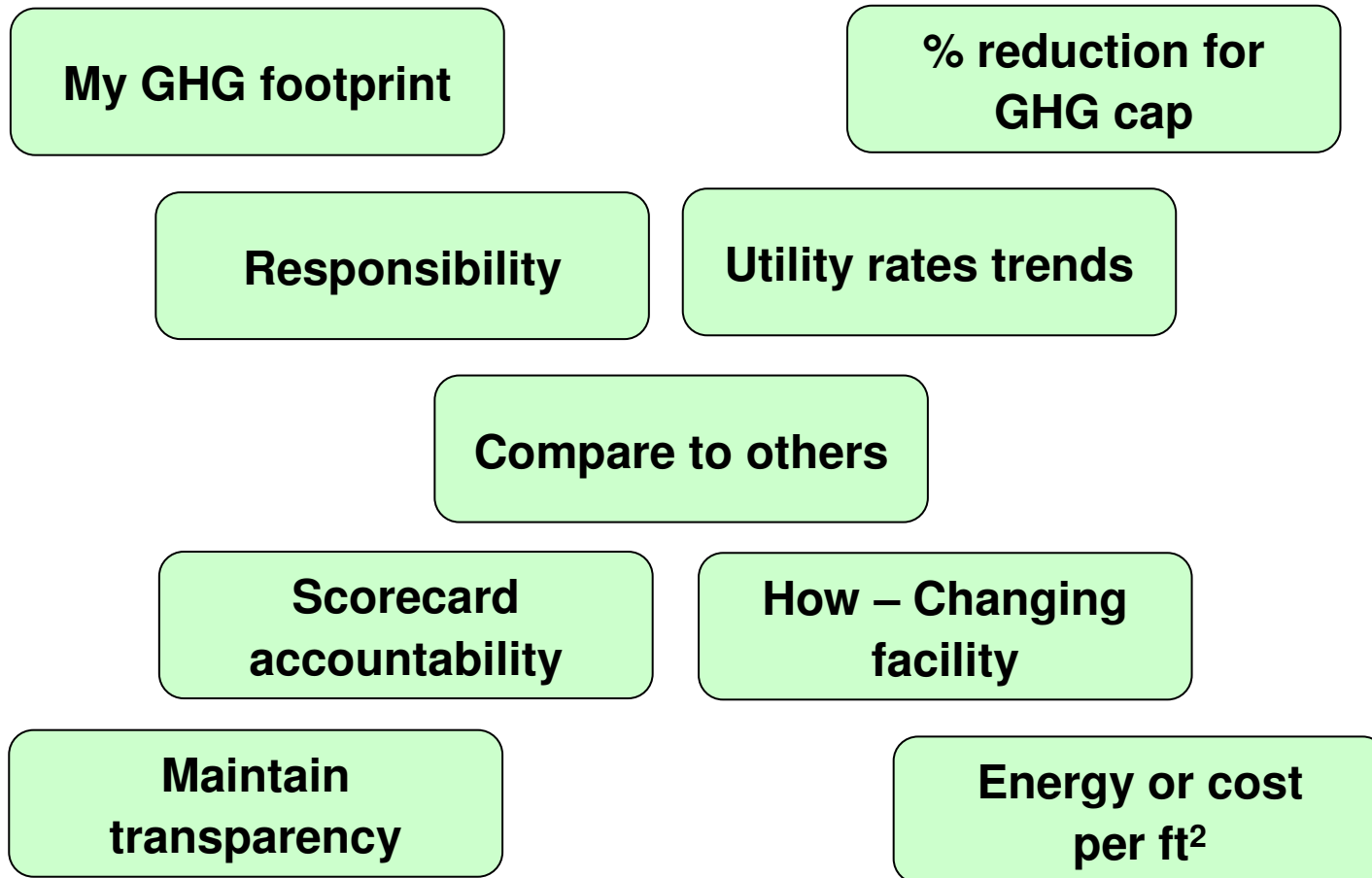


Seven Practical Steps for Benchmarking

**Vivian Lee-Grasby, P.Eng.
November 3, 2010**

Honeywell

Why Benchmarking





7 Practical Steps to Benchmarking

Benchmarking

Step 1: Choose Boundary



Benchmarking – Boundary

Organization

- Multiple facilities
- Facilities to include
- Consider ownership
- Consider administration
- Reporting guidelines

Facility

- Facility grouping
- Facility type

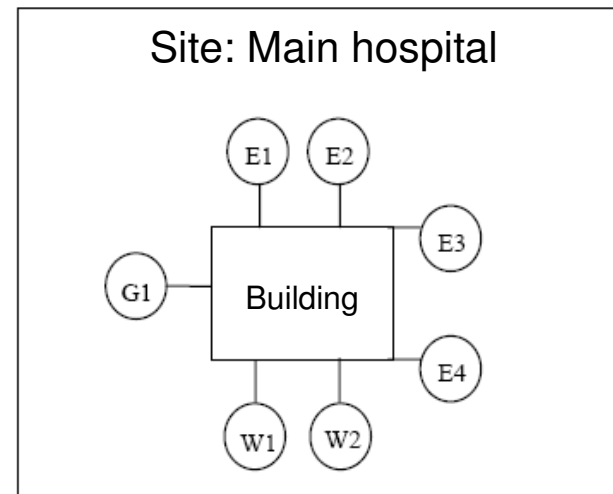
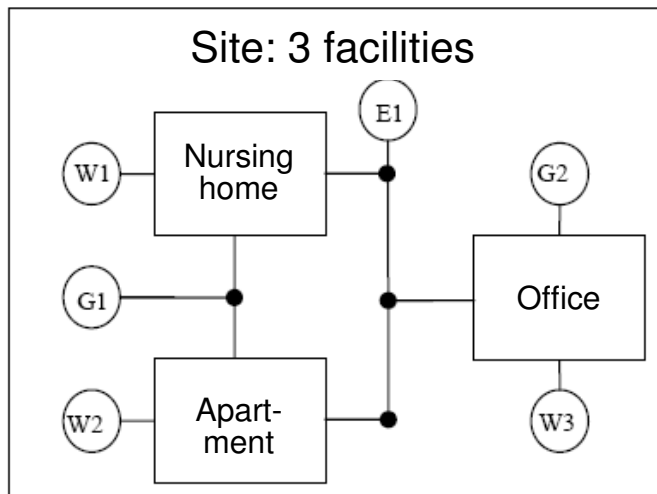
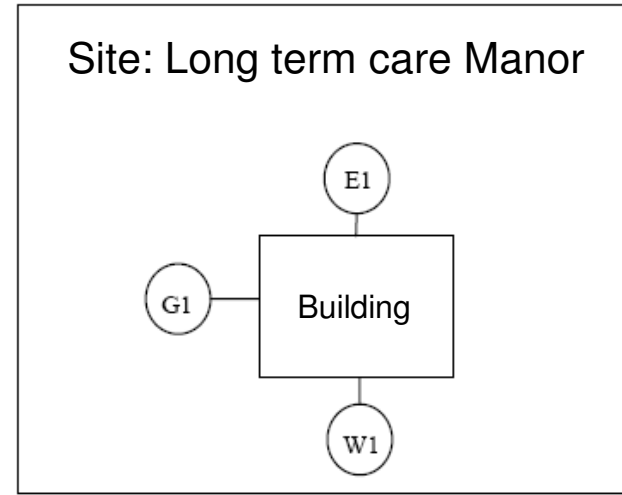
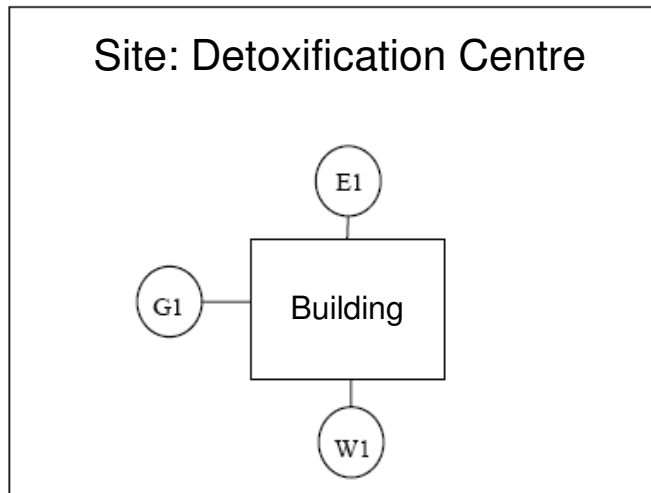
Meter

