Presentation for:

New Jersey Green Homes Office

MICROLOAD HOMES

March 23, 2009

Presentation Outline

- Microload Homes
- Tetrasomic Design
- Tetrasomic Design Recommendations
- Microload Case Study
- Q & A

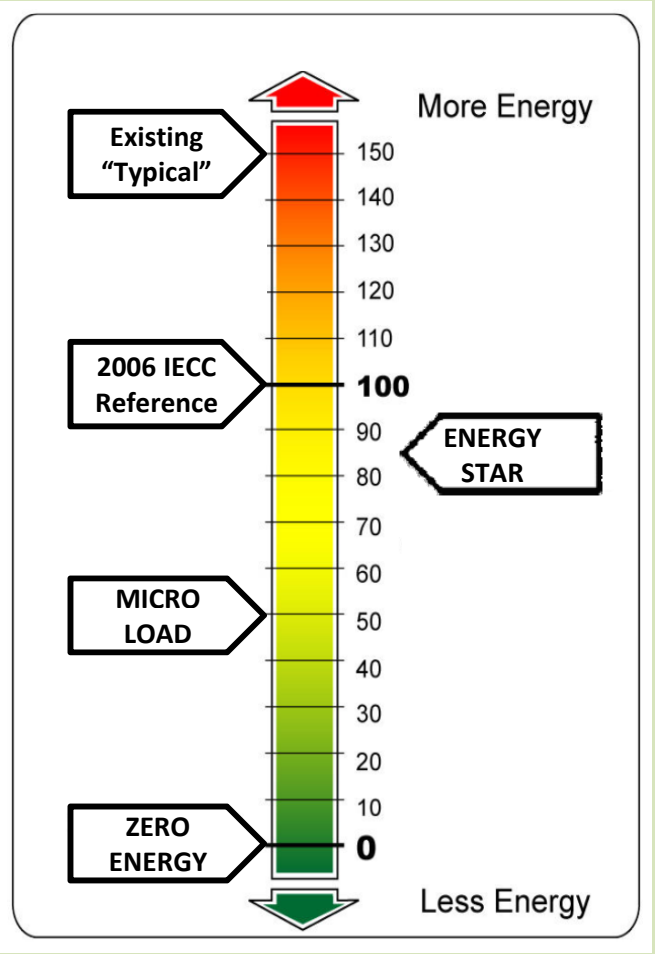
What is a Microload Home ?

Combines: **Energy Efficient Construction**
+ Energy Efficient Appliances
+ Renewable Energy Systems
Approach Net Zero Energy

Where does Microload Begin?

- **HERS Index**
  1% Increase in Energy Efficiency corresponds to 1 Point Decrease in HERS Index

