



Environmental Energy Technologies Division Lawrence Berkeley National Laboratory

# Home Energy Saver A bit of Past, Present & Future

PG&E Visit, March 13, 2012

# The Home Energy Saver

## Web-based Energy Audit Tools & Services

### Home Energy Saver - Consumer

### Home Energy Saver - Pro

### Home Energy Scoring Tool

**HOME ENERGY SCORE**

Score: 6 / 10

Potential Savings: \$520

Recommended Upgrades:

- Seal Air Leaks
- Upgrade to Energy Star Appliances
- Install Programmable Thermostat
- Upgrade to Energy Star Water Heater
- Upgrade to Energy Star HVAC System

**Video: What is Home Energy Score?**

Watch this 3 minute video to learn about the DOE's new Home Energy Score Program. Home Energy Score offers householders and home buyers an easy and economical way to get a credible, home energy audit, with customized advice on how to save energy in your home and money on your utility bills.

- The Department of Energy's Home Energy Scoring Tool allows qualified assessors to:**
- Generate clear, credible home energy assessments at a reasonable cost;
  - Recommend customized upgrades and other cost saving tips; and,
  - Help consumers compare the energy use of different homes.

The Home Energy Scoring Tool is quick and easy to use. Qualified assessors can gather the information needed to assess a home in one short site visit. This low-cost, high value assessment can be provided as a stand-alone service or as an add-on to a home inspection or comprehensive energy audit.

For more information on how to become a qualified assessor or receive a home energy score, visit [www.homeenergyscore.gov](http://www.homeenergyscore.gov).



The Home Energy Scoring Tool was developed by Lawrence Berkeley National Laboratory in collaboration with the U.S. Department of Energy. The modeling engine can be licensed as a web service API.

# Key Milestones

- HES Consumer tool founded in 1994 by Evan Mills
- Partnership with the National Association of Rural Electric Cooperatives (NRECA) / Touchstone adopted HES as the official calculator for their ~30 million customers
- Licensing calculation engine to third-party software developers (started in 2009 with Microsoft)
- R&D100 award in 2010
- Launched Social Network for home performance pros in 2010 – ([homeenergypros.lbl.gov](http://homeenergypros.lbl.gov))
- Expansion to multifamily and Weatherization & Intergovernmental Program applications: 2010-2013

# Customer-facing Strategy

- Empower diverse users to apply state-of-the-art research & know-how to reduce home energy use, cost, and greenhouse-gas emissions
  - Do-it-yourself audit for consumers
  - More sophisticated tool for professionals
  - Asset rating for time-of-sale and other cross-home comparison situations
- Free user interfaces / Non-proprietary
- Customized experience (not “brochure-ware”)
- Reduce time required (and thus cost) for professional audits
- Serve diverse communities & building types
- Objective – Accurate – Transparent – Evolving

# Home Energy Saver: Consumer

**HOME ENERGY SAVER™**

START DESCRIBE COMPARE UPGRADE LEARN

*Save money, live better, help the earth!* Over 6 million visits!

**ENERGY CALCULATOR**

Enter your zip code, or  
 Enter previous session #

**GO**

[Look up zip code](#)

**Case Studies**

"Home Energy Saver helped me save thousands of dollars per year. It is one government service that makes paying taxes worthwhile."  
 — Nick Wilder  
 Wheat Ridge, Colorado

[Read more stories. Add yours.](#)

**Energy NewsWire**

- Thermostat Wars
- Seeing the Light: LED Under-Cabinet and Recessed Downlights
- What Kind of Green Jobs Most Interest You?

Get the latest on energy-efficiency tax credits  
 Obama at Home Depot  
 HES featured by Suze Orman in Oprah Magazine

**How do you compare?**  
 Do you program your thermostat?

Yes  
 No (but my thermostat is programmable)  
 I don't have a programmable thermostat

**SUBMIT** [What others say...](#)

More resources for: Teachers... [Energized Learning](#) • Professionals... [HESpro](#) • Help implementing our recommendations... [ENERGYSTAR.gov](#)

**HOME ENERGY SAVER™**

START DESCRIBE COMPARE UPGRADE LEARN

SMALL CHANGES MATTER | MAKING IT HAPPEN | DEEP RETROFITS | WHAT OTHERS ARE DOING | READINGS & RESOURCES

**WHAT OTHERS ARE DOING**

**CARBON FOOTPRINT**  
 Footprint Map | CarbonIQ

Scale (yearly tons of carbon dioxide per home)

Map Points Selector  
 Median by Zipcode/State (depends on zoom level)  
 Individual users

Put Yourself on the (Carbon) Map

Facebook

Annual CO<sub>2</sub> Emissions (metric tons per year):  
 Users in this Zip Code: 25838 (16 users)  
 Users in Maryland: 17,733 (132 users)  
 All U.S. users: 12.4 (22866 users)