- Multiple meters
- Separate or blend
- Load type

System

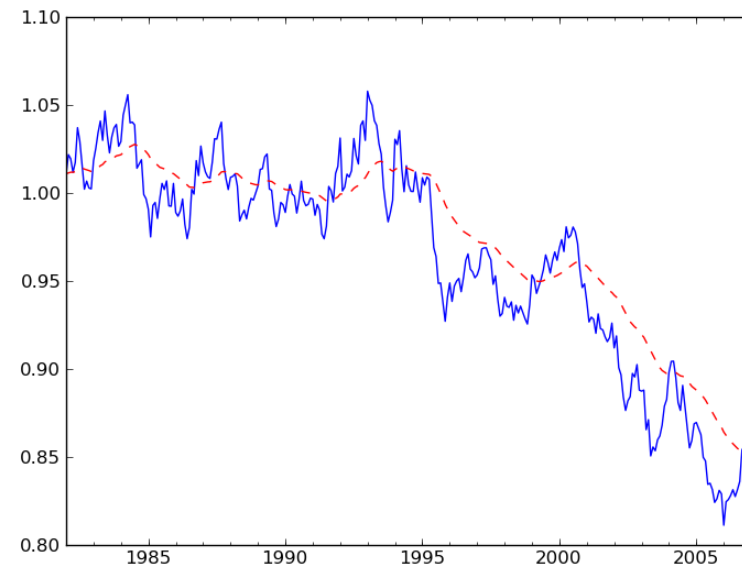
- Chiller plant
- Boiler plant
- Consider cost

Benchmarking – Boundary



Benchmarking

- Step
1: Choose Boundary
2: Gather Data



Benchmarking – Data

Gather Utility data

Historique de consommation					
Période du	au	Nombre de jours	Volume (m ³)	Taux* (¢/m ³)	Montant* (\$)
11 DE 2006	15 JA 2007	35	20 072 R	52,837	10 605,37
15 JA 2007	12 FE 2007	28	31 211 R	50,976	15 910,01
12 FE 2007	13 MR 2007	29	33 298 R	51,446	17 130,62
13 MR 2007	12 AC 2007	30	20 137 R	54,169	10 907,92
12 AL 2007	10 MA 2007	28	3 612 R	59,660	2 154,93
10 MA 2007	12 JN 2007	30	251 R	71,789	187,37
12 JN 2007	12 JL 2007	30	360 R	70,006	252,02
12 JL 2007	13 AU 2007	32	177 R	71,452	126,47
13 AU 2007	11 SE 2007	29	247 R	67,183	300,31
11 SE 2007	11 OCT 2007	30	344 R	67,756	233,08
11 OC 2007	09 NO 2007	29	3 323 R	57,501	1 910,76
09 NO 2007	10 DE 2007	31	19 232 R	51,638	9 931,10
10 DE 2007	15 JA 2008	36	40 581 R	49,900	20 250,03
Total de l'année courante					
15 JA 2007	15 JA 2008	365	152 983	51,832	79 294,62
Total de l'année précédente					
12 JA 2006	15 JA 2007	368	79 495	57,098	45 390,37

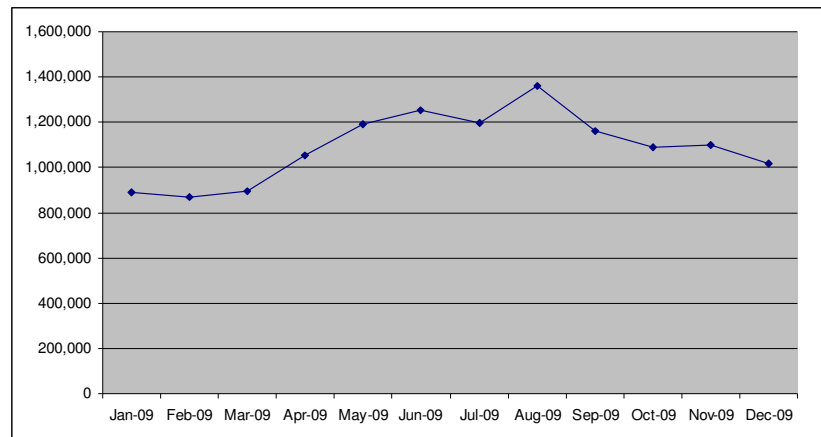
E = Relevé estimé C = Relevé du client R = Relevé réel
* Taxes incluses

Calcul du montant à payer		
Détails du solde précédent		
Solde facture précédente - émise le 13 DE 2007		Montant(s) dû(s) 9 931,10 \$
Paiement reçu le 27 DE 2007 - Merci		9 931,10 \$ CR
Solde précédent		0,00 \$
Détails du montant courant		
Montant facturé pour la période du 10 DE 2007 au 15 JA 2008		
Volume facturé: 40 581 m ³ (voir verso)	17 940,23 \$	
TPS (Gaz Métro n° 121411813)	897,01 \$	
TVQ (Gaz Métro n° 1010997280)	1 412,79 \$	
Total	20 250,03 \$	20 250,03 \$
Autres montants facturés		
Contribution Fonds vert (0,261 ¢/m ³)	105,92 \$	
TPS (Gaz Métro n° 121411813)	5,30 \$	
TVQ (Gaz Métro n° 1010997280)	8,34 \$	
Total	119,56 \$	119,56 \$
Information sur les taxes		
TPS Gaz Métro	902,31 \$	
TVQ Gaz Métro	1 421,13 \$	

