Remodeling for Comfort, Health & Energy Efficiency

Why Remodel?

To live comfortably

- Highly-insulating windows
- Water efficient high speed clothes washers
- Efficient duct systems
- Well-insulated ceilings, attics & crawlspaces
- Energy efficient compact fluorescent or LEDs

http://hes.lbl.gov/consumer/
Why??

To live healthier:
By reducing health problem associated with mold, carbon monoxide, and other toxic chemicals

U.S. Environmental Protection Agency (EPA) studies show that levels of air pollution inside the home are often 2 to 5 times higher than outdoor levels.
Why Again???

Where does my money go!
Energy Use

- Cooling: 30%
- Heating: 16%
- Water heating: 14%
- Appliances: 13%
- Lighting: 12%
- Electronics: 4%
- Other: 11%
Typical home energy improvements include:

• High-Efficiency Air Conditioners
• Simplified Duct Layouts and Air-Balance
• Attic Insulation and/or radiant barriers
• Duct Sealing
• Sealing External Air Leaks – not caulking
• Solar Shading (external)
• Energy Star Lighting and Appliances
Who Can Help

• Regardless of your knowledge, experience and skills, the following organizations and/or the publications they’ve developed can help you do it yourself (DIY) or find someone who will help you.
  – Environmental Protection Agency (EPA) and Department of Energy (DOE) Energy Star for Homes, WaterSence, Indoor airPlus
  – Oncor
  – ASID & USGBC - REGREEEN Guide
  – Energy Efficiency and Renewable Energy branch of the DOE “Building America Guides”
Energy Star

Home Energy Yardstick it’s online and it’s free

https://www.energystar.gov/index.cfm?fuseaction=home_energy_yardstick.showGetStarted
WaterSense

<table>
<thead>
<tr>
<th>Water Heater Type</th>
<th>Efficiency (EF)</th>
<th>Installed Cost 1</th>
<th>Yearly Energy Cost 2</th>
<th>Life (years) 3</th>
<th>Total Cost (Over 13 Years) 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional gas storage</td>
<td>0.60</td>
<td>$350</td>
<td>$350</td>
<td>13</td>
<td>$5,394</td>
</tr>
<tr>
<td>High-efficiency gas storage</td>
<td>0.85</td>
<td>$1,025</td>
<td>$323</td>
<td>13</td>
<td>$5,220</td>
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<tr>
<td>Condensing gas storage</td>
<td>0.88</td>
<td>$2,000</td>
<td>$244</td>
<td>13</td>
<td>$5,170</td>
</tr>
<tr>
<td>Conventional oil-fired storage</td>
<td>0.55</td>
<td>$1,400</td>
<td>$654</td>
<td>13</td>
<td>$11,289</td>
</tr>
<tr>
<td>Minimum Efficiency electric storage</td>
<td>0.90</td>
<td>$750</td>
<td>$463</td>
<td>13</td>
<td>$6,769</td>
</tr>
<tr>
<td>High-eff electric storage</td>
<td>0.95</td>
<td>$820</td>
<td>$430</td>
<td>13</td>
<td>$6,528</td>
</tr>
<tr>
<td>Demand gas (no pilot) 5</td>
<td>0.32</td>
<td>$1,600</td>
<td>$250</td>
<td>13</td>
<td>$4,925</td>
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<tr>
<td>Electric heat pump water heater</td>
<td>2.20</td>
<td>$1,660</td>
<td>$190</td>
<td>13</td>
<td>$4,126</td>
</tr>
<tr>
<td>Solar with electric back-up</td>
<td>1.20</td>
<td>$4,800</td>
<td>$175</td>
<td>13</td>
<td>$7,072</td>
</tr>
</tbody>
</table>

1. Purchase costs include our best estimates of installation labor and do not include financial incentives.
2. Operating cost is based on hot water needs for a typical family of four and energy costs of $0.56/kWh for electricity, $1.40/therm for gas, $2.49/gallon for oil.
3. Life expectancy for water heaters is highly variable, largely dependent on water hardness, and on maintenance.
4. Future operating costs are neither discounted nor adjusted for inflation.
5. Currently, there is too little data to accurately estimate life expectancy for tankless water heaters, but preliminary data shows that tankless water heaters could last up to 20 years. For all water heaters, life expectancy will depend on local variables such as water chemistry and homeowner maintenance.

http://www.aceee.org/consumer/water-heating
Indoor airPLUS

Why does indoor air quality matter?

