SPSU IDC

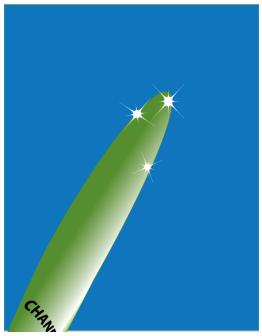
Memorandum

To Dr. Palmer

From Peter Carlson

Date October 31, 2010

Subject Feasibility Analysis: Home Energy Saving



I provide an analysis of the feasibility for the idea to *improve the efficiency of an existing house* under the umbrella of home energy saving.

In conclusion, I have found that this idea is feasible because I can further analyze the range of proposed solutions by using available research material.

Background

Jim Wilson and his wife Alison live in a 1950s house. Jim wants to make it more energy efficient. He does not spend much on energy, but he finds some of the rooms uncomfortable because of temperature variations. He also would like to set an example in the neighborhood. He is willing to spend between $5,000 and $10,000. Alison supports the idea, but questions some of the specific improvements. Some of the improvements have complex trade-offs. Jim has a good grasp of science; therefore, he would like a thorough analysis to help him analyze his options.

Making use of the government tax credits, Jim recently arranged an energy audit of his home under the Home Performance with ENERGY STAR® program ("Home performance," n.d.). He was impressed with the quality and depth of the audit, which included a 20-page report complete with pictures (Wallace, 2010). However, he was overwhelmed with the large number of recommended actions. He was not sure how to prioritize them; whether they really made sense for his particular situation; or how to engage the right contractors to work on them.

Goals

The goals address some of the complex actions from the report.

- One action involved insulating the crawl space. Jim considered this controversial: research showed this was not always the best option.
- Another action was insulating all the exterior walls. The audit rated this at a low priority and gave this little attention. This surprised Jim.
- Another implied action was improving the attic insulation. Jim was concerned that the current fiberglass insulation had health risks.

Another stretch goal is to identify suitable contractors who may perform the work. This may not be feasible because it broadens the scope of the study considerably.

After preliminary analysis, the goals seem feasible. Some of the issues related to crawl space insulation are well discussed, such as by Lstiburek (2009) and Pass (2004). For example, the recommended shape of insulation under the floor is shown in Figure 1 (Lstiburek, 2009, p. 13).

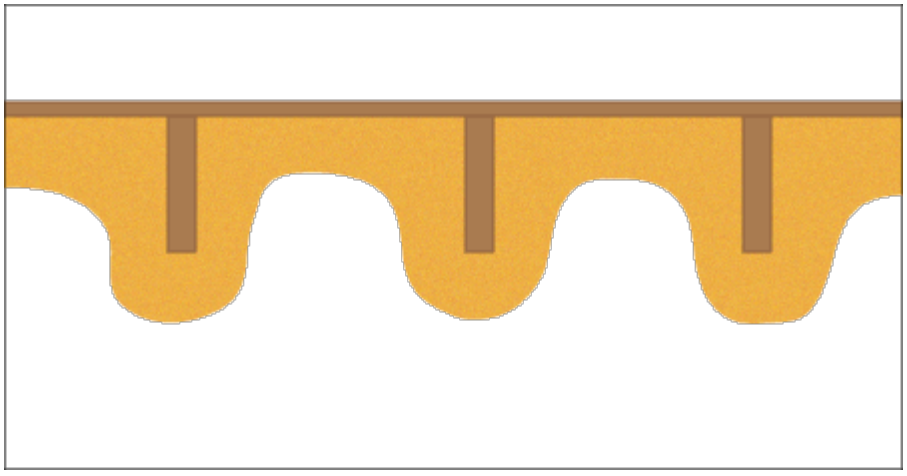


Figure 1.
Shape of insulation under the floor, covering both floor and joists.

For wall insulation, Lstiburek (2010) describes the methods, which are well established. I have established at least one cost estimate. According to inflation-adjusted U.S. Department of Energy (1995) figures, to insulate the exterior walls with R-13 loose-fill cellulose, Jim would pay approximately $430, excluding any rebates.

The cancer risk from fiberglass appears to be low, according to three different sources: American Lung Association (2008), Boffetta et al. (1997), and Checket-Hanks (2004).

Important criteria include rough estimates for

- the percentage reduction in energy consumption; and
- the improvement in temperature variations.

Benefits

Jim will feel a better citizen when he takes the next steps to improve their house, because it benefits the environment. Jim and Alison will also enjoy a more comfortable house if the improvements succeed. Jim would like to know the difference in energy consumption, not so much in financial terms but as a percentage improvement.

Readers

Jim will be the primary reader of the report. Alison and building contractors who may perform the improvements will be secondary readers. Jim and Alison are the sponsors, but the ultimate decision comes from Jim. He will solicit views from his children who often visit his house. The children are fond of the house; they do not want to see it changed too much. Any major improvements may also affect the neighbors. The children and neighbors are important stakeholders. All this makes for a complex audience.

Annotated Bibliography

American Lung Association. (2008). *Lung disease data: 2008*. Retrieved from http://www.lungusa.org

The 188-page report warns that "pollutants in the air in the home, school or workplace increasingly have been recognized as threats to lung health." (19). The report describes many indoor air pollutants, such as asbestos, tobacco smoke and radon. However, the report does not mention fiberglass.