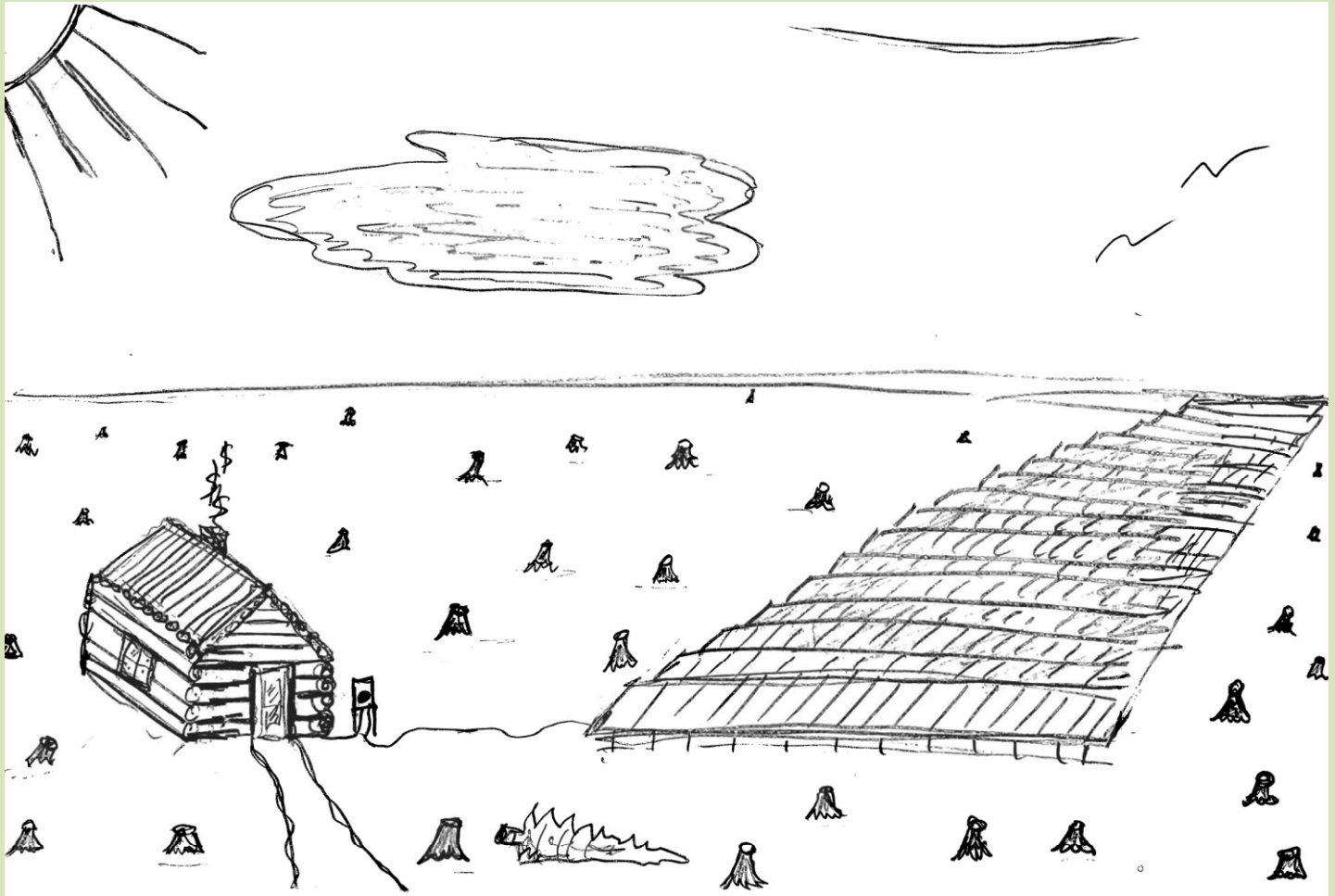
- **100 - Reference Home**
- **0 - Net "Zero" Energy Home**
- **85 - Energy Star Home**
- **50 - Mircoload Begins**



Microload Home Overview

- Focus on Energy Efficiency through Consumption and Production
- Utilize ½ the Energy or less of what we are typically building today
- Reduce environmental impacts and global warming through Energy Efficiency

Is this how we get there?



Bridging the Agency Gaps

- "Energy" agencies focus on optimal energy efficiency
- "Green" agencies focus on optimal utilization and protection of resources
- "Building" agencies focus on occupant wellbeing through 'minimum' building standards
- "Lending" agencies focus on giving the smallest amount that will result with their highest return

Tetrasomia – Doctrine of the Four Elements

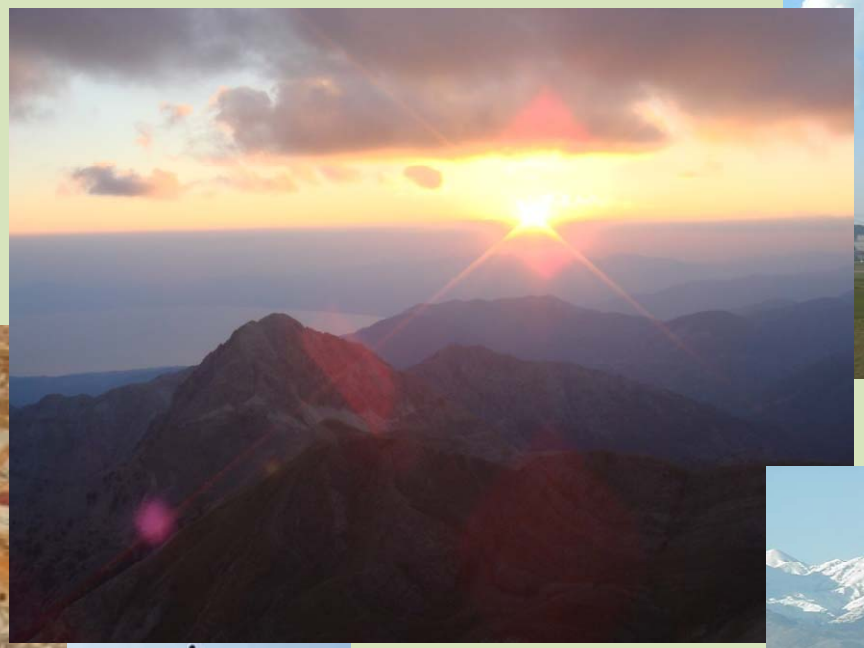
Empedocles 483BC

Empedocles was the first philosopher who stated that there are four primordial elements: Earth, Air, Fire and Water.