Benchmarking – Data

Organize Utility data

Billing Read Date	Days	Consum. kWh	Demand kW	Demand rkVA	PFact %	Consum. \$
31-Jan-09	31	891,987	2,242	2,320	97%	\$83,771.56
28-Feb-09	28	868,457	2,009	2,082	96%	\$69,127.91
31-Mar-09	31	896,273	2,188	2,268	96%	\$12,210.77
30-Apr-09	30	1,054,412	2,185	2,285	96%	\$86,609.23
31-May-09	31	1,189,380	2,662	2,792	95%	\$122,828.80
30-Jun-09	30	1,250,737	2,647	2,788	95%	\$107,391.01
31-Jul-09	31	1,198,178	2,665	2,801	95%	\$123,106.09
31-Aug-09	31	1,357,496	3,027	3,204	94%	\$156,039.58
30-Sep-09	30	1,161,963	2,580	2,723	95%	\$114,785.28
31-Oct-09	31	1,090,467	2,339	2,454	95%	\$112,277.63
30-Nov-09	30	1,100,764	2,221	2,300	97%	\$99,625.30
31-Dec-09	31	1,017,425	2,185	2,262	97%	\$111,391.23
31-Jan-10	31	1,084,459	2,222	2,289	97%	\$106,838.75
28-Feb-10	28	942,663	1,999	2,068	97%	\$95,126.44
31-Mar-10	31	1,019,002	2,192	2,267	97%	\$136,177.99
30-Apr-10	30	1,094,966	2,192	2,276	96%	\$118,258.76
31-May-10	31	1,295,356	2,850	3,000	95%	\$140,294.50
30-Jun-10	30	1,317,601	2,788	2,925	95%	\$121,885.72
31-Jul-10	31	1,689,829	2,788	2,925	95%	\$204,406.28