Map Data ©2011 Google, Berkeley - Home Energy Saver

Current View  
 Zip-code level

**HOME ENERGY SAVER™**

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SMALL CHANGES MATTER | MAKING IT HAPPEN | DEEP RETROFITS | WHAT OTHERS ARE DOING | READINGS & RESOURCES

**DEEP RETROFITS**

**TOOLS OF THE TRADE**

**The State of the Art**  
 Your House as a System  
 Non-Energy Benefits

**Tools of the Trade**  
 Heat of Shame  
 Resources

A hammer and a saw used to be the key tools for home contractors. Today, the best-in-class also use high-tech equipment while performing a **professional energy audit** or verifying that construction has been done correctly. **Infrared cameras** can "see" heat loss and find hidden energy savings opportunities. **PFT tests** or **blower door tests** measure a home's air leakage and tell you when sealing has been successful. Combustion monitoring equipment and indoor-air pollution detectors ensure that a heating system is not only efficient but also not dumping dangerous pollutants into the home. All of these practices should be conducted with a mind towards **"whole-house system performance"**. **Professional energy audits** will bring many of these tools into play to help provide a very close look at how the house is built and operated.



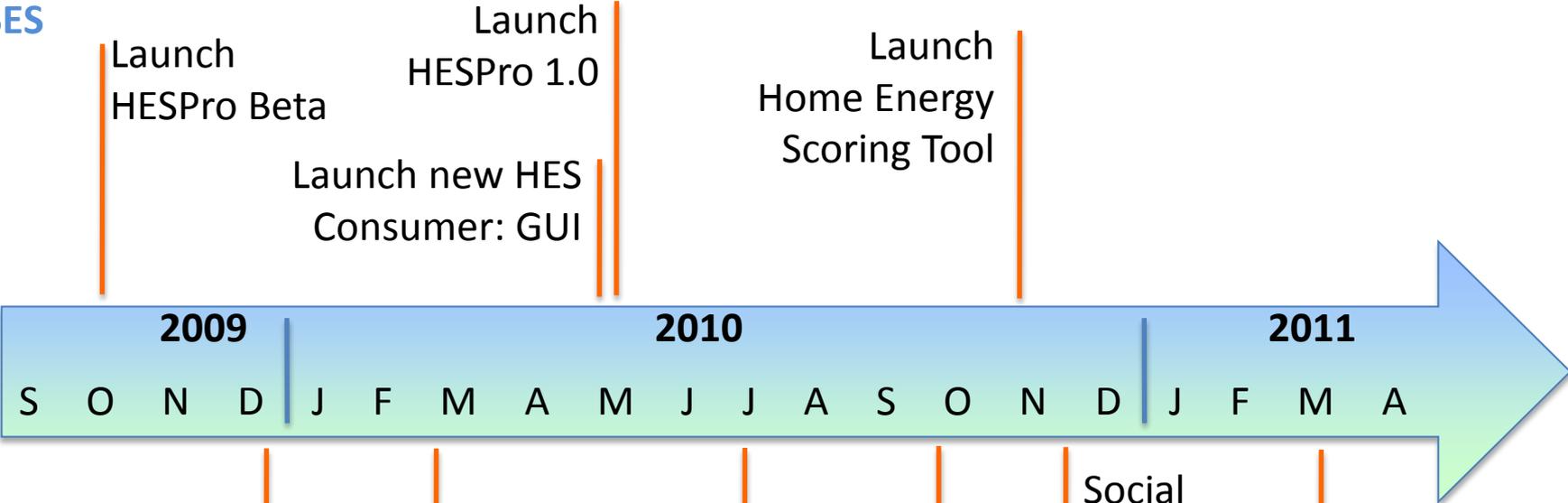
## Appliance Rebates in Your State



Each state and U.S. territory designed its own rebate program, and all 56 plans have been approved by the U.S. Department of Energy (DOE). [Learn about those programs, including their program start dates and specific eligibility criteria.](#) (Note: This Web site is the only official DOE-sponsored Web site; be

