Installed Cost Estimating for Multifamily Energy Audits

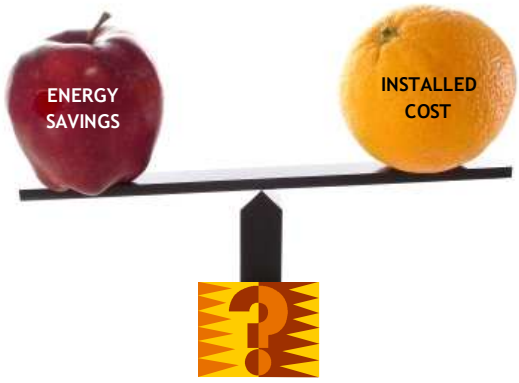
March 2012

Installed Cost *is one-half of the equations that determine the feasibility of implementing an energy conservation measure. Sometimes, the importance of installed cost is missed as we focus so much on energy savings.*

Underestimating costs can result in unforeseen costs during bidding or construction, which can jeopardize an entire project .

Overestimating can result in a premature dismissal of a measure that could have saved energy but was never considered.

Accurate estimating will result in realistic decisions that can optimize energy savings within the project budget.



Cost Estimating is One-Half of the Equation

KEY EQUATIONS

$$\text{Simple Payback (years)} = \frac{\textbf{Installed Cost}}{\text{Energy Savings per Year}}$$

Savings to Investment Ratio (SIR)

$$\text{SIR} = \frac{\text{Present Value of Energy Saving Stream}}{\textbf{Installed Cost}}$$

BEST PRACTICE

1. Estimate Accurately and Realistically
   - Start with the list of measures under consideration generated by the audit.
   - Break each measure into its components.
   - Re-check quantities before finalizing the report.
2. Stay Organized
   - Create and use spreadsheets that include clearly labeled headers and have appropriate units and multipliers. See Examples.
   - Note your sources for equipment and labor costs.
   - Group similar items together.
3. Be Consistent
   - Use the same units for similar items.
   - Use consistent multipliers and discount rates for similar items.
4. Be Inclusive
   - Include the work of all trades involved or note when such work is not included in your estimate.

The Estimating Process

WHERE TO START:

1. **IDENTIFY** each of the energy measures to be considered and break it down into its components. Note:

   QUANTITY
   SIZE OR CAPACITY
   ACCESSORIES

2. **LIST OR SKETCH** your installation. Even if a sketch is not needed, think about all the trades that may be involved in the installation of each item. Take your time in this step to think of all the work involved: omitting an element entirely at this point could have an even bigger effect on your estimate than having an inaccurate unit cost. For example, in addition to the cost of the unit, a replacement, high-efficiency rooftop air handler might require:

   ELECTRICAL Costs:

   Will electrical disconnection of the existing unit and reconnection of power to the new unit be needed?

   PLUMBING Costs:

   Will the new gas-fired unit require a gas supply?

   If the air handler includes air conditioning, will there be a plumbing connection or a roof drain for condensate drainage?

   STRUCTURAL Costs:

   Will the roof need additional structural support for the weight of the new air handler?

   How will the unit get up to the roof? Will it be assembled in pieces or will a crane be necessary?

   TEMPERATURE CONTROLS Costs:

   Will the unit be locally controlled or will it need integration with a building energy management control system?

   Sometimes estimates are broken out by trades, so if associated costs such as the ones above are included elsewhere, note these exclusions on your estimate. This will help prevent either double counting or, even worse, gaps or omissions.

3. **GATHER** your source material for pricing. Use up-to-date listings because recent material shortages can result in price spikes. Common pricing sources are:

   - RS Means Building Construction Cost Data
   - Grainger, Inc. (www.grainger.com)
   - Manufacturer representatives' quotes
   - Manufacturer's websites and/or catalogs

4. **SET UP** your spreadsheet.

   Layout:

   Spreadsheet formats can vary, but there are key elements that work to ensure that you capture all the significant direct and indirect costs. At the very least, include:

   Description. Include as much specific information as you can, including the date of the estimate.

   Quantity. Count items carefully and check that the count is up-to-date before your final submission.

