Jumpstart to Energy Efficient Construction
Context
Sustainability Definition

Improving QUALITY OF LIFE FOR ALL while enhancing nature
Global Movement

- 80 affiliated cities
- 25% of global GDP
- 1 in 12 people worldwide
- 8,068 actions to combat climate change
Global Movement

9400+ Cities
Global Movement

Oslo: 75% of 2019 car sales electric
Global Movement

Copenhagen's ambitious push to be carbon-neutral by 2025
Global Movement

50,000 South Australian homes to get free solar and batteries
Global Movement

India’s Goal: Power 60 Million homes with Solar Power
Global Movement

Global investors including sustainability criteria in credit ratings and investments
Background

Global Floor Space Growth (2015 – 2035)

Source: Adapted from the McKinsey Global Institute, *Urban World: Cities and the rise of the consuming class*, 2012.
The Future

Degenerating
life-supporting systems

Sustaining
a degraded planet

Regenerating
past, present and continued impacts

Conventional Design
One step better than breaking
the law. *Code*

Green Design
Relative improvement
*LEED, BREEAM*

Sustainable Design
Neutral, 100% less bad
*Living Building Challenge*

Restorative Design
Humans doing things to nature
*Assisting the evolution of
sub-systems*

Regenerative Design
Humans enhancing ecosystems
through participation as nature
*Co-evolution of the whole system*

Approximate percentage of new construction activity in US:

75%  25%  <1%  <.1%  <.01%
Global Movement
City of Vancouver Code

2012 Green Homes Program

- High Efficiency Heating
- R22 Effective Walls
- Attic R50
- Energy Star Windows (R4)
- Electric Vehicle Charging
# City of Vancouver Code

<table>
<thead>
<tr>
<th>Exterior Insulation R-value added to exterior of sheathing</th>
<th>Effective Wall R-value Accounting for Thermal Bridging &amp; Fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2x4 stud wall @ 16” o.c. with R-14 batts</td>
</tr>
<tr>
<td></td>
<td>2x6 stud wall @ 16” o.c. with R-22 batts</td>
</tr>
<tr>
<td>1.5” Mineral Wool (R-6)</td>
<td>-</td>
</tr>
<tr>
<td>1.5” XPS (R-7.5)</td>
<td>-</td>
</tr>
<tr>
<td>3” Mineral Wool (R-12)</td>
<td>23.2</td>
</tr>
<tr>
<td>2.5” XPS (R-12.5)</td>
<td>23.7</td>
</tr>
</tbody>
</table>
City of Phoenix Goal

New buildings are **Net Positive** in energy & materials

15 vibrant compact complete centers

25% Tree and shade canopy
The Sustainable Home Design Competition

CRITERIA:

- Beautiful
- 80% less energy use (without solar)
- Design suitable for widespread adoption
- Can be built at the cost of standard construction
Homenz provides a new model for single family home construction in Phoenix

- A modern home with open, flexible spaces
- Designed to operate at near net-zero energy use
Homenz Typical Phoenix Lot
Homenz Key Features

- Fits on a typical Phoenix 60’ x 110’ lot with assumed setback lines
- Works in any lot orientation
- 1,980 square feet livable space
Homenz  Key Features

- 3 bedrooms, 2 1/2 baths
- HERS score of 30
- HERS score of -4 with photovoltaic panels
## Homenz Cost and Affordability

Based on early 2019 estimate

Excludes land / site:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>House (Excluding Land)</td>
<td>$347,490.00</td>
</tr>
<tr>
<td>Solar Panel System</td>
<td>$14,330.00</td>
</tr>
<tr>
<td>On-site Battery Storage</td>
<td>$7,500.00</td>
</tr>
</tbody>
</table>
Homenz Floor Plan

1. Entry Foyer
2. Family Room
3. Living Room
4. Kitchen
5. Master Bedroom
6. Bedroom
7. Laundry
8. Bathroom
9. Garage
10. Full Height Fabric Screen
11. Covered Porch
Natural day lighting
Led light fixtures
Smart thermostat
Energy efficient appliances
Variable sped air conditioner
Battery backup ready
Water retention
Homenz  Elevation
 Orientation flexible

 Shading at glazing
- Structural insulated panels
- Slab and stem-wall insulation

1. Insulated Wall Panel 9-1/4”
2. Fabric Screen
3. Glazing
4. Roofing Over 11-1/4” Insulated Roof Panel
5. Air Louver with Automated Damper
6. Operable Window
7. Underslab Insulation 3”
‘Solarban 70XL’ glass

Operable windows are located throughout the home.