# Accomplishments under ARRA-BT

## TOOL RELEASES



## SUPPORTING ACTIVITIES

HESPro pilot testing

Social Media: FB & Twitter

R&D 100 Award

Social Media: Home Energy Pros

APIs 1.0 Launched

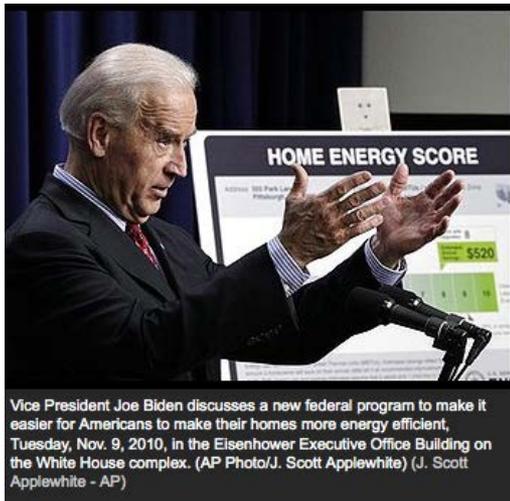
14 API Licensees

# Home Energy Saver: Pro

Not just a DOE-2 interface

Add/Remove	Upgrade	Upgrade Choice & Description	Yearly Savings	Estimated Added Cost	How Much is Too Much?	Simple Payback Time	Estimated Return on Investment	Avoided Emissions (lbs. CO <sub>2</sub> )
<input type="checkbox"/>	Check/Uncheck All Upgrades	<b>Total for Selected Upgrades:</b>	<b>\$2261</b>	<b>\$8192</b>	<b>\$22610</b>	<b>4</b>	<b>27%</b>	<b>22916</b>
<input checked="" type="checkbox"/>	Basement wall insulation	R-11	\$530	\$ 720	\$5300	1	74%	5384
<input checked="" type="checkbox"/>	Electric clothes dryer	Switch to gas dryer	\$100	\$ 160	\$1000	2	62%	303
<input checked="" type="checkbox"/>	Thermostat	ENERGY STAR-labeled program	\$159	\$ 320	\$1590	2	50%	1616
<input checked="" type="checkbox"/>	Duct Sealing	Reduce leakage to 6% of total air	\$403	\$ 890	\$4030	2	45%	4088
<input checked="" type="checkbox"/>	Indoor lights	CFLs in high-use fixtures	\$46	\$ 88	\$460	2	44%	846
<input checked="" type="checkbox"/>	Wall insulation	R-11 wall + R-5 exterior foam	\$520	\$ 1196	\$5200	2	43%	5278
<input checked="" type="checkbox"/>	Gas furnace	AFUE=90 ENERGY STAR	\$370	\$ 1126	\$3700	3	33%	3757
<input checked="" type="checkbox"/>	Clothes washer	MEF=1.42 WF=9.5 ENERGY STA	\$59	\$ 180	\$590	3	32%	428

# Home Energy Scoring Tool



Vice President Joe Biden discusses a new federal program to make it easier for Americans to make their homes more energy efficient, Tuesday, Nov. 9, 2010, in the Eisenhower Executive Office Building on the White House complex. (AP Photo/J. Scott Applewhite) (J. Scott Applewhite - AP)


Home Energy Scoring Tool
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Lawrence Berkeley  
National Laboratory



U.S. DEPARTMENT OF  
**ENERGY**

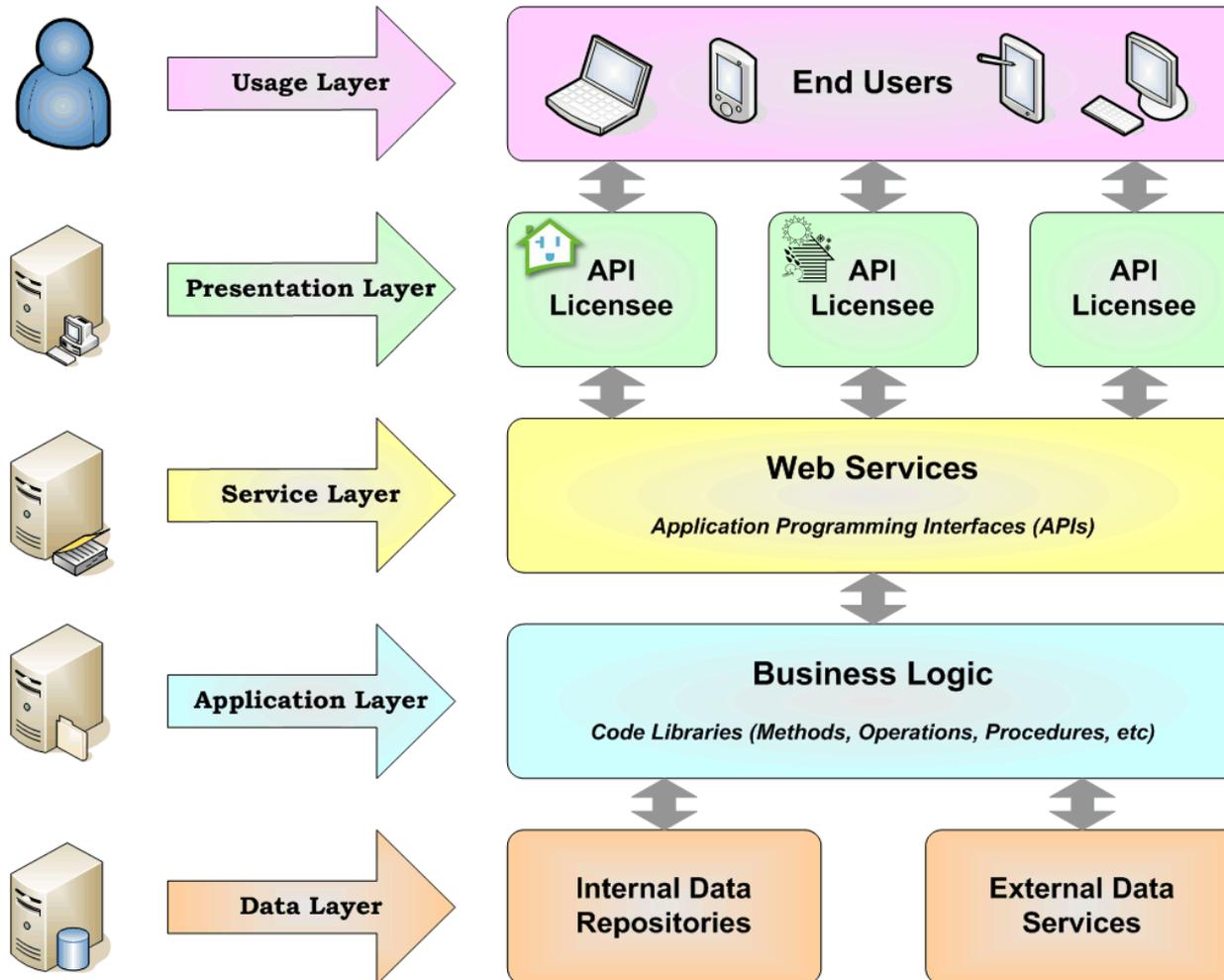
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[Privacy Policy](#) | [About Us](#) | [Contact Us](#)