   Sources: Note the source of your cost data. Include a record of the date in case the spreadsheet is re-used at a later date or for another project.

   Direct cost per item. Keep track of your source for information. Was it from a catalog, a representative's quote, an estimating manual such as RS Means?

   Installation cost, per item. This can come from published labor rates such as those found in RS Means or from experience. Again, keep a record of your source– especially if it's less firm. Include geographic adjustors to account for varying labor costs for some cities.

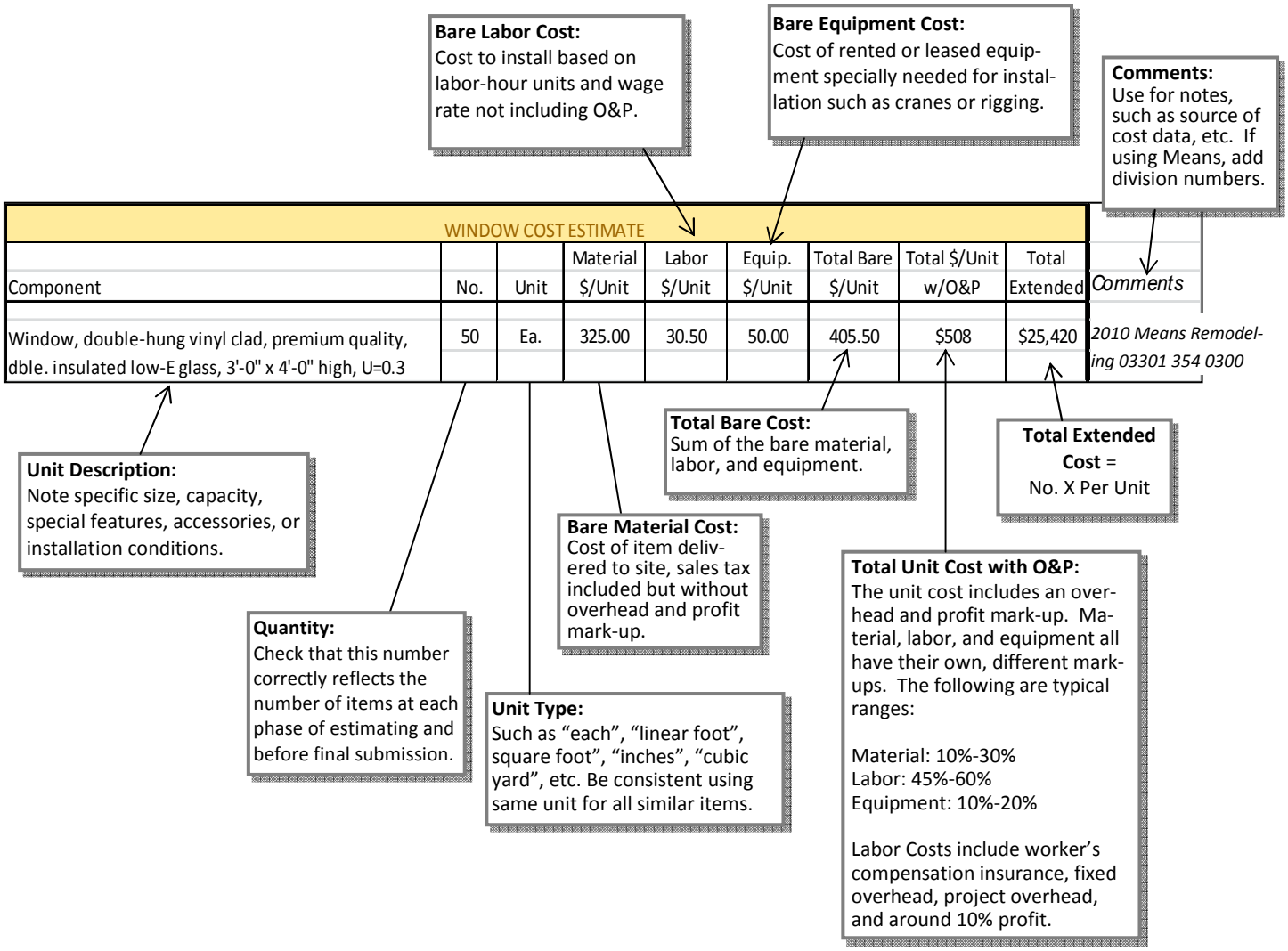
   Overhead and profit. Know what the typical mark-ups are. Mark-ups for material is fairly straight-forward, but labor mark-ups for overhead can consist of a complex combination of local rates, insurance premiums, taxes, project size, etc. Research your area.