Watch out for strange peaks

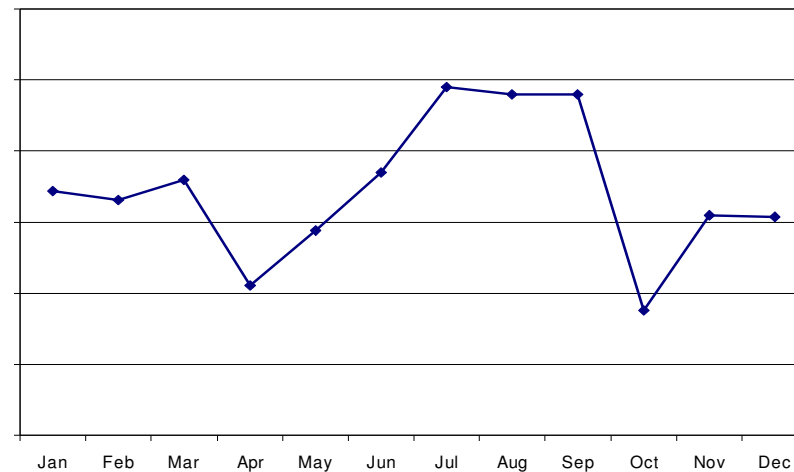
Benchmarking

Step

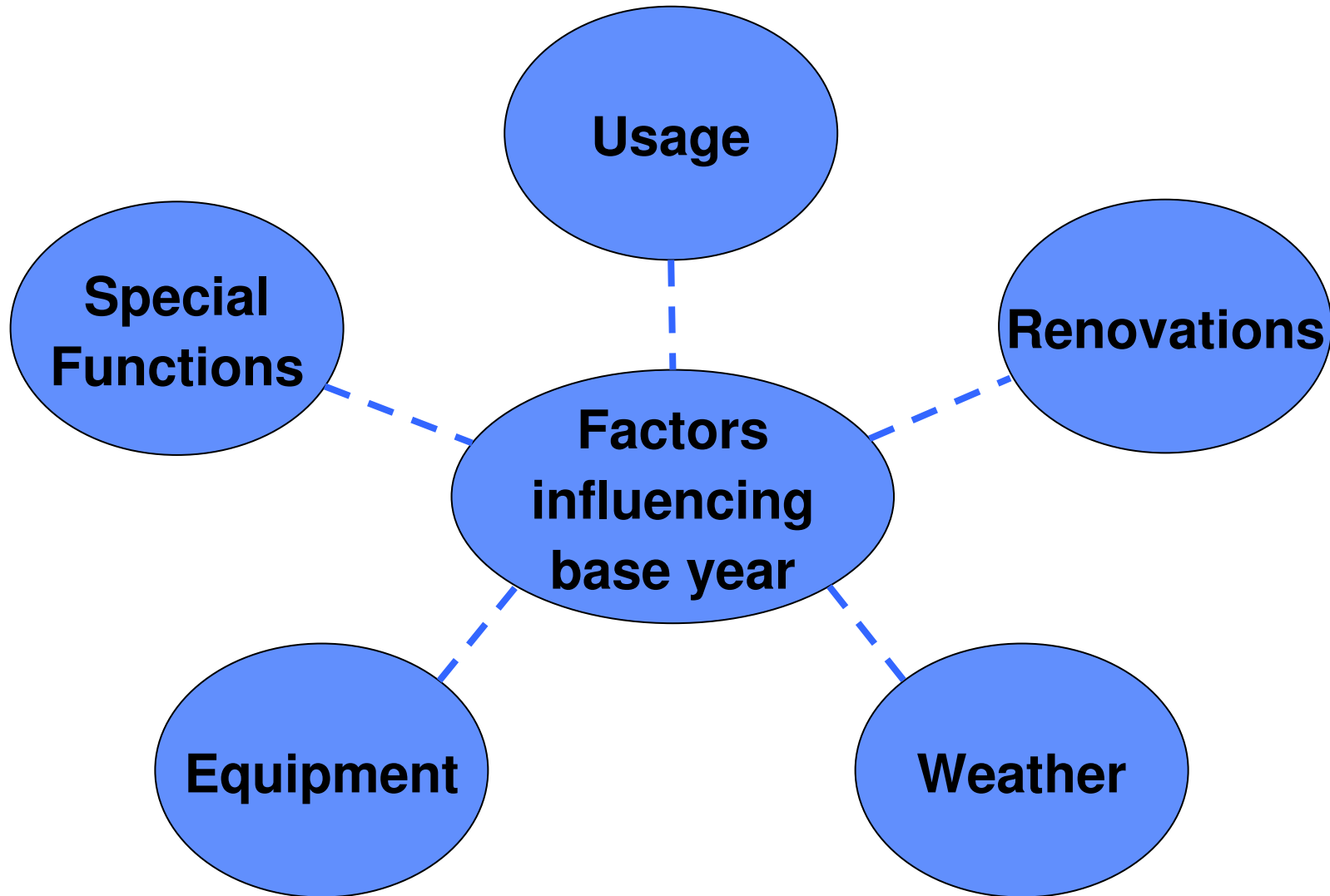
1: Choose Boundary

2: Gather Data

3: Select Base Year



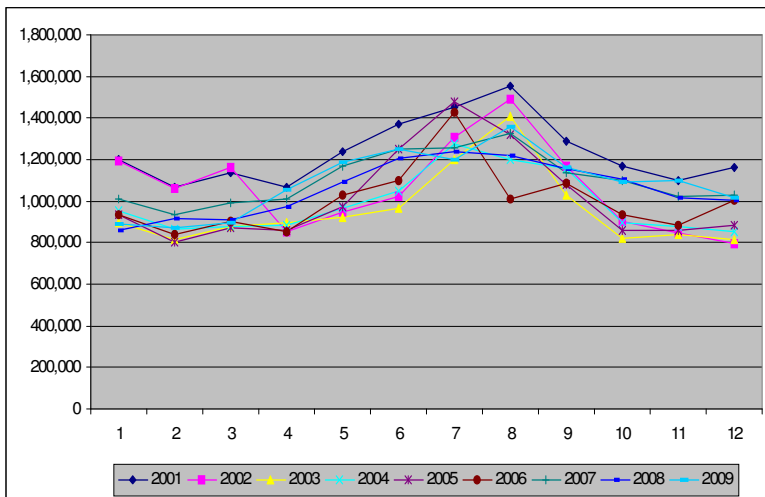
Benchmarking – Base Year



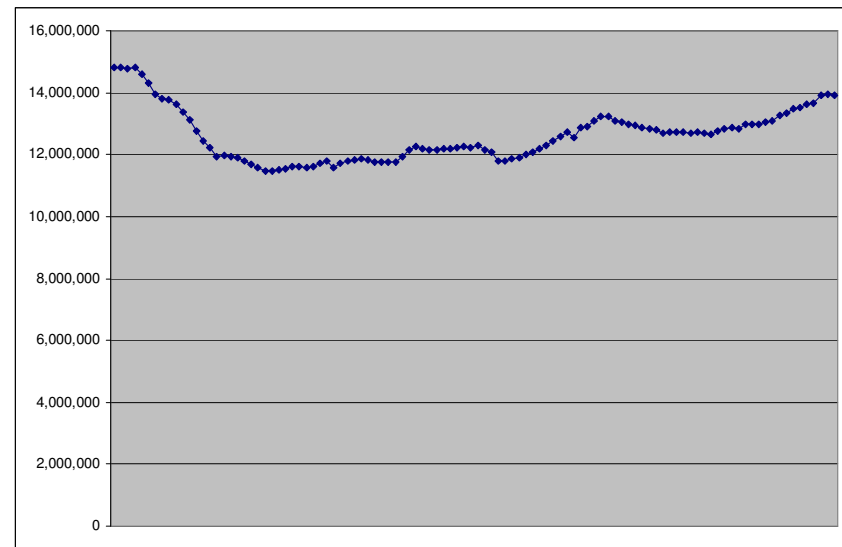
Benchmarking – Base Year

- 2 visuals to assist with base year selection

Overlay trending



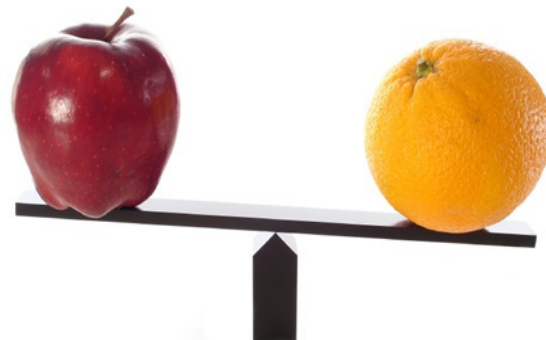
12 month rolling sum



Benchmarking

Step

- 1: Choose Boundary
- 2: Gather Data
- 3: Select Base Year
- 4: Pick Comparison Unit



Benchmarking – Comparison Unit

Organization or Facility

- \$ per square foot
- GJ per square foot
- \$ or GJ per patient
- m³ water per square foot

Meter or System

- kW per ton (chiller)
- GJ per btu (boiler)
- GJ per lb of steam
- GJ per lb of laundry
- GJ per meal
- m³ water per lb of laundry

Know What You Need

Benchmarking

Step

- 1: Choose Boundary
- 2: Gather Data
- 3: Select Base Year
- 4: Pick Comparison Unit
- 5: Compare Against Others



Benchmarking – Compare

1. Categorize facility
2. Gather data for similar facilities
3. Note outliers
4. Plot

Benchmarking – Compare

1. Categorize facility

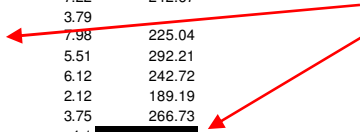
- Facility type
 - Healthcare
- Services
 - Hospital
 - Clinic
 - Long term care
- Age
- Size
- Patients
- Geographical location