- Launched by Vice President Biden November 9, 2010 [BETA]
- Pilots Tests Spring-Summer 2011
- National Launch version 1.0 – 1<sup>st</sup> Quarter 2012

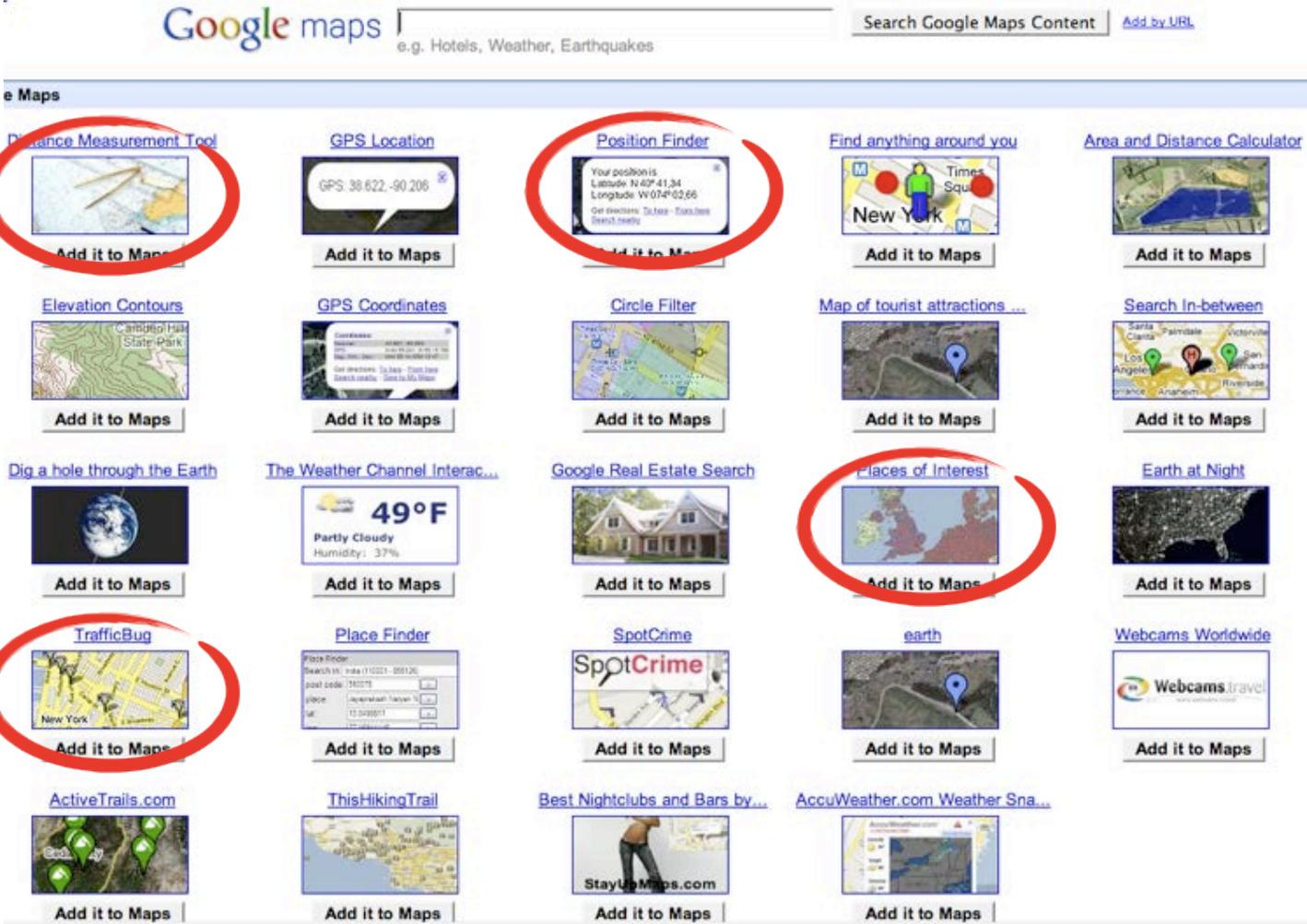
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Building Technology & Urban Systems