   Accuracy:

   Check that all columns have been added correctly even if you are using computer-generated spreadsheets. Check for any missing data and for changing quantities.

The following example shows the key elements of an inclusive estimate. There is no "right" way to set up an estimate, but if you include the elements below, you are more likely to create a realistic estimate that will best inform decision making and optimize your client's budget.

Elements of a Cost Estimate



$ TIP— LIST PRICING VS. DISCOUNT PRICING

- Unit costs may be quoted as either "LIST" or "CONTRACTOR" pricing and it is essential to know which one you are working with.
- A "List Price" is typically the manufacture's suggested price that is quoted in a catalog or advertisement . A list price is often subject to a discount.
- A "Contractor Price" is the discounted price offered to a qualified contractor who generally does not pass this discount on directly to the owner or client.
- You usually apply a mark-up to a Contractor Price or any other kind of discounted price when estimating the final cost to the building owner. The mark-up may vary typically from 10% up to 50%. Larger equipment such as a boilers, or multiple units such as a large quantity of lighting fixtures, will usually require a smaller mark-up that reflects economy of scale.

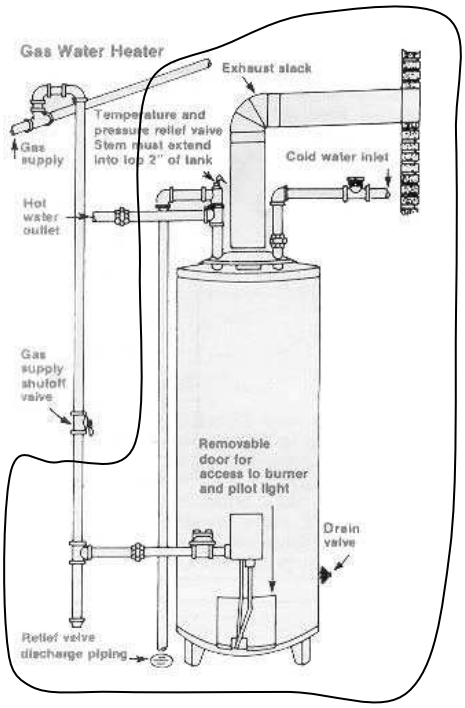
Estimate Example #1

Example 1: Gas Fired Domestic Water Heater Replacement

Components:

Condensing Domestic Water Heater, 100 MBH, 50 gal
Hot Water Piping, Valves, Fittings, Controls
Pipe Insulation
Gas Piping and Drip Leg
Drain Piping
Safety Valves—Pressure Temperature Relief Valve
Venting, CPVC
Demolition and Removal of Existing Heater
Temperature Control– Pump Tie-in

Assumptions: Cold water tie-in will be after existing back-flow prevention and shut-off valve. Gas connection will be after building pressure reduction and gas shut-off valve. Floor drain existing. Combustion air via an existing, adequately sized louver in heater room. No concrete housekeeping pad required. Circulating pump not included.