Benchmarking – Compare

2. Gather data for similar facilities

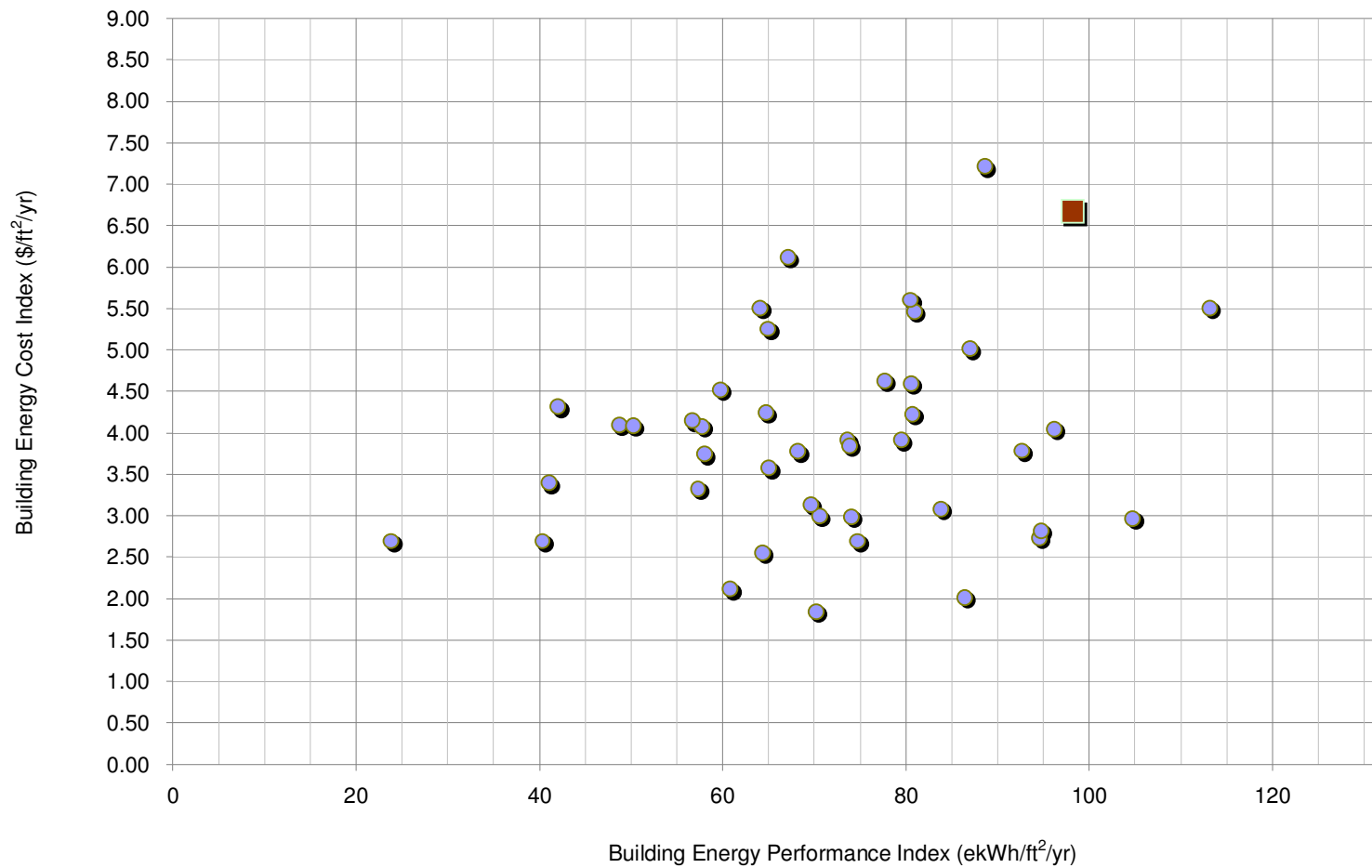
Building	Province	Area sf	ekWh/sf	\$/sf	L/sqft
Facility 1	On	43,000	74.7	2.7	119.54
Facility 2	On	45,617	23.79	2.02	
Facility 3	On	65,000	40.29	2.56	
Facility 4	On	70,000	86.39	3.09	211.3
Facility 5	On	70,000	64.32	4.05	158.79
Facility 6	On	72,000	83.79	5.47	459.64
Facility 7	On	90,023	96.15	4.6	107.85
Facility 8	On	91,025	80.89	2.74	291.73
Facility 9	On	91,215	80.53	4.53	207.75
Facility 10	On	93,000	94.53	5.51	313.44
Facility 11	On	96,000	59.71	1.85	153.81
Facility 12	On	103,000	113.13	7.22	242.67
Facility 13	On	106,185	70.16	3.79	
Facility 14	On	122,000		7.98	225.04
Facility 15	On	125,000	88.57	5.51	292.21
Facility 16	On	130,000	92.61	6.12	242.72
Facility 17	On	140,000	64.05	2.12	189.19
Facility 18	On	141,700	67.09	3.75	266.73
Facility 19	On	143,000	60.79	4.1	
Facility 20	On	150,000	58	2.99	
Facility 21	On	167,000	48.66	2.97	265.17
Facility 22	On	195,000	74.01	5.02	189.74
Facility 23	On	202,989	104.71	3.78	421.12
Facility 24	On	247,232	86.96	4.63	457.72
Facility 25	On	275,000	68.18	3.58	199.92
Facility 26	On	300,000		3.59	
Facility 27	On	368,000	77.63	4.09	332.9
Facility 28	On	375,000	65.02	4.08	303.05
Facility 29	On	380,000	50.21	2.82	328.96
Facility 30	On	380,990	57.71	3.33	251.83
Facility 31	On	382,000	94.67	4.23	243.32
Facility 32	On	425,844	57.27	3	215.85
Facility 33	On	434,486	80.66	5.61	
Facility 34	On	446,000	70.5	4.15	448.44
Facility 35	On	452,000	80.44	5.26	422.48
Facility 36	On	460,000	56.63	3.14	278.05
Facility 37	On	473,782	64.94	3.92	270.08
Facility 38	On	480,000	69.58	4.25	
Facility 39	On	529,430	79.42	3.92	342.29
Facility 40	On	563,183	64.66	3.85	347.8
Facility 41	On	648,000	73.56	3.4	356.17
Facility 42	On	707,400	73.8	4.32	260
Facility 43	On	720,000	24	2.33	260
Facility 44	On	818,154	28.2	2.22	375.04
Facility 45	On	834,562	31.44	2.69	
Facility 46	On	885,796	75.73	3.47	300.62
Facility 47	On	1,070,514	52.34	3.11	168.15
Facility 48	On	1,331,295	28.5	2.63	336.34

3. Note outliers



Benchmarking – Compare

4. Plot



Benchmarking

Step

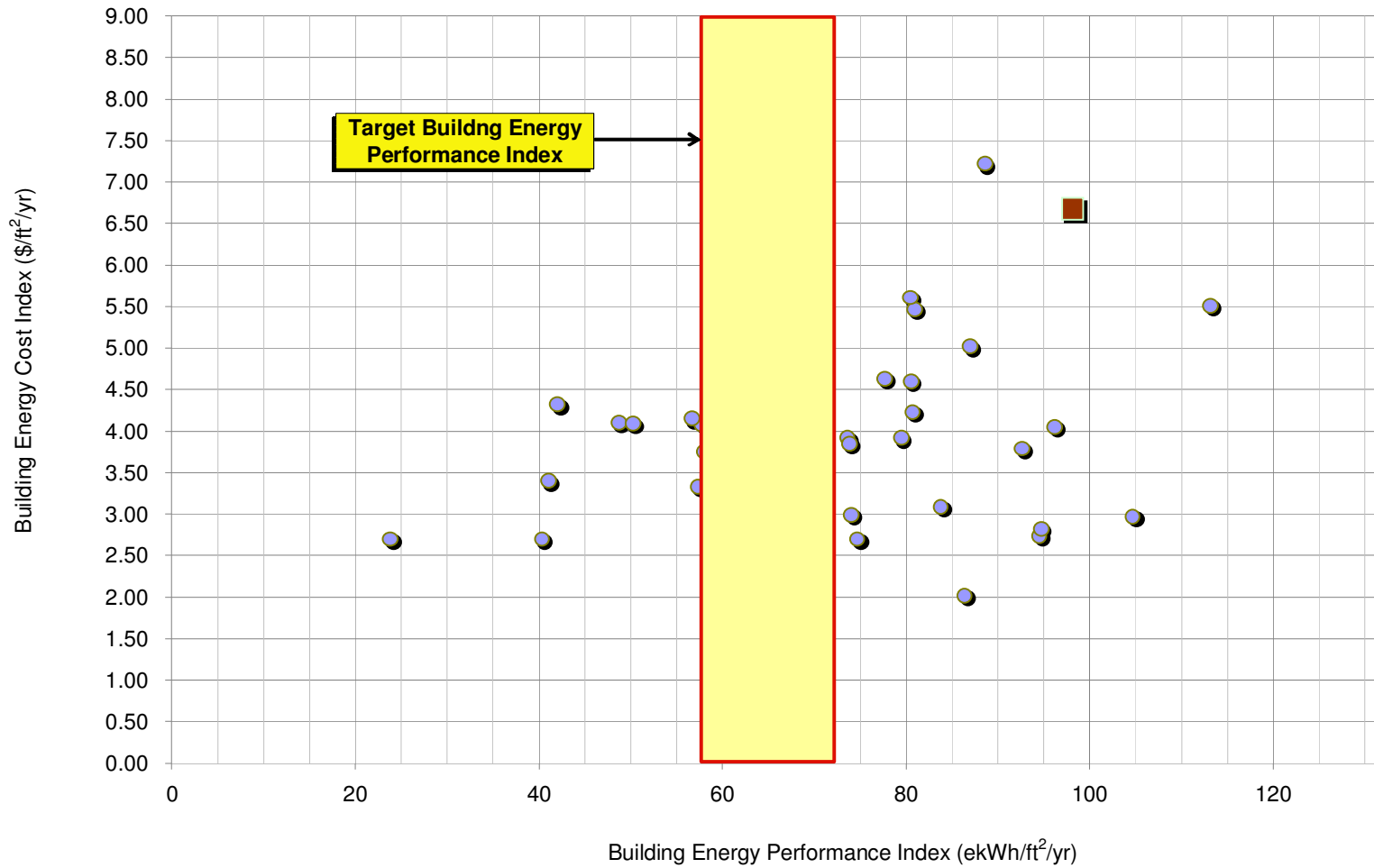
- 1: Choose Boundary
- 2: Gather Data
- 3: Select Base Year
- 4: Pick Comparison Unit
- 5: Benchmark Against Others
- 6: Set Target



