

Why Konaus?

A realistic design approach to “smart” energy-independent house construction

Jim Farrell
Partner, KONAUS LLC
Life Senior Member, IEEE
Austin, USA
jim@konaus.com

Yoshito Yamaguchi
Business Director, KONAUS LLC
Founder, Sennett Corporation
Kamakura, Japan
yamagusp@sennett.co.jp

Abstract—The KONAUS housing design initiative is a new approach to solve current housing construction and energy consumption problems. KONAUS utilizes current available materials and products to produce an energy independent home that automatically charges its own electric vehicle.

Keywords—housing; energy; building; electric vehicle; efficiency; photo voltaic; solar

I. INTRODUCTION

Early in 1977, I was employed by Motorola’s Semiconductor Product Sector in Austin, Texas as a 6800 microprocessor applications engineer. The microprocessor operations had recently been moved from Phoenix to Austin. My Phoenix-based 6800 applications engineering colleagues were working on a microprocessor-based house that was completed in 1979 called The Ahwatukee **House of the Future**. This house was a future-looking architectural design from the Frank Lloyd Wright Foundation, with five Motorola 6800 microprocessors controlling its heating and cooling environment. This house was one of the first microprocessor controlled homes ever built, and is still standing in Ahwatukee, Arizona (a suburb of Phoenix).

In 1989, the TRON Association, in collaboration with several members and others, built the TRON Intelligent House in the Roppongi district of Tokyo. Like the much earlier Ahwatukee House, this house had excellent architectural credentials and was extremely attractive. Unlike the Ahwatukee House, the TRON house utilized a very large number of microprocessors, and controlled virtually every activity that occurred in the home. This project was followed in 2005 with the TRON PAPI House of Sustainability, which was built with the collaboration of the Toyota Corporation.

While all of these houses demonstrated what technology could bring to commercial housing, none were ever built in production. However, a great deal was learned over the last 35 years.

Early in 2010, my wife Kathy and I were researching housing and land in Hawaii (the Big Island) with the intent of buying

an existing house or perhaps building a new one. They saw many houses, and were quite disappointed with those in the “mid-level” price range for this market both new and older.

The only existing houses that were well-built seemed to be extremely large and prohibitively expensive – even in a depressed housing market. While researching Kona architects, we found Paul Bleck who is an innovative and well-known home designer both in California and Hawaii.

In the course of discussing house planning and building options with Paul, it became apparent that my skill set in consumer electronic applications and marketing would be a good match with Paul’s architectural expertise for developing an energy-independent Smarthouse. I had been involved with the TRON House of the TRON Association, the Motorola Ahwatukee House, as well as many electronic housing applications and electric vehicles. Paul developed the First KONAUS™ House building plan in early September, 2010.

II. KONAUS DESIGN STRATEGY: WHY KONAUS?

A. Design Criteria

Using the latest housing CAD (Computer Aided Design) technology, each KONAUS™ House is specifically designed for the geographic region and actual location where it is built. In Hawaii, the roof slope will be approximately 19 degrees, while in California; it will be approximately 30 degrees. These roof slopes are based on the House’s latitude and altitude to maximize the efficiency of the PV panels. Even in Hawaii, the KONAUS House design would vary to accommodate the multiple climate zones, altitudes, and other climate building factors of the Aloha State. A steel roof, unlike asphalt composition, enables an optional water catchment system without introducing gritty aggregate or residual petroleum pollution, which is a contaminant in the storage system.

B. Value and Longevity

The design of the KONAUS™ House satisfies the owners’ family needs and requirements as well as being easy to build. This design can also be modularized for off-site construction,

minimizing cost, and weather exposure during “site build” time. This can be a significant building cost reduction.

III. KONAUS CONSTRUCTION

A. Home Building Environment

The housing market is changing, both in the US and internationally. The emerging demand is for better houses, not bigger ones. Energy acquisition is becoming a critical issue as highlighted by the Gulf of Mexico oil spill a few years ago and the ongoing problems with the damaged Fukushima nuclear power plant in Japan. The KONAUS™ House fully addresses the energy needs of houses now and in the future, as well as the challenge of increasing fuel prices for the family vehicle. KONAUS LLC is a value-added housing design resource that will license its home design intellectual property, and fully support the builder with plans, resources and accreditations to build the KONAUS House. The KONAUS House will be a structurally and environmentally sound, energy independent smarthouse with high retained value. KONAUS will also enable third-party lender creative solar financing for the homebuyer to minimize his or her initial home expense.

B. Materials

The KONAUS House will eliminate archaic and toxic building materials. Structural elements will be steel, not dimensional lumber. Roofs will be steel or ceramic, not petroleum releasing asphalt shingles or chemically treated shake shingles. This will allow effective rain water catchment (implementation regionally dependent on climate). Collected rainwater will be stored in the large cistern built under the house lanai (Hawaiian porch). This cistern will not be visible, and will comply with most neighborhood association regulations.

C. Steel Studs

The KONAUS House will use standard commercial steel studs and steel beams instead of the current dimensional wood elements currently used. The advantages are obvious. Steel does not rot, burn, become moldy, and is not eaten by insects. It is also much more resistant to wind and floods than wood is. In production, the incremental additional materials cost for steel over wood should be about 15 %.