# What is an API?



# A Familiar API....

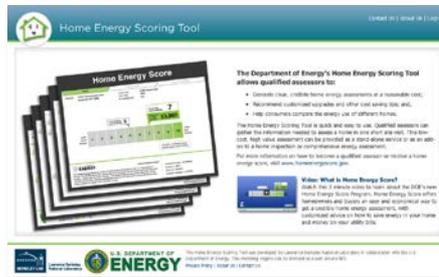


The image shows a screenshot of the Google Maps API tools page. At the top, the Google Maps logo is on the left, and a search bar with the text "Search Google Maps Content" and a link "Add by URL" is on the right. Below the search bar, a grid of 20 tool cards is displayed. Each card has a title, a small preview image, and an "Add it to Maps" button. Four cards are circled in red: "Distance Measurement Tool", "Position Finder", "Places of Interest", and "TrafficBug".

Tool Name	Preview Description	Button
Distance Measurement Tool	Map with two points and a line between them.	Add it to Maps
GPS Location	GPS coordinates: 38.622, -90.208.	Add it to Maps
Position Finder	Your position is Latitude: N 40° 41.34 Longitude: W 074° 02.66.	Add it to Maps
Find anything around you	Map of New York with a person icon and red dots.	Add it to Maps
Area and Distance Calculator	Map of a blue polygon.	Add it to Maps
Elevation Contours	Topographic map of Capitol Hill State Park.	Add it to Maps
GPS Coordinates	Map with a location pin and coordinate fields.	Add it to Maps
Circle Filter	Map with a yellow circle filter.	Add it to Maps
Map of tourist attractions ...	Map with a blue location pin.	Add it to Maps
Search In-between	Map showing locations between Santa Clara, Palmate, Victorville, Los Angeles, San Fernando, Riverside, Orange, Anaheim.	Add it to Maps
Dig a hole through the Earth	Image of Earth from space.	Add it to Maps
The Weather Channel Interac...	Weather widget showing 49°F, Partly Cloudy, Humidity: 37%.	Add it to Maps
Google Real Estate Search	Image of a house.	Add it to Maps
Places of Interest	Map of Europe with red location pins.	Add it to Maps
Earth at Night	Satellite image of Earth at night.	Add it to Maps
TrafficBug	Map of New York with a traffic bug icon.	Add it to Maps
Place Finder	Form for finding a place with fields for search, postal code, place, and lat.	Add it to Maps
SpotCrime	SpotCrime logo and map.	Add it to Maps
earth	Map with a blue location pin.	Add it to Maps
Webcams Worldwide	Webcams.travel logo.	Add it to Maps
ActiveTrails.com	Map with green location pins.	Add it to Maps
ThisHikingTrail	Map with a hiking trail.	Add it to Maps
Best Nightclubs and Bars by...	Map with a person icon.	Add it to Maps
AccuWeather.com Weather Sna...	AccuWeather.com logo and map.	Add it to Maps

# Existing HES API Users

Home Energy Saver:  
Consumer | Pro | Scoring Tool

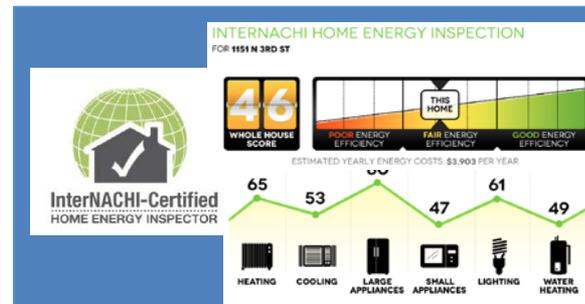


Cool California: CARB

Wattzon



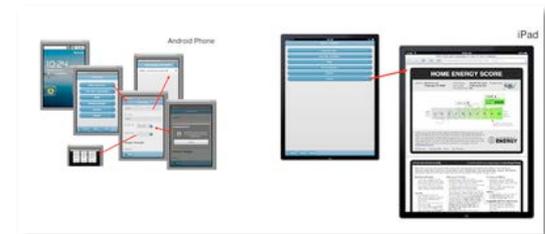
InterNACHI



iViro (iPhone)



