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August 31, 2010

To: Whom It May concern

RE: Findings - Review of New HVAC Software Program

Dear Mr. Vice President:

I hereby submit the results of my review of the new software program

Summary of Findings.

I have investigated the partially completed computer program being prepared by Idea Tree of York, Pennsylvania for your possible use. I was given complete access to the program under development, called for the sake of this report, the "Utility Model".

Based on my observations and prior experience, I find the Utility Model to be an excellent analytical tool for home energy use and a potentially powerful marketing product for your use superior to any other currently on the commercial market.

I have found that the Utility Model can calculate the reasonable use of energy in most homes quickly, economically and technically based. It is flexible enough to account for the normal variations of energy use that cannot be calculated without expensive and time consuming optimization.

As intended, the Utility Model can be used by lightly trained marketing personnel to calculate existing and proposed energy uses (and costs) for a wide variety of improvement projects or proposals. It will be necessary for you to finalize the variety of improvement projects calculated, the construction costing involved and the formats of the final outputs of the Utility Program before it can be deployed. I have included some thoughts as to how this may be accomplished,

In conjunction with the discussions below and without any knowledge of the economics involved, I recommend that you seriously consider the purchase/licensing of the Utility Model and the completion of all programming to achieve a complete, useable, and working product.

Actions Taken.

As part of the evaluation process of the Utility Model, I have taken the following steps:

1. Purchased and reviewed the Air Conditioning Contractors of America (ACCA) Manual J - Residential Load Calculation by Hank Rutkowski, P.E., eight edition, version two. This manual is the basis for most of the calculations used in the Utility Model.
2. Travelled to the offices of Idea Tree in York, Pennsylvania on two occasions. I met with the COO and senior programmer for the Utility Model. We discussed the history of the model and its current widespread use by contractors across the county. He set up a separate computer for my use and testing of the current version of the program. I put the model through a series of program changes to see if the results were in keeping with my expectations - they were.
3. Accompanied an HVAC serviceman to two homes in the area. Observed the steps taken to prepare an energy audit for a Community Assistance Program including boiler testing, blower door testing, assessment of windows, insulation, air leakage, lighting, etc. The audit was very professional and thorough for the guidelines of the program.
4. Received a computer link to and tested the latest version of the Utility Model from Idea Tree (on my office computer). I tested it using my own home's specifications and energy costs. I found the output of the Utility Model to be a reasonable match to my home's natural gas heating bills. I was able to input most U values. The accessing by the model to Google maps, Zillow, NOAA weather and other default values was fast and clever. This link model was only set up to evaluate geothermal heat pump options (not others).

Existing Computer Model.

The existing Utility Model is under development and is not complete. Idea Tree is currently working to complete sections of the model to meet your requirements. The model is an adaptation of the commercial model currently used by hundreds of contractor members of ACCA. The ACCA model uses the Manual J Residential Load Calculation methods described therein.

The existing Utility Model consists of some 10,000 lines of PHP language programming instructions. These instructions or code perform the calculations of maximum energy use (design heat loss and heat gain) according to Manual J. In addition the model calculates annual energy use from retrieved weather data based

on NOAA locations nearest the home being investigated. The code uses BIN data and not heating or cooling degree day methods.

The resulting calculation findings are not displayed for observation or checking unless specifically requested for output. Thus it was not possible for me to see the heat loss calculation results for windows, walls, roof, floors, air changes, etc. It is not possible for me to read PHP language and thus I was only able to verify final output cost values currently displayed by the existing program. It is possible to program these output values each time they are needed but I feel this will not be necessary for the final product.

The existing model is capable of calculating energy use for space heating and air conditioning of a home including all of its components - windows, walls, floors, roof, air changes, building orientation (to the sun), doors, furnace efficiency, fuel type, duct losses and a number of smaller items. These calculations can be for both the existing home and revised energy uses if specific parameters are changed for proposed projects. For example if a new heating system (or a part of the home changed) is proposed, the program can calculate old energy use, proposed energy use and annual energy savings just for the heating system.

The existing model contains a feature called a "slider" or a button that can be moved by a mouse on the input page of the program. The purpose of the slider is to easily adjust the calculated energy consumption of the existing home to more closely match actual energy use and corresponding savings. The slider actually changes the inside occupied temperature of the home from the default setting either up or down as the slider is moved on the input page. The actual temperature finally selected by the slider and used in the calculations is not shown but is a reasonable method to compensate for the many unknowns that occur.

The Utility Model that I used was set up for geothermal heat pumps. I did not see outputs for conventional furnaces or high efficiency boilers or water heaters. I also did not see the output for sizing of conditioning equipment. I believe both exist in other similar Idea Tree models, but did not review these steps.

Uncompleted Model Features.

At the time of my evaluation, the program was being developed to evaluate other options besides heating and cooling systems. I have seen some of your specifications but would like to outline

what I feel are important areas of other potential program improvements for houses.

1. New windows.
2. Attic insulation.
3. Wall insulation
4. Boiler tune-up
5. Fuel change - oil to gas, electric to gas, etc (if available).
6. Digital setback thermostats.
7. Domestic hot water heaters - electric to gas
8. Weatherization - reducing air changes.
9. Efficient lighting - compact fluorescents or LEDs.
10. Appliances - Energy Star.

The savings for each of the above would have to be built into the model calculations.

The construction costs of each of the above would have to be built into the output of the models. It is assumed that your company would want to determine these costs.

The possible energy grants available (federal, state, utility) and tax deduction values for each of the potential improvements would have to be determined by your company.