He further added that two diametrically opposed forces, one of unity(Love) and the other of discord(Strife), coexist with varying portions of the elements to create all things in the universe.

Tetrasomia to Tetrasomic

Earth, Air, Fire and Water = Environment
Love = Green World
Strife = Technology



Tetrasomic Design

Tetrasomic Design utilizes the power of the elements to minimize the energy requirements of modern day living spaces while mitigating the impacts of the human-element interaction.

These Tetrasomic Design principles are applied over three phases of design;

1. **The Living Space Envelope**
2. **Energy Demand Systems**
3. **On Site Energy Generation.**

TETRASOMIC DESIGN by: Peter Ypsilantis

Phase 1 - Living Space Envelope

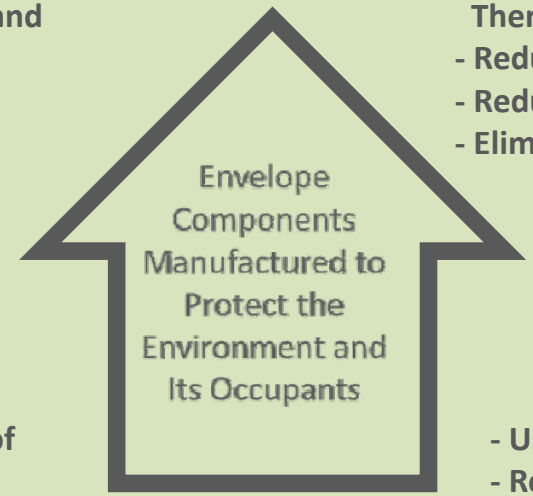
Absorb Power and Mitigate Human- Element Interaction

FIRE – SUN

- Influence Energy Demand through Passive Solar
- Reduce Energy Demand through Day Lighting
- Use Envelope Resistant to Fire
- Minimize Heat Gains through Continuous High Thermal Resistant Envelope
- Use Roof Materials that Reduce Heat Island

AIR – WIND

- Influence Energy Demand through Prevailing Wind
- Use Envelope Materials Resistant to Tornadoes & Hurricanes
- Minimize Heat Loss through Continuous High Thermal Resistant Envelope
- Reduce Air Infiltration
- Reduce Sound Transmission
- Eliminate Formaldehyde & VOC Materials



EARTH – GROUND

- Influence Energy Demand through use of High Mass Envelope
- Use Envelope Resistant to Seismic Events
- Vermin/Termite Resistance
- Provide Radon Evacuation Methods
- Use Recyclable & Low Waste Materials

WATER – OCEAN

- Use Envelope Resistant to Flooding
- Reduce Water Infiltration
- Eliminate Materials that can Mold and Rot

Phase 2 - Energy Demand Systems

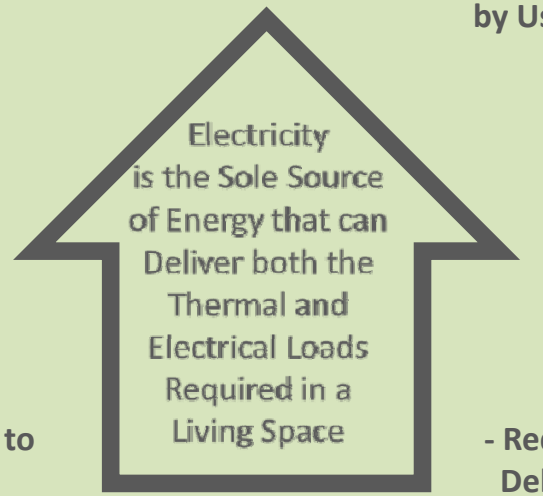
Absorb Power and Mitigate Human-Element Interaction