Protective fabric screens prevent 95% of direct sunlight from reaching the glass
12% of the building envelope is comprised of fully shaded glass

03% of the building envelope is exposed glass
LED Light Fixtures

Smart thermostat with home and away functions

Energy efficient appliances

Variable speed air conditioner limits start/stop energy load, boosting efficiency by 800%
Natural convection with solar chimney
Mechanical louvers vent air
Operable windows allow fresh air into the home
Damper automatically opens & closes according to weather conditions

Standard, unprotective glazing allows for air within the solar chimney to raise temperature and create convection currents
Roof perimeter designed with four roof outlets to direct rainwater & provide landscape irrigation

Reduces use of city resources which reduces energy footprint
Solar energy collection optimized

Solar thermal system for domestic hot water

Future battery backup
Home nz Renewable Energy

- Only 18 photovoltaic panels are required for power
- 2 panels for solar water heating
HERS: Home Energy Rating System

- The industry standard for measuring a home’s energy efficiency
- Nationally recognized system for calculating energy performance
# Homenz HERS Report

**HERS® Index Score:**

30

Your home’s HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit [www.hersindex.com](http://www.hersindex.com)

**Annual Savings**

$2,275

*Relative to an average U.S. home*

## HOME NZ ESTIMATED ENERGY USE WITHOUT SOLAR PANELS

<table>
<thead>
<tr>
<th>Use</th>
<th>[MBtu]</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>1.2</td>
<td>$40</td>
</tr>
<tr>
<td>Cooling</td>
<td>6.7</td>
<td>$228</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.2</td>
<td>$41</td>
</tr>
<tr>
<td>Lights/ Appliances</td>
<td>19.1</td>
<td>$647</td>
</tr>
<tr>
<td>Service Charges</td>
<td>-</td>
<td>$158</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28.2</strong></td>
<td><strong>$1,114</strong></td>
</tr>
</tbody>
</table>
Home Feature Summary:

- **Home Type:** Single family detached
- **Model:** Home NZ
- **Community:** N/A
- **Conditioned Floor Area:** 2,173 ft²
- **Number of Bedrooms:** 3
- **Primary Heating System:** Air Source Heat Pump • Electric • 10 HSPF
- **Primary Cooling System:** Air Source Heat Pump • Electric • 21.5 SEER
- **Primary Water Heating:** Water Heater • Electric • 0.95 Energy Factor
- **House Tightness:** 3 ACH50
- **Ventilation:** 132.0 CFM • 69.0 Watts
- **Duct Leakage to Outside:** 0 CFM25_PER_100SF
- **Above Grade Walls:** R-45
- **Ceiling:** Vaulted Roof, R-70
- **Window Type:** U-Value: 0.26, SHGC: 0.15
- **Foundation Walls:** N/A

HERS Score without Solar Energy Generation
**HOME NZ ESTIMATED ENERGY USE WITH SOLAR PANELS & BATTERY**

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<tr>
<td>Service Charges</td>
<td>$158</td>
</tr>
<tr>
<td>Generation (Solar)</td>
<td>-$956</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$158</strong></td>
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City of Phoenix Sustainable Home Design Plans

Architect: Marlene Imirzian & Associates Architects
Structural Engineer: SCL Consulting
MPE Engineer: Henderson Engineers
Construction Cost Estimate: Furcini Construction
HERS Evaluation: Desert Skies Energy Services
Sustainable Home Design Permit Process
Standard Plan RPRS 1904201
https://www.phoenix.gov/sustainability/home

Thank you for downloading the HOMEnz Sustainable Home Plans. The approved standard plans for this home are on file at the City of Phoenix Planning and Development Department. However, it is necessary to obtain a permit to construct the home on a specific lot. Please follow the steps below to identify and obtain the necessary permits prior to construction.
**Homenz Permit Process - Step 1**

**Step 1 – Research site conditions and requirements**
We strongly encourage customers to consult with staff at the **Residential counter** on the 2nd floor of City Hall to determine specific site conditions which may affect the permitting process, prior to purchasing a lot. Single-family design review is required for lots that are 65’ or less in width or within a zoning overlay district where it is required. Please visit the **Site Planning counter** on the 2nd floor of City Hall for more information.
Step 2 - Determine the type of grading and drainage plan required and submit for review and permit
A civil engineer licensed in the State of Arizona shall prepare a Grading and Drainage plan or plot plan for
review and approval. The submittal application and completed plans may be submitted to the Site
Development counter on the 2nd Floor of City Hall.

Resident Single Lot Grading and Drainage Guideline:
Site/Civil Submittal Application
Homenz Permit Process-Step 3

Step 3 - Submit application, plot plan and special inspection certificates for review and building permit. The permit application, plot plan and special inspection certificates should be emailed to plotplan.submittals@phoenix.gov.

Special geotechnical inspection for soils, and special structural inspection for steel construction, concrete construction, and post-installed anchors are required when submitting the request for permit. These certificates must be completed and sealed by a registered design professional in the state of Arizona. Once a permit is issued, the stamped “Home Design Plans” downloaded online need to be printed and made available onsite for all inspections during the construction process.
Please note **A photovoltaic system is not included within the standard plan.** Your solar installer can assist you in obtaining a separate permit, to reach net zero energy.

**Special Geotechnical Inspection Certificate**

**Special Structural Inspection Certificate**

**Single-Family Plot Plan Example:**

**Residential Construction Permit/ Plan Review Application:**
Vision

- Construction Drawings – Open Source
- Download for FREE
- $0 Building Permit Fees
Jumpstart to Energy Efficient Construction

HERS ZERO Home Plan, Free to the Public

Marlene Imirzian
MARLENE IMIRZIAN & ASSOCIATES ARCHITECTS

Mark Hartman
Chief Sustainability Officer
CITY OF PHOENIX