The total economic impacts of performing the recommended projects in simple payback period format and/or life-cycle impact could be shown. It may not be possible to identify other benefits in calculations but mentioning benefits such as reduced cash flow, reduced maintenance costs, reduced deferred replacement cost, improved home value, etc.

The amount of energy quantity reductions and reduction in pollution (greenhouse gases by type) may be possible.

The existing model does not have a final report output (format) from the calculations at this time. It is understood that your company is considering such report content and presentation possibilities. Once the calculations are programmed it is a straightforward step to complete the output format.

Possible Additional Features.

If actual prior energy usage and costs for both fuel and electricity are available prior to visiting a customer and presenting a report, this information could be contained in the

report. For example, if your company has access to a customer's utility bills for the preceding year this can be presented. If not available it may still be beneficial to present calculated or estimated annual energy usage and costs for the entire home (and not just the heating and cooling costs). Such information in the report will create strong credibility and enhance the marketing process.

If available, it may be advantageous to show numerically or graphically the performance of the home in question against national averages. For instance it may be possible to show the actual EUI (Energy Utilization Index) of the home in btus/SF versus low-medium-high averages for the area. Or it may show on a scale of 1 to 10 the energy performance of the home versus the range of home usage (or cost). Of course low performance would be a good motivator to make proposed improvements.

It may also be beneficial if the report can generate a reasonable breakdown of a home's existing performance (costs) by major categories by fuel as shown below. This would reveal the room for improvement.

Natural Gas:

- Space heating
- Domestic Hot Water
- Cooking
- Clothes Drying
- Other
- Summary of All users

Electricity:

- Heating
- Air Conditioning
- Lighting- Indoor and Outdoor
- Domestic Water Heating
- Cooking
- Clothes Drying
- Refrigerator(s)
- TVs & Small Appliances
- Computers
- Other
- Summary of All Users

The program will have no trouble calculating costs and savings of single improvement projects one by one. There may be complications if two projects compete for the same or part of the same savings - called interactive savings. For instance, if there is a recommendation to replace oil with natural gas and also installing a new gas furnace. The program could have problems giving a priority to which project gets all of the

savings and which one does not. The easy way out is to say at the outset that the report findings do not include interactive savings at this time.

It is good policy to have a statement of accuracy in the report to cover variations that cannot be known in advance or in the future. Such variations may be the result of conditions not addressed in the calculations such as:

- Number of occupants - full time or temporary
- Length of time of occupancy - full or partial
- Comfort level Desired - some like it hot, some prefer lots of fresh air, etc.
- Maintenance levels for equipment and structures
- Location factors such as top of hill, shade from trees
- Home arrangement such as split level, semi-detached, two floor, additions, etc. The model does not account for these now.
- Specialized energy users such as pools, wood stoves, fireplaces, welding equipment, extra freezers, space heaters, multiple computers, large screen TVs, etc.
- Unknown construction factors such as wall and ceiling insulation.

While the purpose of the report is to present opportunities for energy and cost savings, it is likely that there will be projects that are not recommended. The report may want to state that certain improvements were investigated but are not recommended by your company at this time. The report can either list the titles of those not recommended or show the costs involved to be more convincing.

The report should also clearly state that solar panels for either hot water or photovoltaic reasons were not investigated and are not normally recommended by your company. The same would be true for wind electricity generation.

Report Output Discussion.

I would like to see on the report output the design loads of the home in btu's per hour and not just the annual costs. This would provide a reasonable check of the recommendation as it pertains to heating and cooling.

This report is not intended to propose specific formats of program outputs. There are a few comments that may help the final results of the program.

It may help to have an overall summary of results tabulated at the beginning of the report including "recommended" and "not recommended" projects. For each specific project it may be helpful to have more description, perhaps a paragraph, of what is being proposed. If there is a picture or a diagram showing what equipment is involved it will help the customer.

I suggest that all pages of the report have page numbers and dates shown.

I suggest that all numbers and costs shown have commas (thousands). The present program does not.

I suggest that all calculated costs be rounded to either two or three significant figures. This will reflect the level of accuracy of the program. Computers calculate to too many decimals and give the impression of higher confidence than the input data warrants.

Wherever possible it is recommended to use color images to make the report more interesting.

Recommendations.

I am comfortable with the power of the Utility Model to reasonably and easily calculate existing and proposed energy usage and costs for the home energy improvements listed above.

I realize that the Utility Model is not a finalized and proven product. As such it will take some time to work out bugs even after the program is initially completed and put into use. The best way to improve the final product is to put it into early use.

I suggest that your company use the output of the early versions of the Utility Report as "preliminary" for initial contacts. For contracts with customers, a careful consideration of construction costs and savings must be made even if different from the Utility Report's initial findings.

Other Discussions.

The Utility Model does not need the count of the number or size of the windows. It uses a factor of 14.5 percent of the floor space to estimate the window area and is based on experience. This is reasonable for heat loss/gain purposes but may not be adequate for estimating the cost of replacing windows if single pane windows are involved. Your company may want to come up with a reasonable way of pricing window replacements.

The Utility Model does not know the size of the actual ceiling of the house but has assumed it is the same as the area of the house. For a two story house the ceiling will be half the area of the house, etc. Thus the Utility Model may not reasonably calculate the correct area of the attic for calculating energy savings and construction costs. Idea Tree is aware of this problem and has agreed to fix the problem.

Thank you for the opportunity to be of service to your company. If there are any questions or concerns regarding this report or related matters, please call at (610) 898-0252, or email at william.mcmahon.econ@earthlink.net.

Respectfully submitted,

William M. McMahon Jr. P.E. CEM
President