FIRE – SUN

- Use Solar to Reduce Hot Water Production Costs

AIR – WIND

- Use Energy Recovery Ventilation to:
  - Provide Continuous Filtered Fresh Air
  - Remove Bath/Stale Air
  - Reduce Thermal Energy Losses
- Eliminate Carbon Monoxide Producing Fixtures by Using all Electric Systems



EARTH – GROUND

- Use the Earth's Thermally Stored Energy to Reduce Heating and Cooling Production Loads

WATER – OCEAN

- Reduce Energy Required to Produce and Deliver Water by using Low Consumption Fixtures
- Use Efficient Water Distribution Systems to Reduce Thermal Line Losses
- Use Rainwater Harvesting and Grey Water Systems
- Reduce Water Consumption by Using Native and Drought Tolerant Plant Species

Phase 3 - On Site Energy Generation

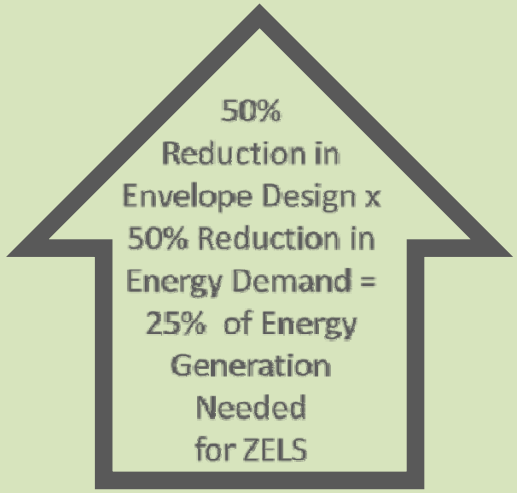
Absorb Power and Mitigate Human-Element Interaction

FIRE – SUN

- Use Grid Tied Solar PV to offset Electrical Energy Usage

AIR – WIND

- Use Grid Tied Small Wind Turbines to Offset Electrical Energy Usage



EARTH – GROUND

WATER – OCEAN

Phase 1 - Living Space Envelope Recommendations

Target: Achieve 50% reduction in Energy Loads through Living Space Envelope Selection & Design Prior to Phase 2 Design

- **Below Grade/Foundation Walls :** Insulated Concrete Forms (ICF's) are fast, pre insulated, finish ready, air tight and seamless

- **Under Slab :** Continuous Vapor Barrier and Rigid Insulation Throughout

- **Wall Framing :** Insulated Concrete Forms

Above Grade Wall Framing Choices:

Framing Type	Fire Resistant	Tornado Hurricane Resistant	Air Infiltration	Sound Trans. Class	Formalde-hyde Free	Eliminates Moisture Mold Rot	Wall Mass (lb/sf)	Seismic Resistant	Vermin Termite Resistant	Axial Load Capacity (lb/lf)	Steady State R-Value	Thermal Mass R-Value
2x4 Wood Framing	20 min	No	.35 ACH	33	No	No	2	No	No	435	11	11
3 5/8" 18G Metal Framing	20 min	No	.35 ACH	46	No	No	2	No	No	500	7	7
5.5" Structural Insulated Panels	20 min	No	.1 ACH	29	No	No	2	No	No	3300	22	22
6" Insulated Concrete Forms	4 hr	Yes	.1 ACH	51	Yes	Yes	32	Yes	Yes	22000	21	37(NJ)

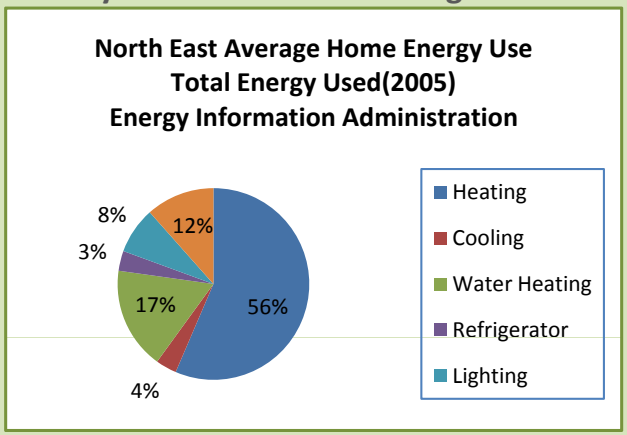
- **Windows/Doors :** Energy Star Labeled Fiberglass

- **Ceiling/Roof :** Conventional Framing w/ R-50 Sprayed Rigid Foam Insulation and High Reflective Roofing