GAS-FIRED CONDENSING WATER HEATER ESTIMATE								
Component	No.	Unit	Material $/Unit	Labor $/Unit	Bare Costs	plus O & P	Subtotal	*Comments*
Condensing Water Heater, 100 mbh, 50 gal	1	Ea.	$3,520	$345	$3,865	$4,321		*Graingers List w/15% n*
Copper tubing, type L, 3/4", hanger 10' oc	24	L.F.	$3.83	$5.50	$9.33	$286.50		*Means, 2010*
Pipe Insulation, fiberglass, 1" thick	18	L.F.	$1.91	$5.45	$7.36	$170.51		*Means, 2010*
Wrought copper 90 elbows, 3/4"	8	Ea.	$3.27	$22.00	$25.27	$261.50		*Means, 2010*
Wrought copper unions, 3/4"	2	Ea.	$2.36	$19.85	$22.21	$57.51		*Means, 2010*
Wrought copper Tee, 3/4"	2	Ea.	$3.12	$34.50	$37.62	$97.50		*Means, 2010*
Temp/Pres Relf valve, bronze, 3/4"	1	Ea.	$137.00	$22.50	$159.50	$200.50		*Means, 2010*
Thermometer	1	Ea.	$37.54	$20.00	$57.54	$72.93		*Means, 2010*
Aquastat	1	Ea.	$72.00	$20.00	$92.00	$116.00		*Means, 2010*
Drain Piping, Type L, 1"CPVC	8	Ft.	$4.76	$9.05	$13.81	$141.72		*Means, 2010*
Vent pipe, 3" CPVC with termination	8	Ft.	$16.50	$14.15	$30.65	$312.16		*Means, 2010*
Black steel pipe, weld, sch 40, 1" (gas)	10	Ft.	$3.75	$8.05	$11.80	$151.53		*Means, 2010*
Black steel Tee Sch 40, 1"	1	Ea.	$12.32	$32.50	$44.82	$57.65		*Means, 2010*
Tie-into existing pump controls	1	Ea.	$50.00	$100.00	$150.00	$192.50		*Local quote*
Demolition and Removal	1	Ea.	$0	$100	$100	$100		*Local quote*
Subtotal							$6,246	

Notes:
Unless otherwise indicated, 10% material mark-up and 30% labor mark-up was used
Estimate does not include:
Circulating pump or pump controls, existing to be re-used.
Shut-off valves, pressure regulator, combustion air- existing to be re-used.

Round-up to $6,300!

Best Practices

Rounding Out Numbers:

Apply common sense to your figures. When entering numbers for a line item, and when reporting the sum of a list of items within a sub-group, use the guidelines below. Too detailed a number looks foolish at best and, at worst, implies more accuracy than you really have. On the other hand, rounding out your figures too aggressively may inflate an estimate, especially if you have a large multiplier.

Cost from…	Round to the nearest...
$ .01 to $50	$ 0.1
$50.01 to $100	$ 0.5
$100.01 to $500	$ 1.00
$500.01 to $1,000	$ 5.00
$1000.01 to $10,000	$25.00
$10,000.01 to $500,000	$100.00
$500,000.01 and above	$500.00

For reporting items or project totals, rounding up to two significant digits is generally more appropriate, for example:

$567	becomes	$570
$10,450	becomes	$11,000
$152,800	becomes	$160,000

Consider Height of Installation:

Most cost estimates that include labor assume an installation of under 15 feet. Heavier building components, such as light fixtures or ductwork will require an adjustment to the labor cost where higher elevations are involved. The following are common multipliers for light fixtures and ductwork (Source Means, 2010):

Height	Light Fixtures	Round Duct	Rectangular Duct
10'-14'	+ 0%	+10%	+ 6%
15'-20'	+10%	+20%	+10%
21'-25'	+20%	+25%	+15%
26'-30'	+30%	+35%	+21%
31'-35'	+40%	+40%	+24%
35'-40'	+50%	+50%	+30%
41' +	+60%	+55%	+33%

Consider Economy of Scale:

If the project calls for a large quantity of identical items, often a per-unit discount is available for the equipment cost but not for the labor cost. For example, Means, 2010, lists the following discount for light fixtures:

25-50 fixtures: -15%
51-75 fixtures: -20%
76-100 fixtures: -25%
101+ fixtures: -30%

City Cost Indices:

Use this index to accurately reflect material and labor rates for various regions within NY State. The factors below should be combined with the O&M mark-up multipliers.

City	Materials Costs	Labor Rates
Albany	97.7	97.6
Binghamton	98.8	89.5
Buffalo	100.3	102.8
Elmira	96.3	87.8
Glens Falls	92.2	90.5
New York	107	166.3
Poughkeepsie	100.3	134.3
Queens	101.8	162.4
Rochester	99.8	97.4
Schenectady	98.2	97.3
Syracuse	99.3	93
Utica	97.2	88.9
Watertown	99.1	91.9
White Plains	100.7	136
Yonkers	105.7	136.1

Source: Means 2010

Estimate Example #2

Here is an example of a different, more informal layout which may be more useful when precise design details have not yet been worked out. To keep track of the different equipment and labor mark-ups, similar table elements as the previous examples are used. Notes are included to alert the reader of design and installation assumptions.

