners
2. Daily Telegraph (2014) 10 Best Sellers of Amazon.co.uk
3. Amazon.co.uk (2016) Current most popular vacuums
4. <http://service.hoover.co.uk/repair-terms/>
5. <http://www.bankofengland.co.uk/publications/Pages/inflationreport/2016/feb>



Questions?



CONSTRUCTIVE EXPERTISE