A Living Sustainability Laboratory for Students

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Texas A&M University has an opportunity to lead solutions by creating a living laboratory which focuses on residential energy efficiency and sustainable practices. Sustainability appears daily in the news. Energy prices soar and then drop, only to soar again. With the increasing demand on energy, the world may soon replace the term "sustainability" with "availability". The fundamental concept is to create a 100+ acre sustainable housing development, involve students in all aspects and create courses which link sustainability to real life. These functional houses then serve to test and demonstrate concepts, provide housing for students so that they fully experience building, repairing and living in sustainable housing. All colleges could be beneficiaries and include Architecture, Engineering, Business, Medical, Liberal Arts and the Sciences. Courses would be interdisciplinary which would create an educational environment with interacting disciplines.

Energy availability and increasing world population are key drivers. As energy prices skyrocket the economy faces increasing pressure on the nation's productivity in all industries and activities, which consume energy. The price of manufacturing and industrial output will increase. Transportation costs will rise significantly. The cost of sustaining comfort and health in buildings and homes will also rise significantly.

This white paper proposes a laboratory which would extend what we can currently accomplish in the built environment. Today, a 15% to 25% reduction in energy use can be achieved in existing buildings with approximately a 2 year payback (Culp 2004). A 30% to 50% reduction can be achieved, using current technology, in new residential construction with a 0% to 15% increase in first cost (Lstiburek 2005). The laboratory's goals would address reducing energy use in affordable ways in housing and small buildings. A secondary outcome would provide retrofit methods for existing housing.

Before getting into specifics of the Living Sustainability Laboratory, the drivers and facts need to be understood.

Key Facts

Dramatic increases in energy prices are occurring

Natural gas cost jumped from about \$2 to \$3 in 2003, to about \$6 in 2004 and to \$10 to \$12 in 2005. Oil has risen from \$30 per barrel to the \$60 to \$70 range. Expect electricity cost increases to follow. Rapid energy demand growth in the Chinese (Zhaoguang 2005), Indian and ROW economies drive the price of energy. The world's peak production seems to be occurring in this decade (Deffeyes 2001). This peaking of oil production combined with increasing demand results in a rapidly increasing price for oil until alternate energy sources become economically viable. Nonetheless, large swings exceeding 25% can expected.

Most existing commercial buildings operate inefficiently

The existing building inventory contains about 50% of the square footage below 20,000 sqft (CBECS). Most buildings have dysfunction energy consuming systems that cause 20% to 40% in excess energy consumption (Culp 2004).

Most housing uses 50% more energy than a well designed house

The existing housing inventory average age is over 20 years old, built before energy efficiency codes became required (RECS). Texas adopted the IECC energy efficiency codes in 2001, resulting in an energy efficiency increase of about 10% for new houses being built to the minimal code level. A 30% to 50% reduction of energy use while maintaining a healthy environment can be accomplished with a 0% to 15% increase in cost (Lstiburek 2005). Using 2004 energy and building costs, the lowest net cost including mortgage and energy cost occurs at a 40% reduction over current energy use (Anderson 2005).

Current practice in rebuilding disaster areas often reduces energy efficiency and health.

Totally destroyed housing and buildings typically get torn down and rebuilt to the current code, if the area has an energy efficiency code and assuming that the trade-people and inspectors perform as required. More often, in the rush to rebuild, numerous short-cuts occur because of lack of adequate insulation and other materials. The owners of these buildings then live with the increased energy use and cost for the life of the building.

Skilled Energy Engineers in Short Supply

A few Universities have undergraduate and graduate curricula focused on energy efficiency in buildings. Texas A&M has one of these programs and graduates fewer than 10 skilled engineers per year. Other universities graduate similar numbers of energy efficiency engineers. To have an impact on the 20,000,000,000+ square feet of existing buildings, this number must increase. One engineer can successfully oversee about 500,000 to 1,000,000 square feet. The US needs 20,000 to 40,000 engineers to meet this challenge and we currently have a few hundred experienced engineers with this specialty.

New 13 SEER Air Conditioner Requirement

The new 13 SEER requirement for A/Cs improves the efficiency of newly installed A/C units for replacement and in new homes approximately 25% beginning January 23, 2006. Although an excellent move in the right direction for the long term, this will produce a 2% to 5% annual reduction in residential energy use after 5 years and a 4% to 8% annual reduction after 10 years. The downside to this is that approximately 35% of all failed units are being repaired and do not achieve the higher SEER ratings (Culp 2008)

Impact of Building Energy Efficiency

Energy efficiency has been demonstrated to reduce consumption and pollution, with increases in efficiency of 20% to 30% possible using existing technology for individual applications. In the built environment, a 20%+ reduction typically has a payback of 2 years at 2004 energy costs and approximately 1 year at 2005 energy prices. The lack of an adequate number of skilled building energy efficiency engineers severely limits achieving broad coverage of energy efficient technology. Implementing energy efficiency on a US wide scale will require 10+ years to organize, educate and implement. Although some increased application of energy efficiency will occur naturally and will be quite beneficial, wide application of energy efficiency will not occur without a massive program focused on building energy efficiency. The alternative involves economic and social disruptions from increasing oil prices. Translation – the US has <u>not yet developed a sufficient infrastructure</u> to widely deploy the current state-of-the-art energy efficiency technology.

<u>Increasing Costs for Energy Harms the Balance of Trade</u>

Saving energy can have about a 2-year payback. Not spending the capital on reducing consumption translates into increased payments to foreign governments. Spending capital on domestic energy reductions stimulates the economy by spending part of the energy budget domestically. Energy savings do require investments in people and equipment.

Projected Impact

With the cost of energy rising dramatically, homeowners and building owners will feel the impact of rising energy costs. As abundant low-cost energy fades, newer energy efficiency technologies will become viable. The key question becomes "how quickly will energy costs escalate?" and perhaps "will energy be available?". Rationing occurred in World War II, driven by domestic petroleum fuel shortages. Assuming the world currently is at the peak oil production and developing countries require increased quantities of oil to maintain their growth, shortages become likely in the next 5 years.

A major effort to address this impending energy shortage could provide the US with the ability to maintain comfortable and healthy homes and buildings. Long term, this approach can reroute 20%+ of the US housing and building energy expenditures to investments in the US economy. Short term, this approach needs immediate attention because of the 5 to 10 years required to create a sizeable infrastructure to accomplish these savings.

Proposal

Texas A&M University, as part of the 2020 Vision, should create a world class 100+ acre sustainable multi-disciplinary housing project. Housing can be built today to use 50% of the energy of a normal house. Housing in the future will use 30% to 40% of the energy of a normal house before on-site generation is applied (Culp 2008).

The basic concept enables students and faculty, working with participating builders to:

design functional houses,
learn to repair and maintain sustainable systems
live the dream and transform their thinking

Mayor White has a vision of College Station becoming a “destination city”. By making this a living laboratory, and providing demonstrations and conducting tours, visitors could learn what modifications work in these homes and potentially what they should change in their own homes to improve their performance.

The benefits of this laboratory are:

- educate students with real experience ,
- increase the number of skilled energy engineers and other energy disciplines
- make a measured difference in improving the quality of life in buildings
- have an A&M laboratory to transfer sustainable technologies to the public and industry

This Living Sustainability Laboratory would draw students, many of whom want to obtain an education in these areas, so they can make a difference in the world.

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