MNCEE: mobile Scoring

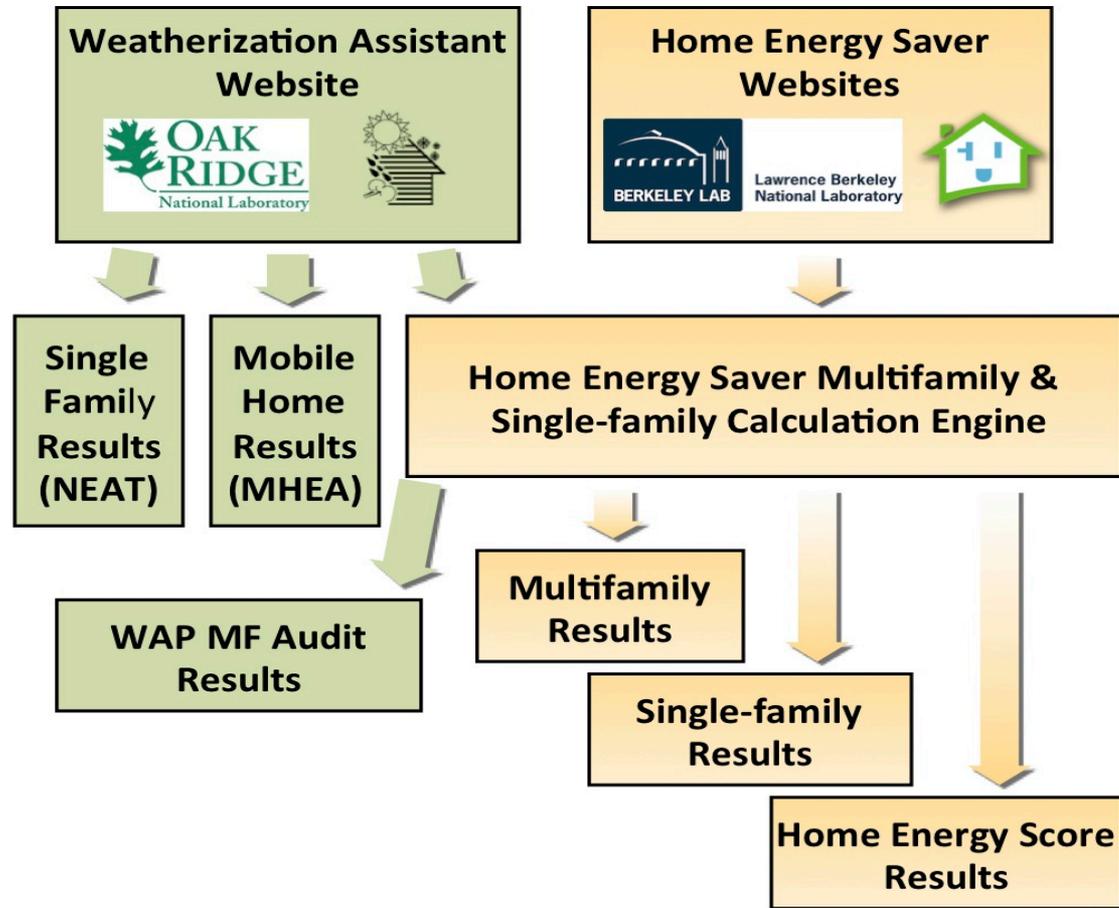


# Weatherization Assistant Changing



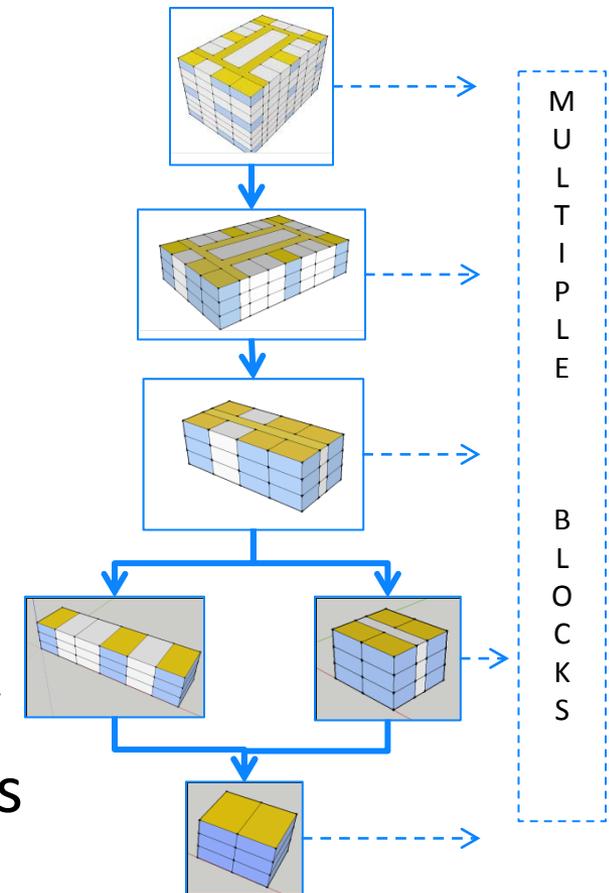
- NEAT, MHEA, H&S, NEBs, new multifamily tool
- All run as Internet web service, secure servers
- Central data base