Benchmarking – Target

- Base on benchmark data
- Filter out top and bottom extremes
- Study best, average, and worst
- Select sensible target
 - E.g. If results shows 90% savings, revisit

Benchmarking – Compare



Benchmarking

Step

- 1: Choose Boundary
- 2: Gather Data
- 3: Select Base Year
- 4: Pick Comparison Unit
- 5: Benchmark Against Others
- 6: Set Target
- 7: Validate Accomplishment



Benchmarking – Validate

- **Various guidelines for Measurement & Verification (M&V)**

- **IPMVP**
 - General Protocol
 - 4 Volume, addressing:
 - ◆ Energy savings (existing and new building)
 - ◆ Energy savings (renewable energy technologies)
 - ◆ Water savings
 - ◆ Indoor environmental quality

 - Website “<http://www.evo-world.org/>”

Benchmarking – Validate

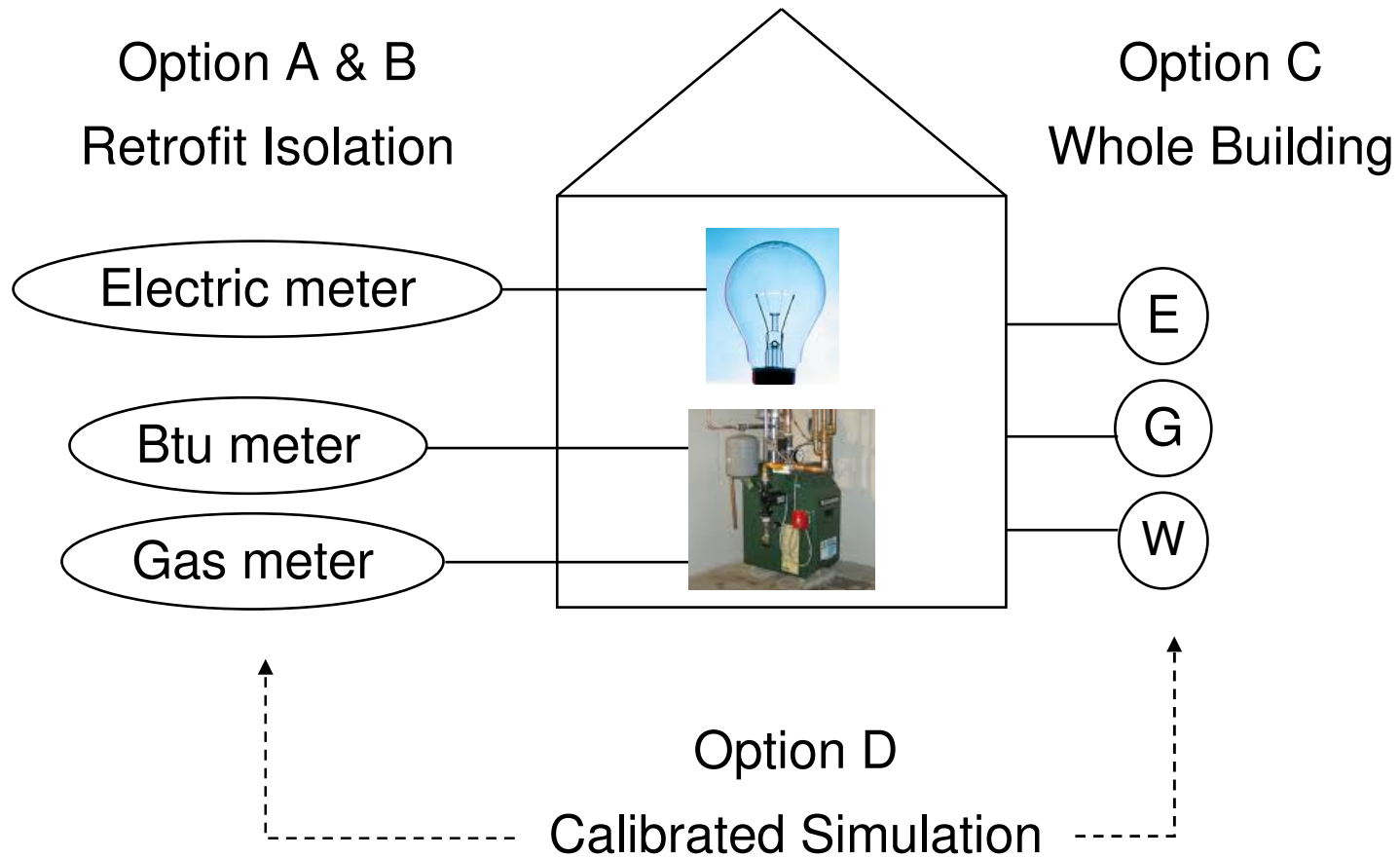
- **FEMP, September 2000**
 - Application-Specific Guideline
 - For U.S. Federal Energy Projects
 - Website “ www.eere.energy.gov/femp”
- **ASHRAE Guideline 14**
- **Air Force Guideline**
- **Army Corp of Engineers Guideline**

Benchmarking – Validate

- **4 basic options in IPMVP**
 - Option A Retrofit Isolation (key parameters measured)
 - Option B Retrofit Isolation (all parameters measured)
 - Option C Whole Building (meter base lines)
 - Option D Calibrated Simulation