Why design and build with Indoor airPLUS?

NEXT SLIDE SIR
Indoor Air Quality Factors

Mold can lead to allergic reactions, asthma, and other respiratory ailments.

- Mold can grow anywhere there is moisture.
- The key to mold control is to maintain control.
- If mold is a problem in your home, you should clean up the mold promptly and fix the water problem.
- Air movers and fans can be used to speed the process.

VOCs cause eye, nose, and throat irritation, headaches, nausea, and can damage the liver, kidney, and central nervous system.

- Volatile organic compounds (VOCs) are chemicals that evaporate at room temperature. VOCs are found in a wide variety of products used in homes including paints, adhesives, glues, floor coverings, cleaners, and household products.
- Some VOCs can be hazardous to health, especially when present in high levels.
- Air movers and fans can be used to help remove VOCs from the air.

Radon is the second leading cause of lung cancer.

- Radon gas enter your home through cracks and openings in floors and walls in contact with the ground.
- Test your home with a do-it-yourself radon test kit. If the test results indicate a high level of radon, you should hire a professional to test your home.
- Ask your builder about including radon Mitigation Systems in your new home at the time of construction.

Carbon monoxide causes headaches, dizziness, drowsiness, nausea, and fatigue, and high levels can be fatal.

- Carbon monoxide is a colorless, odorless gas that is released by burning fuel.
- Install carbon monoxide detectors in your home.

Nitrates cause eye, nose, and throat irritation, impairs lung function, and increases respiratory infections.

- Nitrates are found in diesel exhaust and tobacco smoke.
- Install a proper ventilation system to reduce the levels of nitrates in your home.

Visit www.epa.gov/iaq
Oncor and “Home Performance With Energy Star Programs” can help.

Oncor provides a choice of up to $1,500 in cash incentives or access to third-party financing for qualified energy-saving home improvements. For further savings, you can also take advantage of available federal tax credits.

http://www.texassavesenergy.com/
REGREEN HP

Home Performance
The contractor approaches home energy improvement with:
– a whole-house systems approach,
– Integrating energy efficiency,
– Combustion safety,
– Moisture management,
– Ventilation strategies,
– Overall building durability.
A green gut rehab is all about systems integration: how does one bring the building interior up to 21st-century form and function and other life-style requirements.
Deep Energy Retrofit

Total household energy reductions of 50% to 90% are achieved by addressing all or nearly all loads:
• space conditioning,
• hot water,
• lighting,
• appliances,
• plug load,
• sometimes even transportation.
Benefits of Owning a Builders Challenge Home
For a 2,500 sq ft home using a Builders Challenge Technology Information Package:

<table>
<thead>
<tr>
<th>Upgraded Energy Savings Level</th>
<th>Minimum Builders Challenge Level</th>
<th>Premium Efficiency Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas Electric</td>
<td>Gas Electric</td>
</tr>
<tr>
<td>Savings on annual utility bill</td>
<td>$450 $411</td>
<td>$605 $645</td>
</tr>
<tr>
<td>Increase in annual energy payment from energy upgrades</td>
<td>$137 $147</td>
<td>$250 $439</td>
</tr>
<tr>
<td>Net annual savings</td>
<td>$313 $264</td>
<td>$352 $282</td>
</tr>
</tbody>
</table>

1. Estimated values to the 2006 International Energy Conservation Code, using average utility rates and climate data for this climate. Specific energy will vary.
2. Based on a 30-year mortgage at 7.5% APR.

Using the E-Scale to Market Your Homes
The EnergySmart Home Scale (E-Scale) may be used by builders who use BC TIPS to quality their homes for the Builders Challenge. The E-Scale also helps homebuyers recognize that homes meeting the Builders Challenge represent the best energy performance, quality, comfort, health, and safety available.