# Weatherization Assistant Changing



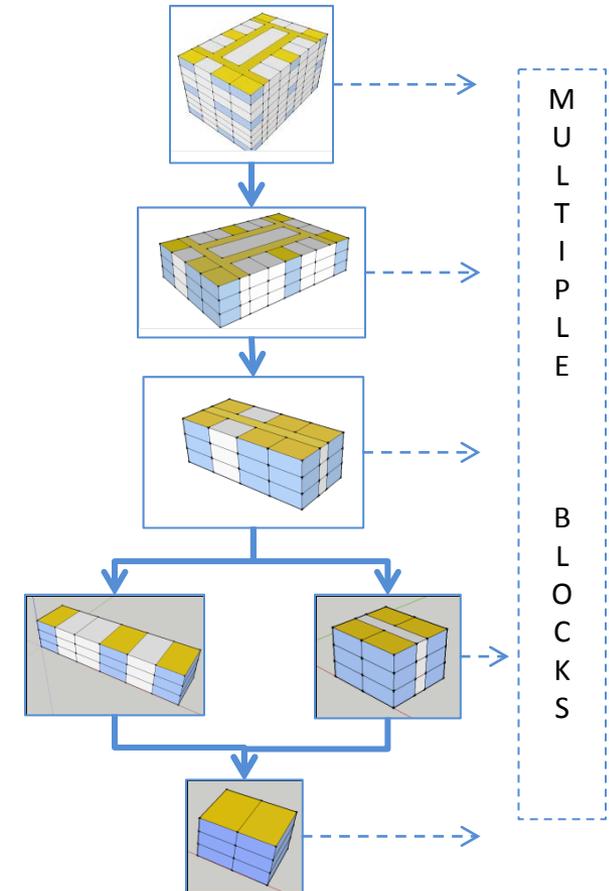
# Multifamily Tools Dev Staging

- **Version 1 (1<sup>st</sup> Quarter 2012)**, will handle buildings with simpler configurations, mostly low-rise buildings, available for testing soon
- **Version 2 (Winter 2013)** will be developed in a second stage and will increase the energy calculation capabilities to handle taller building configurations, more complex energy systems, and more complex measures



# New Modeling Approaches

- Multiple Thermal Zones, adaptive coding approach to generalize most/all geometries
- Simplified Building Typologies, balance simplification of input with complexity of buildings
- DOE-2.1e calculation engine, with specialized models as needed
- Macros and repetitive blocks of DOE-2 code for scaling spaces, surfaces, and systems as needed

