Challenges/Opportunities in providing green financial products in a developing country context

Jeff Culp, August 25, 2015
Drivers to sustainability

- Reduced operating costs important to consumers
- Energy security at a national level
- Reduced pollution
- Better management of peak load demand for utilities
- Availability of international development and GHG funding
- Addressing housing shortages (in quantity and quality)
Co-benefits of sustainable housing

- Social
  - Health
  - Comfort
  - Disposable income
  - Equality

- Environmental

- Economic
  - Employment
  - Imports
  - Competitiveness
  - Expansion of markets

- Energy
  - Energy security
  - Quality of service
Green, sustainable housing

- Was invented in affluent countries where it is colder:
  - Air tight construction
  - Whole-house mechanical ventilation with energy recovery
  - Well insulated

- But our energy (carbon) use is overwhelmingly for space conditioning
No agreement/single approach

- Insulate? Why?
- Are vapour diffusion and thermal bridging even issues?
- Widely varying climate zones
Supply chain issues

- Quality windows
- Mechanical ventilation systems
- Ducting
Plus society is changing

- As affluence grows, so do carbon emissions
- New social policies lead to densification
- Tall buildings operate differently than low-rise buildings
...and that leads to this
One of the most successful Green Mortgage schemes anywhere is in Mexico.

We monitored early examples of houses built to the scheme and found unexpected risks.
Dewpoint – mould risk

Plot 29 Bedroom North Wall
February and March 2013

Ceiling
Top of Wall
Middle of Wall
Bottom of Wall
Dewpoint
Indoor Air Quality – health risk

Plot 38  Carbon Dioxide

- Carbon Dioxide
- Adverse Health
- Level for Safety

ppm

Insulation reduced household energy consumption significantly. All houses monitored had pre-installed air conditioning. Significant energy savings were found in houses with insulation. This means that in some applications, partial insulation installation makes sense. It also means that the greatest heat gain is through the roof.

<table>
<thead>
<tr>
<th>Mes</th>
<th>Convencional</th>
<th>Ahorra es cuándo</th>
<th>Diferencia en %</th>
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<tbody>
<tr>
<td>Junio</td>
<td>740</td>
<td>472</td>
<td>36%</td>
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<tr>
<td>Julio</td>
<td>913</td>
<td>663</td>
<td>27%</td>
</tr>
<tr>
<td>Agosto</td>
<td>1110</td>
<td>826</td>
<td>26%</td>
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<tr>
<td>Sept</td>
<td>832</td>
<td>656</td>
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<tr>
<td>Oct</td>
<td>569</td>
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<td>31%</td>
</tr>
<tr>
<td>Nov</td>
<td>192</td>
<td>124</td>
<td>35%</td>
</tr>
<tr>
<td>Dic</td>
<td>169</td>
<td>99</td>
<td>41%</td>
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Fuente: Lean House
Monitoring allowed us to isolate the consumption of the AC units. Insulation reduced the energy consumption by the AC unit by over 50% in August, representing a savings to the homeowner of 622 pesos – approximately the monthly mortgage payment.

This graph also demonstrates the building's inability to hold heat in the winter because only partial insulation was used. The conclusion is that partial insulation is useful, but not in climate zones that have cool winters (such as Mexicali).

<table>
<thead>
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<th>Ahorra es cuando</th>
<th>Ahorro en %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junio</td>
<td>$541.18</td>
<td>$332.11</td>
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<td>Julio</td>
<td>$731.52</td>
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<td>$296.40</td>
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<tr>
<td>Nov</td>
<td>$272.40</td>
<td>$175.12</td>
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<tr>
<td>Dic</td>
<td>$151.08</td>
<td>$90.00</td>
<td>40%</td>
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Occupant behaviour

<table>
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<th>Plot 29</th>
<th>Plot 38</th>
<th>Plot 40</th>
<th>Plot 41</th>
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<td>max</td>
<td>min</td>
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<td>August</td>
<td>38.5</td>
<td>30.1</td>
<td>37.9</td>
<td>25.2</td>
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<td>33.6</td>
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Air conditioner set-points are very high:

1. We don’t know behaviour well enough to model
2. We may be able to build to avoid air conditioners
Can we ventilate passively?

Range hood to remove CO

Solar chimney for passive ventilation
Air Flow Cooling

- **General Principles**
  - Orient openings to cooling breezes
  - 4 to 6% of floor area in opening windows
  - Leeward windows 50 to 100% larger than windward windows
  - Reduce barriers to air flow through building
  - High ceilings to allow for temperature stratification

Open floor plan, windows oriented to prevailing winds
Air Flow Cooling

Casement windows

Wall fin
Energy modelling software

- Energy modelling software is essential for risk management
- Current packages are inappropriate (thermal mass, thermal bridging, the equator)
- A tested Latin American package needs to be designed
- Do we know enough about occupant behaviour to do baseline inputs?
Problem: Social Housing

Costa Rica social housing units:
- 42 square metres
- No space conditioning
- No hot water systems

How do we reduce energy consumption when there isn’t any?
Materials substitution

Agricultural fiber panels – rice or wheat straw
  • Rice grown in 26 Latin American countries 22m tonnes/year
  • Historically low prices – a market for waste
  • Significant wheat production Brazil, Argentina, Chile

Bamboo
  • Native species grow in almost all Caribbean, Central and South America
  • 11 million hectares
Other opportunities
Costa Rica solar irradiance
Solar irradiance by time: January

700 W/m²
Issues for lenders

- Contractual arrangements to de-couple up-front costs
- Split incentive
- Poor understanding of lifecycle costs
- Tools to reflect new cash-flow implications (“performance value” need to be universal, verifiable and accurate)
Issues for lenders

- No “generally accepted” contract to ensure benefits over time and multiple owners
- Poor understanding of building science which could identify non-financial risks
Voluntary labelling programs
Voluntary labelling programs

- Standards could be voluntary at first, then mandatory
- Aids decision-making on best approaches
- Encourages understanding
- Excellent first step
Why Super E® Works

- Common, basic set of objectives
- Agreed-upon method of meeting objectives, backed by a recognized scientific authority
- A training curriculum
- A central, independent office that keeps records and provides central point of information
- A ruling body made up of members; expertise that can be called upon by the Office
Why Super E® Works

- A documented procedure to test and register houses
- A documented procedure to audit results
- A published manual setting out technical standard and administration and governance
- A credible backer

- A trademarked and marketable “brand name” providing potential value to members