Boffetta, P., Saracci, R., Andersen, A., Bertazzi, P. A., Chang-Claude, J., Cherrie, J., ... Zocchetti, C. (1997). Cancer mortality among man-made vitreous fiber production workers. *Epidemiology*. *8*(3), 259-268.

The study compared the mortality rates of workers in MMVF (Man-Made Vitreous Fiber) production. Glass wool, one of the glass fibers, is included in MMVF group. The study found that "results are not sufficient to conclude that the increased lung cancer risk is related specifically to exposure to MMVF" (267). The analysis covered 22,002 workers.

Checket-Hanks, B. (2004, October). Industry groups push to reclassify fiberglass. *Air Conditioning, Heating, Refrigeration News*. Retrieved from http://www.achrnews.com

"In 1994, Health and Human Service's National Toxicology Program ... listed fiberglass as being 'reasonably anticipated to be a human carcinogen' based on animal test data." (16) However, members of the manufacturing community have been waiting for the reclassification of fiberglass as not a carcinogen. "Fiberglass 'is currently considered not classifiable as a human carcinogen,' stated the American Lung Association (ALA)." (16). This is a commercial magazine with advertising.

Lstiburek, J. W. (2009, March). Making vented crawlspaces work. *Energy Design Update*. 13-14. Retrieved from http://www.aspenpublishers.com

Vented crawlspaces suffer from moisture problems. The basis of a solution is the "principle of eliminating condensation by keeping joists and subfloor warm" (13). This update, provided by Aspen Publishers Inc, summarizes the Building Science article by Lstiburek.

Lstiburek, J. W. (2010, August). Don't be dense with insulation. *ASHRAE Journal*, 54-57. Retrieved from http://www.ashrae.org

The report discusses packing cellulose fiber densely into existing frame walls. The air leakage is reduced by up to a factor of ten or more. Although the report does not provide the energy transfer rates of such walls, it does provide overall guidelines on where and how the insulation should be used. "One of the most effective ways of dealing with existing uninsulated frame walls is to blow cellulose into the wall cavities." (54). This report comes from the Building Science Corporation in Somerville, Mass. The corporation represents the knowledge of several consulting engineers. They offer practical advice. Despite the report's casual and humorous tone, the information appears to be trustworthy, based on author's extended experience in the field.

Pass, K. (2004, September). To vent or not to vent. *Professional Remodeler. 8*(9), 31-34. Retrieved from http://www.housingzone.com

The article shows that venting a crawlspace usually increases the humidity. The outcome is opposite to what you would expect. "Building scientists have found consistently that when warm, moist outside air enters a crawl space, it instantly cools and drastically increases the relative humidity of the crawl space." (1). The author is a contributing editor to the magazine, one of several published by Scranton Gillette Communications (SGC) Horizon. This is a commercial magazine with advertising.

U.S. Department of Energy. (1995, May). *Loose-fill insulations* (DOE/GO-10095-060, FS 140). Retrieved from www.michiganheat.com/doe-facts/25.pdf

This DOE report provides guidelines for insulations using loose-fill technique, such as blowing into wall cavities. For loose-fill insulation the "average installed price per R-value [a measure of insulation] per square foot was about 1.2 cents for blown-in cellulose and rock wool and 1.3 cents for fiberglass." (6). After inflation of 44% is included, the costs today are 1.7 and 1.9 cents respectively. The report is several years old, but the principles still apply.

Wallace, J. (2010, January). Energy assessment report prepared for Jim Wilson, property address 2120 Tree Lane, Atlanta, GA 30324. Prepared by Green Summit Consulting. Copy in possession of author.

The report provides the measured duct leakage and natural air change of the house. The natural air change was high, so the report recommended filling gaps (such as around windows and doors). The report also recommended insulating around the crawlspace to maintain a thermal barrier: "Complete crawlspace vapor barrier and insulate floors. Crawlspace may be a candidate for sealing." (3). The tests indicated little or no exterior wall insulation, so the report suggested this be improved, but gave not specific recommendation.

Other Sources

I need to perform further research, starting with other sources that I have identified but not fully analyzed. The research covers several topics.

In Jim's house, the furnace is in the crawlspace—this complicates the ventilation. To get a feel for cost of crawl space insulation, I need to look at independent summaries of cost.

For wall insulation, I need to quantify the energy transfer, such as by quoting realistic R-values. To predict the lower temperature variations after insulation, I need to further verify the simplified way to calculate R-value presented by Pedersen and Hellevang (2010), possibly by referring to the ASHRAE handbook by Couvillion, Coleman, Suryanarayana, and Ayub. (2009).

To identify suitable contractors—if I decide this is in scope—I may need to analyze consumer ratings or even interview a subject matter expert.

Bibliography

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Wallace, J. (2010, January). Energy assessment report prepared for Jim Wilson, property address 2120 Tree Lane, Atlanta, GA 30324. Prepared by Green Summit Consulting. Copy in possession of author.

Conclusion

After analysis, I have found this idea is feasible because it will realize benefits for the owner and has a reasonable number of unknowns that need research. I can proceed with my topic because there is sufficient research material to meet the goals.

If you have additional questions about my analysis, please don't hesitate to contact me on Vista or by email at pcarlson@spsu.edu.