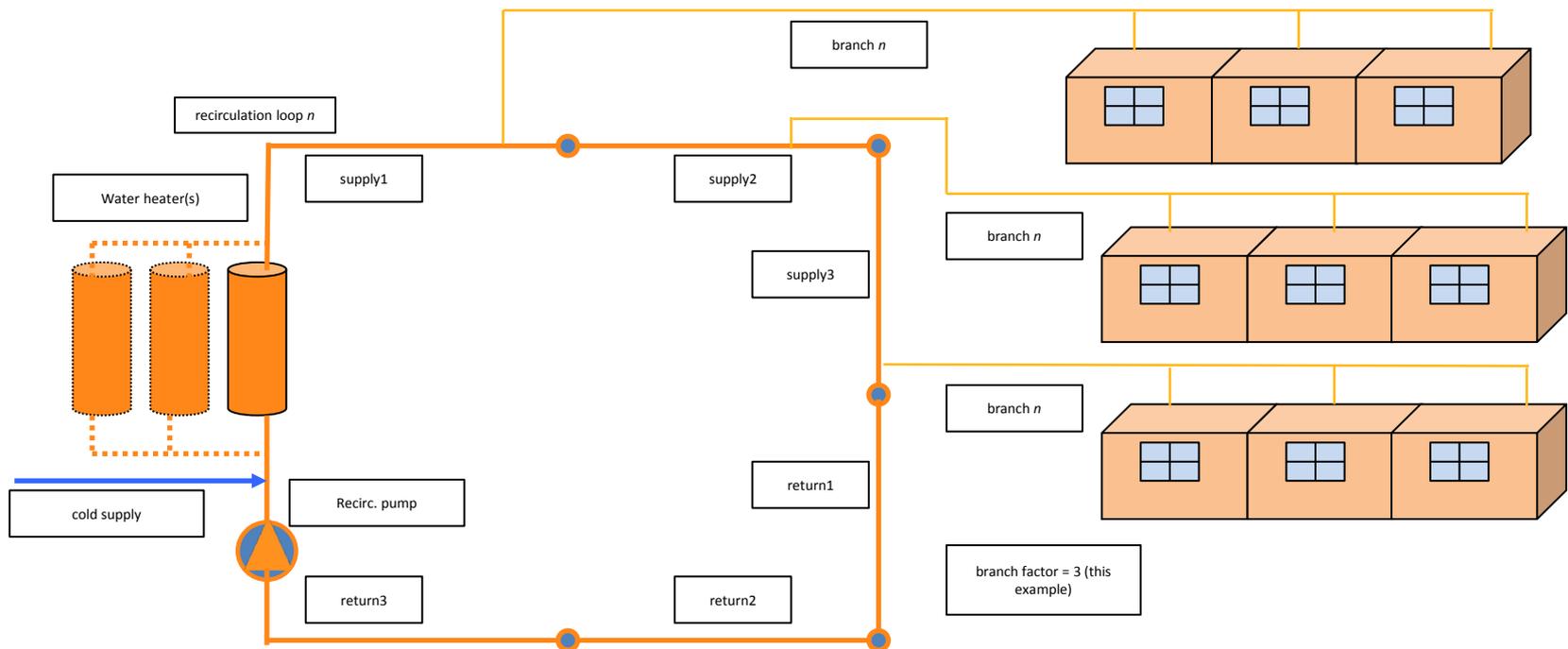


# Major Components Developed for the Multifamily Tool

- New HES MF API web service to HES back end applications (layers) to handle multifamily energy calculations and interfaces to different clients
- New re-architected HES backend building class model using state-of-the-art PHP methods and MySQL database
- Domestic Hot Water models for both single unit and central system types
  - Individual unit systems: Based on the existing Home Energy Saver model
  - Central plant based systems with recirculation loops: A generic non-California specific version built from the multifamily DHW model documented in *Draft Measure Information Template – Water and Space Heating ACM Improvement*, 2013 California Codes And Standards Enhancement Initiative report, May 24, 2011 Public Workshop. (“2013 CASE Space and Water Heating 051911.pdf”, PG&E, SCE, SDGE, Sempra. Download at [www.energy.ca.gov](http://www.energy.ca.gov))

# Major Components Developed for the Multifamily Tool

Central plant DHW systems with recirculation loops



# Future Directions

- Deploying at scale through web services so that third-party developers (public/private) can create user interfaces “powered” by HES
- Building engagement through Social Media communities
- Differentiating HESConsumer and HESPro offerings
  - HESConsumer Multifamily – Tenants
  - HESPro Multifamily – Owners/Property Managers
- Validating against actual home data
  - 1<sup>st</sup> round done with detailed data from Florida, Oregon and Wisconsin
- Mounting new technologies, modeling techniques, and interfaces

# Features in the pipeline

- Improved/updated defaults
- Expanded list of retrofit measures
- Batch run and parametric analysis features
  - Using APIs
- New technologies and end-uses
- Multifamily modeling
- Utility bill calibration
- Behavioral variables

# Team

**Founder and Project Leader - Evan Mills**

## CORE TEAM

Chief Engineer - Rich Brown

Senior Engineer - Norm Bourassa

Senior Engineer - Leo Rainer

Usability - Kath Straub

Research and User Support - Greg Homan

User Interface Programming - Sondra Jarvis and Vinit Jain

Graphic design and art direction - Anthony Ma, Eyespeak, and Karen Lee

Project manager - Chris Havstad

## CONTRIBUTORS

### Modeling

Heating/cooling simulation - Jeff Warner

Miscellaneous equipment - Marla Sanchez

Water heating - Jim Lutz

Ducts - Iain Walker

Electricity tariffs - Chris Bolduc, Richard White, Katie Coughlin

### Data

Weather data - Joe Huang, Steve Konopacki, Robin Mitchell

Zip-code-to-weather-tape correlation - Jesse Cohen

Market research - Mithra Moezzi, Celina Atkinson

Utility tariffs - Hongjie Qu

Carbon emissions factors - Jon Koomey

Appliances - Peter Biermayer, Judy Lai

Infiltration - Nance Matson

Product characteristics - Celina Atkinson

### Outreach

Social Media - Diane Chojnowski

Education - Rolland Otto, Mai Sue Chang, Eli Marienthal

### IT and Software Engineering

Web application programming - Bighead Technologies

### Testing

Infosys

uTest.com

# Extras

# Home Energy Saver in a Nutshell

- Developed at LBNL. Sponsors: DOE, EPA, HUD/PATH, CEC, California Air Resources Board, Touchstone Energy Cooperatives, Infosys
- Web-based hourly simulation: DOE-2 (single-zone) and other models.
- Computes a home's energy consumption (all end uses), cost, and carbon footprint on-line in a matter of seconds for any location in the US. Benchmarks to typical homes, by geography.
- Hundreds of possible “asset” and “operational” inputs, with smart defaults available for each home description question.
- Generates a list of payback-ranked energy-saving recommendations.
- Provides extensive decision-support information to help users implement the recommendations. Linked social media environments.
- Transparently documented – no “black boxes”
- 600k plus web visits each year
- Third-party developers creating derivative tools via APIs for desktop & mobile applications