Go “green” in your home

Top areas where it makes the most sense to go “green” in your home:

• Heating and cooling systems
• Roofing
• Solar
• Windows
• Doors

Source: Environmental Protection Agency
Geothermal Heat Pumps (Ground Source)

If rising energy prices have you feeling like it’s time to go hybrid on the home front, here are a few options to consider.

Facts to consider:
1. Your body temperature is around 98.6 deg
2. Electric heating = air temperature is around 94 deg Fahrenheit (5 deg. less than your body temperature). The air will feel cool
3. Gas heating = air temperature is above 103 deg Fahrenheit (6 deg. warmer than your body temperature). The air will feel warm
4. Propane heating = air temperature is around 106 deg Fahrenheit (9 deg. warmer than your body temperature). The air will feel hot
5. All refrigerant today are required to be R-410(a) or better (esp. chilled water)

http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html
Going Green with Roofing

Metal Roofing

If metal roofing reduces air conditioning cost by up to 20%. Say, your utility cost for air conditioning is $3,000 per year then your annual savings would be 600 dollars. Five years savings would be 3,000 dollars.

I’ll bet you the cost of energy goes up substantially over the life of a metal roof.

Do you want to bet???
Going Green using the Sun

Solar Energy for Heating and Electricity

• Photovoltaic Panels
• Solar Water Heating
• Or both

http://www.dsireusa.org
Going Green with Windows

UPGRADE TO ENERGY STAR
ANNUAL SAVINGS¹

http://www.energystar.gov/index.cfm?c=windows_doors.pr_benefits

¹ U.S. Department of Energy. Savings estimates based on an even mix of one- and two-story detached homes of 1700 or 2600 sq. ft. respectively, with 15% of their floor space in windows that are equally distributed across compass directions. Heating and cooling systems are modeled as either natural gas heat with electric air conditioning or electric heat pump, according to the regional breakdown reported in the Energy Information Administration’s (EIA) 2005 Residential Energy Consumption Survey. Estimates use the EIA’s 2006 average natural gas prices and 2007 electricity prices. Actual savings will vary by local climatic conditions, utility rates, and individual home characteristics. Hawaii was excluded from this analysis, as the assumptions in the standard software program used for calculating the impact of windows on heating and cooling costs for the residential sector diverge significantly from the norm in Hawaii.
# Going Green with Doors

## ENERGY STAR® Qualification Criteria for Residential Doors

<table>
<thead>
<tr>
<th>Glazing Level</th>
<th>U-Factor$^1$</th>
<th>SHGC$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaque</td>
<td>≤ 0.21</td>
<td>No Rating</td>
</tr>
<tr>
<td>≤ ½-Lite</td>
<td>≤ 0.27</td>
<td>≤ 0.30</td>
</tr>
<tr>
<td>&gt; ½-Lite</td>
<td>≤ 0.32</td>
<td>≤ 0.30</td>
</tr>
</tbody>
</table>

$^1$ Btu/h·ft$^2$·°F

$^2$ Fraction of incident solar radiation

\[ .21U = 4.76R \quad .27U = 3.7R \quad .32U = 3.1R \]
Questions????

Remodeling for Comfort, Health & Energy Efficiency

Appendix
## Energy use hot water systems

<table>
<thead>
<tr>
<th>Water Heater Type</th>
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<th>Yearly Energy Cost 2</th>
<th>Life (years)</th>
<th>Total Cost (Over 13 Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional gas storage</td>
<td>0.60</td>
<td>$850</td>
<td>$350</td>
<td>13</td>
<td>$5,394</td>
</tr>
<tr>
<td>High-efficiency gas storage</td>
<td>0.65</td>
<td>$1,025</td>
<td>$323</td>
<td>13</td>
<td>$5,220</td>
</tr>
<tr>
<td>Condensing gas storage</td>
<td>0.86</td>
<td>$2,000</td>
<td>$244</td>
<td>13</td>
<td>$5,170</td>
</tr>
<tr>
<td>Conventional oil-fired storage</td>
<td>0.55</td>
<td>$1,400</td>
<td>$654</td>
<td>8</td>
<td>$11,299</td>
</tr>
<tr>
<td>Minimum Efficiency electric storage</td>
<td>0.90</td>
<td>$750</td>
<td>$463</td>
<td>13</td>
<td>$6,769</td>
</tr>
<tr>
<td>High-eff. electric storage</td>
<td>0.95</td>
<td>$820</td>
<td>$439</td>
<td>13</td>
<td>$6,528</td>
</tr>
<tr>
<td>Demand gas (no pilot) 5</td>
<td>0.82</td>
<td>$1,600</td>
<td>$256</td>
<td>13</td>
<td>$4,925</td>
</tr>
<tr>
<td>Electric heat pump water heater</td>
<td>2.20</td>
<td>$1,660</td>
<td>$190</td>
<td>13</td>
<td>$4,125</td>
</tr>
<tr>
<td>Solar with electric back-up</td>
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<td>$4,800</td>
<td>$175</td>
<td>13</td>
<td>$7,072</td>
</tr>
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</table>