This example also illustrates the useful tool of organizing the work in "modules". In this example a per-floor module is used. Presenting the information this way may make a component cost easier to understand at a glance and mistakes may be easier to spot. A room-by-room or wing-by-wing group could be similarly developed. Modules may be useful whenever there is a large, repeating pattern in a building. A generic library can also be created as long as careful editing is applied for each specific project.

Lighting Replacements (Per Floor Module)

NUMBER OF FLOORS:	**7**									
Assume electrician hourly pay rat	$74.89	(including O&P; Means 2010 and a 1.028 labor city multiplier)								
Existing	**Replacement**	**Quantity**	**Labor Required Per Unit (Hours)**	**Labor Cost Per Unit Plus O&P**	**Bare Material Cost Per Unit**	**Materials Cost Per Unit Plus O&P**	**L+M Cost Per Unit w/O&P**	**Extended Cost**	**Notes**	**Source**
Linear ballast (T12, T8, magnetic, electronic, etc.)	New linear ballast (T8, electronic). Less than 2 lbs., 40W	12	0.75	$56.17	$40.00	$44.00	$100.17	$1,202.01	Estimate change out time of 45 minutes for all linear ballasts, regardless of type.	HD, 9-29-2010 (labor), Means 2010 (mat'l)
Incandescent bulb	Compact Fluorescent Bulb (CFL), 23 Watt	6	0.00	$0.00	$3.00	$3.30	$3.30	$19.80	Screw in CFL with integral ballast. Work by Owner.	Lowes
Wall Light Switch	Wall-mounted occupancy sensor	1	0.5	$37.44	$68.57			$106.01		HD, 9-29-2010
Exit Light	Wall-mounted, LED w/battery, single face	2	1.81	$135.55	$116.00	$127.98	$263.53	$527.07		Means, 2010
SUBTOTAL PER FLOOR								$1,854.89		
EXTENDED TOTAL								$12,984.23		
Other Notes										
City multipliers of 1.003 (material) and 1.028 (labor) were used.										
HD = historical data										

Cost Estimate Summary

ADDITIONAL COSTS TO CONSIDER:

- Accelerated schedules requiring second or third shifts or overtime.
- Owner requested upgrades.
- Unusual conditions, such as extreme height, harsh weather, or difficult access.
- Temporary heating.
- Water supply (often needed during geothermal well drilling.)
- Material or construction equipment shortages or long lead times.
- Survey or testing requirements that may add additional cost or that may affect schedule.
- Lead or asbestos abatement for renovation jobs.
- Demolition expenses including the cost of transportation and lawful disposal.
- Special rigging, cranes, or lifts.
- Demolition and safe disposal costs or additional demolition to gain access or clearance for equipment placing.
- Tax on materials if Owner is a for-profit entity.
- Regional multipliers to include in O&P. Multipliers for various cities in New York State listed on page 5.
- "Flat" or non-competitive bidding structure which may encourage price inflation because of a reduced incentive to win a bid.
- Documentation for LEED Certification where certification is required for project. May be added as a percentage onto the total project cost.
- Contingency allowance. Typically added onto the total project costs. Traditionally 15% for many building construction projects.
- Design fees or a Partner Fee. Typically added onto the total project costs. Traditional design costs run between 8% and 12% for Architectural or Engineering fees.

COST REDUCERS (A much shorter list):

- Work done by Owner.
- Regional multipliers less than 1.
- Economies of scale. Discounts may be available for large orders for lighting fixtures or similar items. RS Means and other sources will usually indicate a reduced unit cost for larger quantities.
- Mobilization costs if contractor is already on site.
- Pre-purchase of material by Owner.
- Rebates or incentives. It is recommended that such grants **not** be subtracted from your estimate but rather be carried through and shown as separate line items in your estimate summary.