Benchmarking – Validate

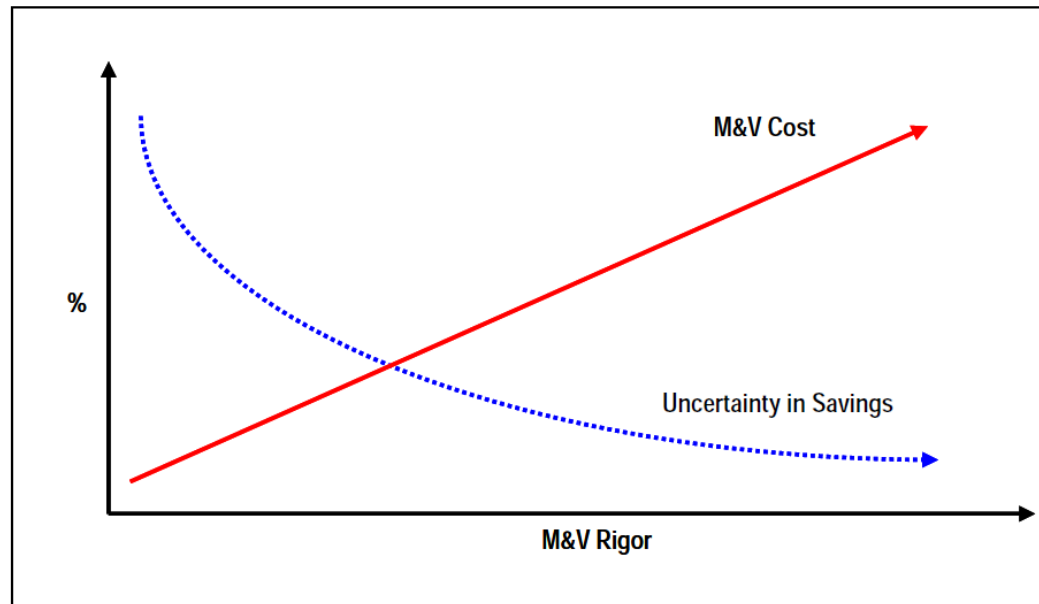
- Illustration of the 4 options



Benchmarking – Validate

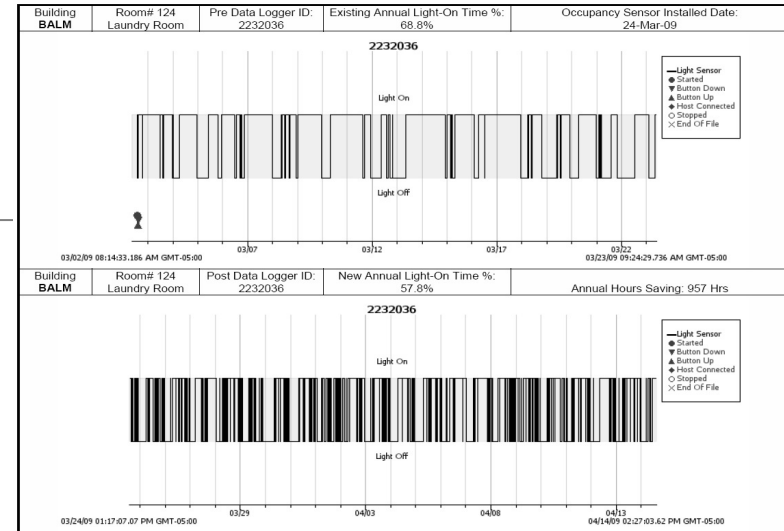
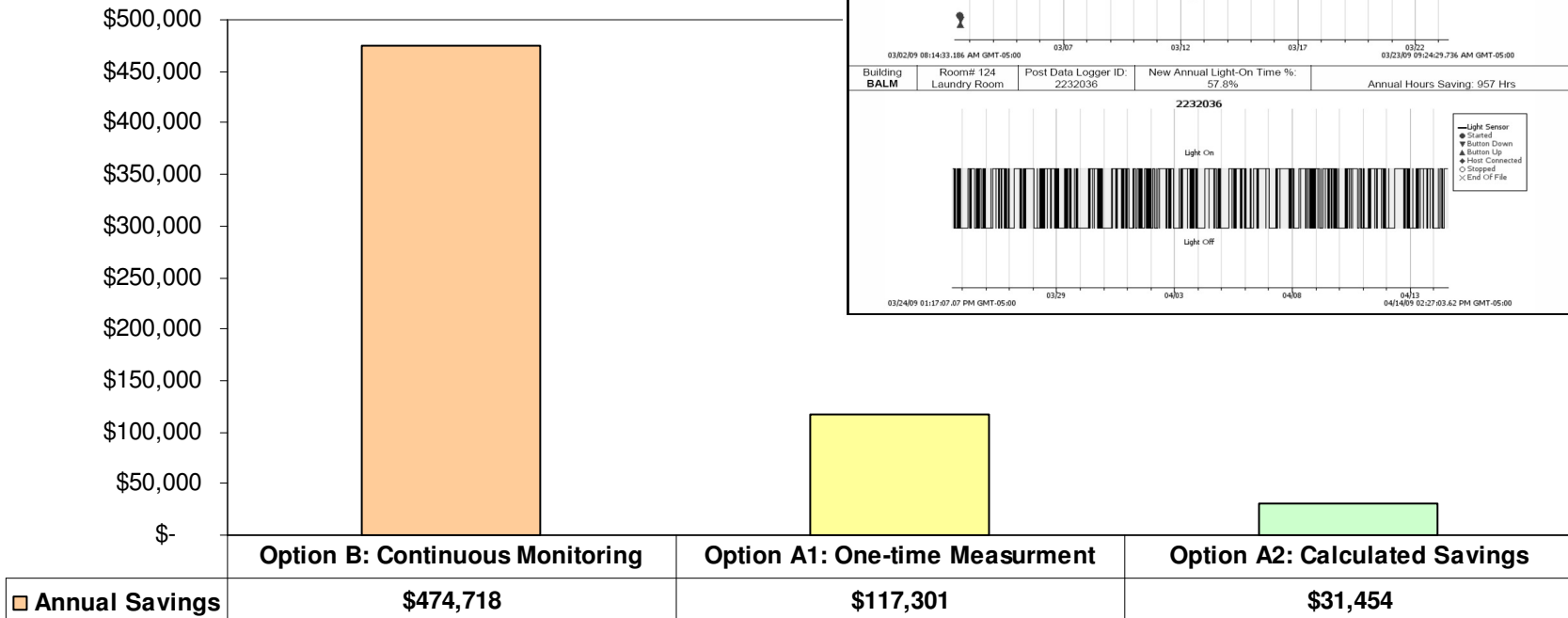
- **Not one option is always better**
- **Need to suit the energy project**
 - Technical & financial
- **More data is not necessarily better**