D. Exterior design

KONAUS house design specifications have been developed to comply with KONAUS environmental criteria while providing the homeowner with a very attractive home and excellent “curb appeal”. It is probable that many KONAUS Houses will be built in development tracts. To accommodate this, Paul Bleck has developed “Parapet” KONAUS House designs, utilizing a parapet wall and a flat roof. These designs will also accommodate narrow lots, while the parapet allows the PV panels to always face south, and not be visible from the ground.

IV. KONAUS PV POWER SYSTEM

A. Selecting a PV System Size

The overall size of the recommended PV solar system will be computed well before construction. The resultant energy budget will need to be updated to include the additional energy demand of the Electric Vehicle (EV) as well as the energy budget of the owner-defined appliances and House systems. Prior to construction, the owner will be asked to make several decisions that will affect the size of the PV system needed, including the projected monthly driving range of the Electric Vehicle.

B. The Grid

We expect that the majority of KONAUS™ House units will be “on-grid” with the local electric utility, in a net-metering operating agreement. In this case, the utility measures the power supplied to the grid by the KONAUS™ House PV system during sunny days, and subtracts the electricity supplied to the KONAUS™ House at night and during cloudy weather. The overall power usage from the utility is reconciled on a monthly basis by the utility, usually with no carry-forward credit allowed. The size of the KONAUS™ House PV system – as well as the energy efficient home demand - will be calculated to provide the homeowner with a system that meets his needs, and requires the absolute minimal net power from the local electric utility.

We expect a significant number of “grid-assist” or “off-grid” deployments, for several reasons. In the grid-assist and off-grid versions, the KONAUS™ House will utilize a battery array to store electrical energy for use when the PV system is not producing. In some deployments, an emergency backup generation system may also be required.

A high power output efficient PV panel is recommended, and is optimal for the KONAUS™ House energy application.

KONAUS, LLC will offer an option of an integrated PV panel micro-inverter that will produce AC (alternating current) power right at the roof PV panel. This will greatly reduce the size and weight of the cabling from the PV panels to the interior power panel of the home, and improve overall system efficiency. This is optimal for net-metered On-grid applications

Another PV development currently in testing is a hybrid PV solar panel. This panel’s front side operates like a standard PV solar panel, but liquid tubing on the back of the panel also provides passive solar hot water heating for home use.

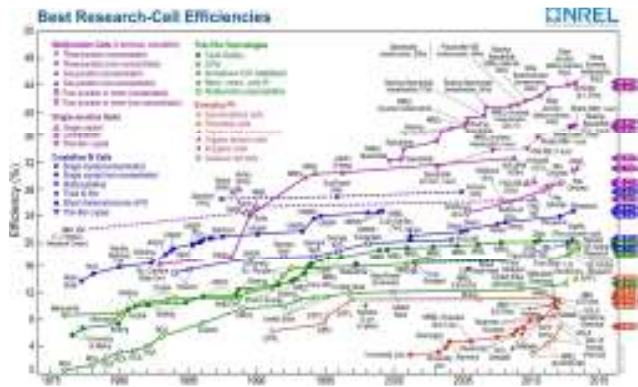


Fig. 1. PV Research Cell Efficiencies

V. PHOTOVOLTAIC EFFICIENCY

A. Photovoltaic

While most PV solar panels in production today have efficiency ranging from 10% to about 20%, efficiencies exceeding 40% have been achieved with advanced techniques, and should be implemented in production in the next few years. The single cell silicon line on this chart represents Silicon technology, which are large majority of current PV sales. As of late 2013, solar panel wholesale prices had fallen to under US\$1 per Watt, in volume. It is expected that these prices will continue to fall as production increases and further efficiency gains are achieved.

VI. ENERGY CONSERVATION

A. Energy Footprint

A key element of the KONAUS House energy independence is energy efficiency. The KONAUS™ House will have excellent energy usage and conservation characteristics, and will require energy efficient ENERGY STAR® appliances. To enable the efficient use of the energy generated by the home's PV system KONAUS™ LLC will research and work with appliance manufacturers and other home product suppliers to provide a list of acceptable appliance options. This list will provide the homeowners the functionality and home features that they want, and still remain within the overall power budget of the KONAUS House.

B. Appliances and Lighting Efficiency

KONAUS House lighting will utilize LED lighting extensively. High-energy consumers – such as hot water heaters, HVAC units, and clothes driers – are a prime concern. The clothes washer must not only be power efficient, but must also be extremely effective at removing water from the clothes during the final spin. This allows the electric clothes drier to operate much more efficiently.

Producing hot water usually requires a lot of energy. KONAUS House specifications offer two solutions. Either a very energy efficient heat pump based hot water heater, or producing hot water utilizing a passive solar array on the roof.