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http://www.aceee.org/consumer/water-heating
Deciding to remodel your home is a big decision. Outside of buying your home, it may be the single biggest investment you make. You need to know that the remodeling contractor you choose is a full-time, dedicated remodeling professional. NARI's certification program offers this assurance through its extensive screening and testing process. Only full-time, professional remodeling contractors are eligible for certification by NARI. You can be assured that any time you hire a NARI certified remodeling contractor, you are hiring an individual who has made a strong commitment to the professionalism of the remodeling industry and to his or her business.
### Annual Estimated Savings for Every $100 of Costs
(Source: www.energysavers.gov)

<table>
<thead>
<tr>
<th>Existing System SEER</th>
<th>New/Upgraded System SEER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COOLING</td>
</tr>
<tr>
<td></td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>$23</td>
</tr>
<tr>
<td>11</td>
<td>$15</td>
</tr>
<tr>
<td>12</td>
<td>$8</td>
</tr>
<tr>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
</tr>
</tbody>
</table>

### Annual Estimated Savings for Every $100 You Spend on Fuel
(Source: www.energysavers.gov)

<table>
<thead>
<tr>
<th>Existing System AFUE</th>
<th>New/Upgraded System AFUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HEATING</td>
</tr>
<tr>
<td></td>
<td>75%</td>
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<tr>
<td>50%</td>
<td>$33</td>
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<tr>
<td>55%</td>
<td>$27</td>
</tr>
<tr>
<td>60%</td>
<td>$20</td>
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<td>65%</td>
<td>$13</td>
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<td>70%</td>
<td>$7</td>
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<td>75%</td>
<td>-</td>
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<tr>
<td>80%</td>
<td>-</td>
</tr>
<tr>
<td>85%</td>
<td>-</td>
</tr>
<tr>
<td>90%</td>
<td>-</td>
</tr>
</tbody>
</table>

*Assuming the same heat output*

For information on Building America visit www.buildingamerica.gov. The website contains expanded case studies, technical reports, and best practices guides.
Figure 3.1. Basic Decisions for Replacing Your Cooling System

For information on Building America visit www.buildingamerica.gov. The website contains expanded case studies, technical reports, and best practices guides.
**Table 3.1. Common Cooling Systems Options**