Figure 5-2 The Law of Diminishing Returns for M&V



Benchmarking – Validate

- Option A or B results



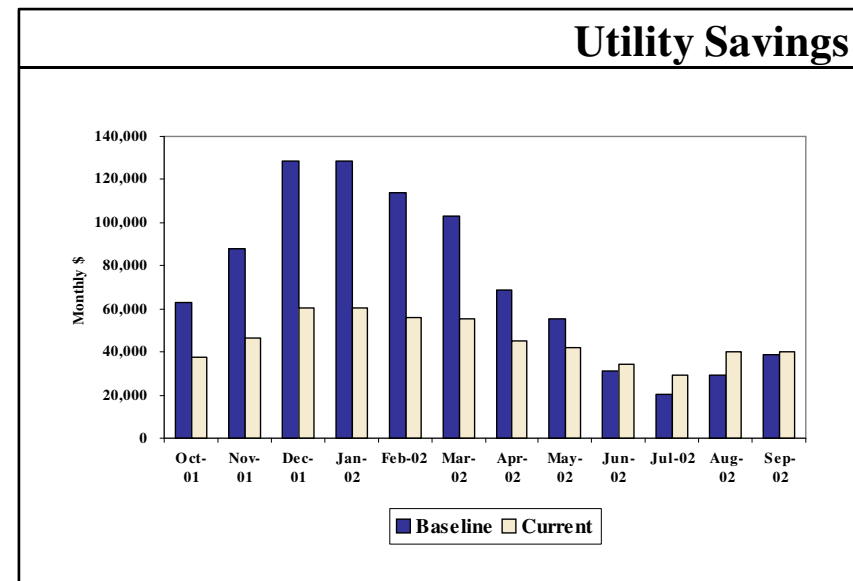
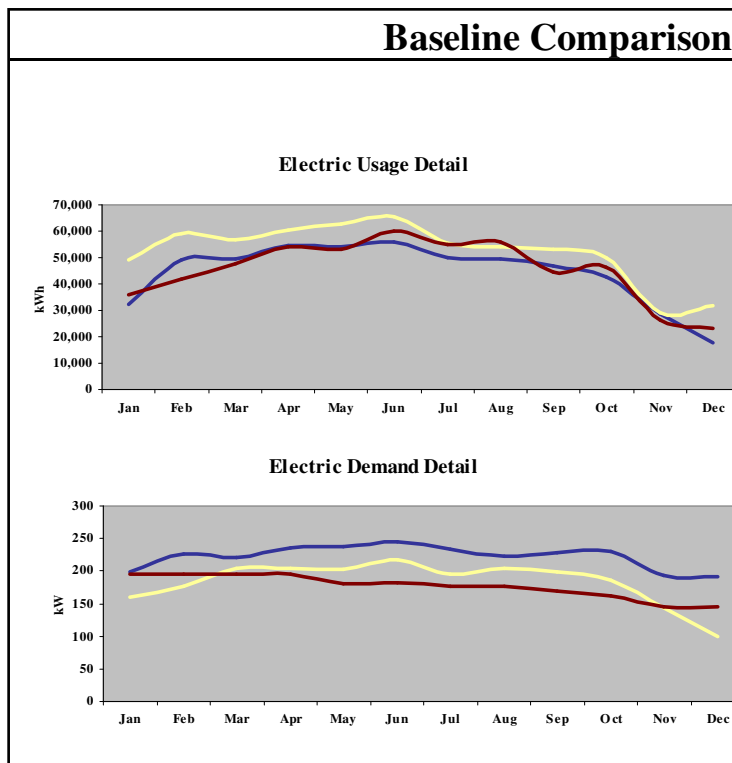
- Fan scheduling
- VSD

- Lighting
- PC control

- Steam trap
- Insulation

Benchmarking – Validate

- Option C results



Benchmarking – Validate

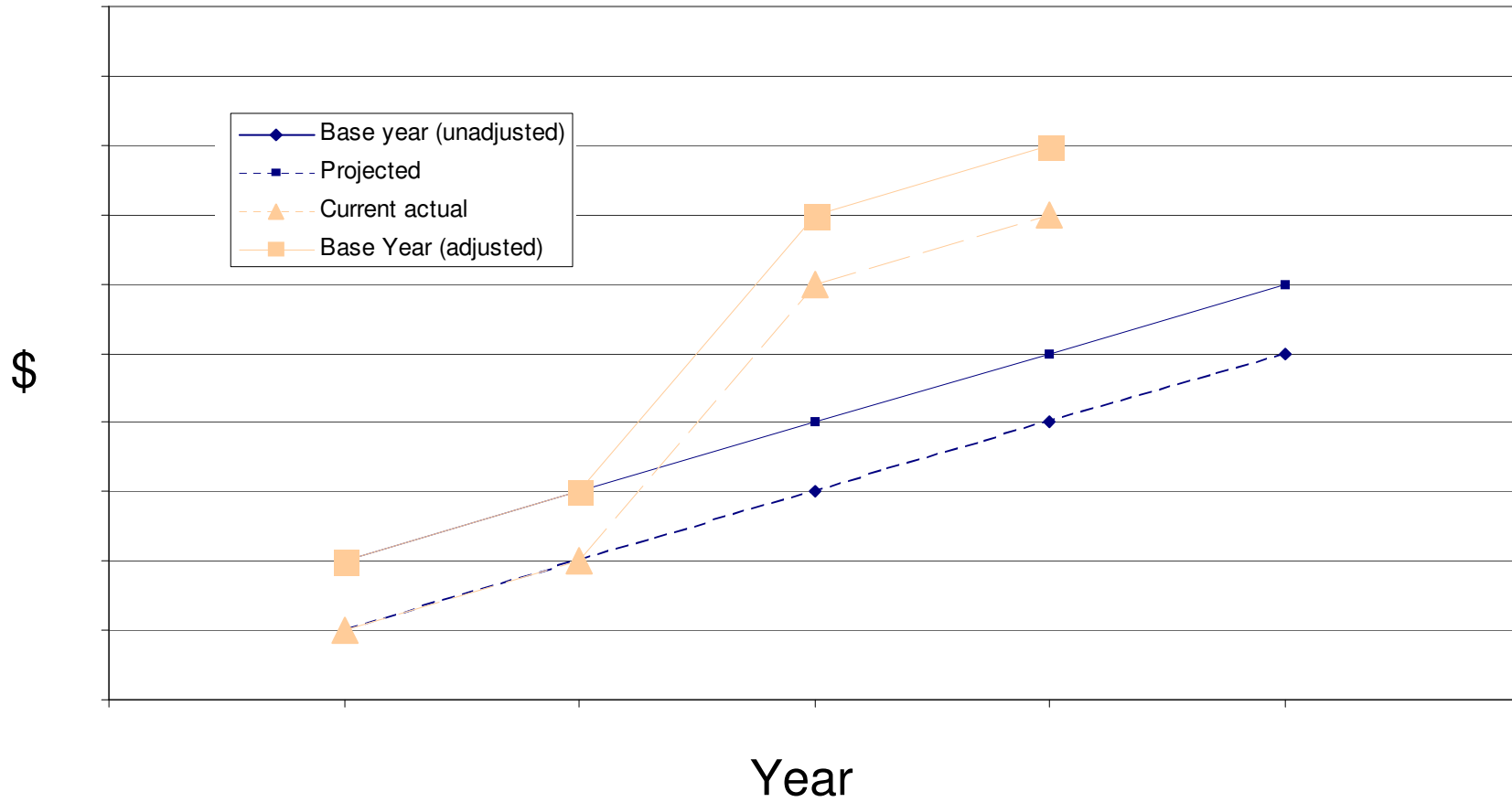


\$ today - \$ before retrofit
= Performance results

RIGHT?

- **Adjustments**
 - Rate change
 - Expansion / renovation / demolition
 - Increased meals or laundry
 - Equipment inventory change

Benchmarking – Validate



Summary



Summary for Benchmarking

- 1. Choose Boundary**
- 2. Gather Data**
- 3. Select Base Year**
- 4. Pick Comparison Unit**
- 5. Benchmark Against Others**
- 6. Set Target**
- 7. Validate Accomplishment**
 - Various method
 - Pick the suitable one
 - Adjust for changes

Summary for Benchmarking

Honeywell

Vivian Lee-Grasby

Honeywell Ltd

National Risk Manager, Energy Solutions Canada

Tel: 289-333-1381

Email: vivian.lee-grasby@honeywell.com