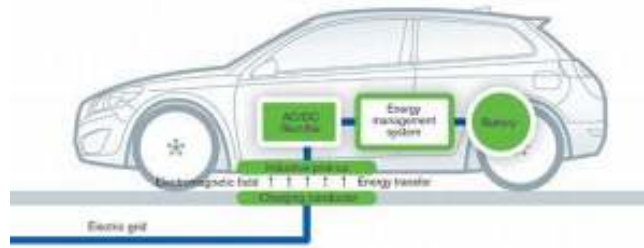


Fig. 2. Electric Vehicle Charging

VII. ELECTRIC VEHICLE (EV)

A. EV Technology

An Electric Vehicle is a key element – and inclusion - of the KONAUS™ House. The EV itself does not expel any emissions into the environment. Its exhaust footprint is indeed zero. However, in today's reality, its batteries must usually be charged with power supplied by a local utility. In the US, this power is frequently generated by burning coal (about 40% of all US power generation), which is extremely detrimental to the environment. Utilizing the KONAUS™ House PV solar system for the EV, battery charging effectively completely offsets the additional power that would be generated by the utility. This not only saves the environment from utility emissions, it saves the homeowner the significant expense of fueling his or her car at the gas station or from the local utility.

B. EV Charging

The KONAUS™ House provides the power for the Electric Vehicle. We will implement an EV inductive (resonant) charging system. This will eliminate the large power cord hanging around in the garage. The driver simply parks over the charging area embedded in a garage floor pad, and the EV will be automatically charged while parked. It is planned that the EV will be housed in the KONAUS House garage. This not only provides greater security, but facilitates the charging of the vehicle. KONAUS, LLC will implement a SAE Standard J2954 - Wireless Charging system. By simply parking the EV over the inductive floor charging pad in the garage, and the EV batteries would be automatically charged overnight, or during the daytime. The system requires a dedicated 220 Volt, 30 Ampere line from the house grid for best (fastest) charging results.

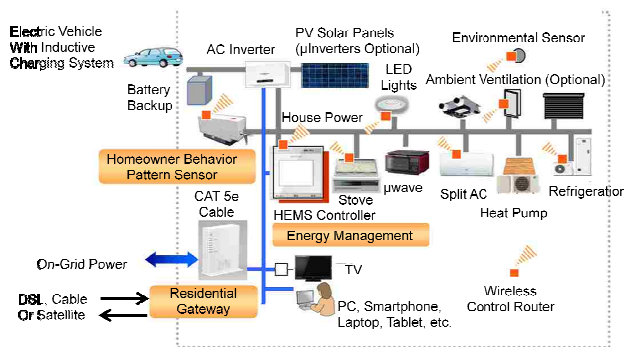


Fig. 3. Home Automation and Energy Management

VIII. KONAUS HOME AUTOMATION

A. Home Monitoring and Control

The KONAUS™ House utilizes a home automation smarthouse technology, including a home energy management system (HEMS). A “single pull” cable distributed from the home’s residential gateway for entertainment and communications is also planned. The overall system provides wireless energy control and reporting throughout the house. The house will have a unique secure website, accessible and controllable by the owner, both locally and remotely via a Smartphone. The house will enable safety, security, communication, house energy control, information and entertainment defined and controlled by the homeowner.

IX. LANDSCAPING

A. Selecting Hardscape Elements

The lot topography of the KONAUS House lot will be analyzed prior to landscaping. Utilizing existing stone, trees and other elements will be a priority. Ultimately, KONAUS lot will utilize local rock, stone and other design and decorative elements that do not require shipping long distances, or is otherwise disruptive to the environment.

B. Selecting Plants

The plants used on the Konaus lot will be hardy local varieties, or other plants that will do in the local climate, using minimal water, fertilizer or insecticide. There will be height and location constraints on trees and shrubs to maintain the integrity of the PV solar panels.

X. CONCLUSION

The patented KONAUS House will provide the homeowner with an energy independent extremely attractive smart home. Today, a standard “stick construction” (wooden studs) usually is initially sold with a one-year complete warranty and a ten-year warranty on the major construction elements of the house. The KONAUS House will offer the homeowner a warranty that is much longer (to be defined). It is the intent of the KONAUS initiative to attract long-term homeowners wishing to purchase a moderately priced home that is comfortable, attractive, and energy independent.

References

- [1] Motorola SPS, Motorola, Inc., Phoenix, Arizona, 1979
<http://greginthedesert.net/ahwatukey-arizonas-house-of-the-future/>
- [2] US Patent and Trademark Office, KONAUS LLC Patent Number 8,549,801, issued October 8, 2013.
- [3] Society of Automotive Engineers, SAE Standard J2954 - Wireless Charging.
- [4] Photovoltaic cell efficiencies reported from National Renewable Energy Laboratory (NREL).
- [5] TRON Intelligent House, 1989
<http://tronweb.super-nova.co.jp/tronintthouse.html>
<https://www.youtube.com/watch?v=7jPKEyM44GU>
- [6] Sakamura, K. (2005). Intelligent House in the Age of Ubiquitous Computing, In A House of Sustainability: PAPI. In *A+U*. A+U Publishing. pp. 56-65. TRON PAPI House, 2005
<http://tronweb.super-nova.co.jp/toyotadreamhousepapi.html>
<https://www.youtube.com/watch?v=vyhO6y2nUO>