<table>
<thead>
<tr>
<th>System</th>
<th>Fuel Type</th>
<th>Cost*</th>
<th>Ducts or No Ducts?</th>
<th>Central or Room Cooling</th>
<th>Operates as Heater in Winter</th>
<th>Federal Minimum Efficiency Req</th>
<th>Efficiency Range for high-performing models</th>
<th>Energy Star Minimum Efficiency</th>
<th>CEE Minimum Efficiency</th>
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</thead>
<tbody>
<tr>
<td>Ducted Central AC (Split)*</td>
<td>Electricity</td>
<td>Medium</td>
<td>Ducts</td>
<td>Central</td>
<td>No</td>
<td>SEER 13</td>
<td>SEER 14.5-20, EER 9-15</td>
<td>SEER 14.5, EER 12</td>
<td>Tier 1:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Tier 2:</td>
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<td></td>
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<td></td>
<td>Tier 4:</td>
</tr>
<tr>
<td>Room Air Conditioning</td>
<td>Electricity</td>
<td>Low</td>
<td>No Ducts</td>
<td>Room</td>
<td>No</td>
<td>EER 9.8</td>
<td>EER 10.7-12</td>
<td>10.7 EER**</td>
<td>9.8-11.8 EER***</td>
</tr>
<tr>
<td>Air-Source Heat Pump</td>
<td>Electricity</td>
<td>Medium-High</td>
<td>Ducts</td>
<td>Central for Air-Source HP</td>
<td>Yes</td>
<td>SEER 13</td>
<td>SEER 14.5-22, EER 9-14</td>
<td>SEER 14.5, EER 12</td>
<td>Tier 1:</td>
</tr>
<tr>
<td>Ground-Source Heat Pump</td>
<td>Electricity</td>
<td>Very High</td>
<td>Ducts</td>
<td>Central</td>
<td>Yes</td>
<td>---</td>
<td>EER 8.7-23**</td>
<td>EER 14.1</td>
<td>Closed-loop M1 EER, Open-loop 16.2 EER, Direct Expands, 15 EER, With Desuperheater</td>
</tr>
<tr>
<td>Ductless Heat Pump</td>
<td>Electricity</td>
<td>High</td>
<td>No Ducts</td>
<td>Room for Ductless</td>
<td>Yes</td>
<td>SEER 13</td>
<td>SEER 14.5-26</td>
<td>SEER 14.5, EER 12</td>
<td>Tier 1:</td>
</tr>
<tr>
<td></td>
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<td>Tier 3:</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tier 4:</td>
</tr>
</tbody>
</table>

*Estimated typical installed costs; does not include adding or repairing ducts. Low: $1,500 or less; Medium: $1,500-$4,500; High: $4,500-$10,000; Very High: $10,000 or more (www.energysavers.gov).

**This is the ENERGY STAR level for closed-loop water-to-air systems. Find minimum EERs for other configurations at EnergyStar.gov.

***This is the ENERGY STAR level for window units with four-sided and capacity between 14,000-19,999 Btu/hr. Find minimum EERs for other configurations at EnergyStar.gov.

1CEE is the Consortium for Energy Efficiency, www.cee.org

2Depends on air conditioner size:
- >8,000 Btu/hr: Tier 1=11.2 EER, Tier 2=11.6 EER
- 8,000-13,999 Btu/hr: Tier 1=11.3 EER, Tier 2=11.8 EER
- 14,000-19,999 Btu/hr: Tier 1=11.2 EER, Tier 2=11.6 EER
- >20,000 Btu/hr: Tier 1=11.8 EER, Tier 2=12.2 EER

3Seasonal Energy Efficiency Ratio (SEER): SEER is a measure of equipment energy efficiency over the cooling season. It represents the total cooling of a central air conditioner or heat pump (in Btu) during the normal cooling season as compared to the total electric energy input (in watt-hours) consumed during the same period.

4Energy Efficiency Ratio (EER): EER is an efficiency rating for room air conditioners based on how many Btu of heat per hour the unit can remove for each watt of power it draws. This ratio is expressed in Btu per hour per watt (Btu/hr/watt).

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### Building America Teams

#### ARIES Collaborative
- **Advanced Residential Integrated Energy Solutions (ARIES)**
  - Lead: The Levy Partnership, Inc.
  - Coordinator: Helen Adams, Director for International Programs, Synapsis, Building Research Alliance.

#### BIRA
- **Building Industry Research Alliance (BIRA)**
  - Lead: Consuel

#### BiRAC
- **Building Industry Research and Technology Alliance (BiRAC)**
  - Lead: Consuel

#### CarB
- **Consortium for Advanced Residential Buildings (CARB)**

#### EIA
- **Energy Information Administration (EIA)**
  - Lead: Consuel

#### NREL
- **National Renewable Energy Laboratory (NREL)**
  - Lead: Consuel
  - Members: National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory.

#### NREL/DOE
- **National Renewable Energy Laboratory/Department of Energy (NREL/DOE)**
  - Lead: Consuel
  - Members: National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory.

#### PARR
- **Partnership for Advanced Residential Retrofit (PARR)**
  - Lead: Gas Technology Institute
  - Members: CNT Energy, the Midwest Energy Efficiency Alliance, the Building Research Council at the University of Illinois, and Future Energy Technologies.

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