Phase 2 – Energy Demand System Recommendations

Target: Achieve 50% reduction in Energy Loads required for Energy Demand Systems Selection & Design Prior to Phase 3 Design

Focus on High Energy Demand Systems
- **Heating and cooling is responsible for more than 60% of the energy used in a home.**
- **Hot Water Production comes in second.**



- Heating System : Ground Source Heat Pump

Fuel Source/Type	Natural Gas AFUE = 78% $1.60/Therm	Propane AFUE = 78% $2.00/Gal	Fuel Oil AFUE = 78% 2.50/Gal	Electric Resistance COP = 1 $.18/kWh	Air Source Heat Pump HSPF = 7.7 $.18/kWh	Ground Source HP COP =4.0 $.18/kWh
Cost Per Mbtu ($)	20.51	27.87	22.89	52.74	23.37	13.24

- Cooling System : Ground Source Heat Pump

Fuel Source/Type	Air Source Heat Pump SEER = 15 $.18/kWh	Ground Source HP EER =20 $.18/kWh
Cost Per MBtu ($)	12.00	9.00

Single System Delivers Heating and Cooling
Saves 35% - 50% over Fossil Fuels
Same system can save 50% on Hot Water Production Cost

Phase 2 – Energy Demand System Recommendations

- Ventilation System : Energy Recovery Ventilator for Continuous Exhaust /Fresh Air with Bath Exhaust Boost Timer

Use “Wheel” Type and Not “Plate” Type Exchangers. They are called “HRV’s” Heat Recovery Ventilators for a reason. They do not work well in the summer because of there inability to remove incoming latent heat from the air. Energy Wheels require 1 ton of AC to be produced for every 1000 cubic feet of fresh air exchanged while Plate Exchangers require 4 tons.

- Hot Water System : Use Ground Source Heat Pump w/ Desuperheater to reduce DHW production costs

Use Solar Hot Water Systems if you do not use Ground Source Heat Pumps

Use Instant Hot Water Heater in line with your Geothermal or Solar Hot Water System

- Appliances : Energy Efficient Appliances

- Lighting : Energy Efficient Compact Fluorescent Fixtures Throughout the Living Space
Use Occupancy Sensors

Phase 3 – On Site Energy Generation Recommendations

Phase 1 - Saved on Energy Required within the Living Space Envelope
Phase 2 - Energy Requirements were Reduced through Energy Demand System Selections
Phase 3 - Energy Generation Requirements now substantially reduced to achieve a Zero Energy Living Space

Grid tied Solar and Small Wind Turbine Systems

- Summer: Solar Good, Wind O.K.

- Winter: Wind Good, Solar O.K.

- Night: Wind Good, Solar Not So Good

- A Wind Turbine System costs half as much as an equivalent producing Solar Array.

Microload Case Study

The Meadows at Oldwick

Microload Case Study - The Meadows at Oldwick

Living Space Envelope

- Insulated Concrete Forms
  - Used for Frost Foundation and Walls
  - High R-Value/Mass & Low Air Infiltration
  - 4 Hour Fire Separations
  - Seismic, Tornado, Flood Resistant
  - No Formaldehyde/VOC Materials
  - No Mold or Rotting Possible
  - Vermin / Termite Resitant
  - High Sound Attenuation + I.A.Q.
  - Sustainability (Energy Star, LEED, C2C, ..)
  - 200+ Year Life Expectancy

- Fiberglass Windows & Doors
- Full Under Slab Insulation w/ Vapor Barrier
- High R-value Roof Insulation
- Light Colored Reflective Roofing Materials
- Building Orientation
  - Overhangs for Passive Solar
  - Breezways Designed for Prevailing Wind

Microload Case Study - The Meadows at Oldwick

Energy Demand Systems

- All Electric Systems
  - Reduced CO2 Emissions for Energy Delivery and CO Dangers
  - Simplified and Cost Effective Project Delivery

- Variable Refrigerant Heat Pumps
  - Reduced Power Consumption
  - No Duct Work
  - Individual Room Control
  - Simplified Project Delivery

- Domestic Water Supply
  - Efficient Local .95EF Hot Water Heaters
  - Low Consumption Water Fixtures

- Energy Recovery Ventilators
  - Continuous Balanced Fresh Air Exchanges
  - Used for Bath Exhaust w/ Boost Time Control
  - MERV 12 Filtration & CO Detection

- Lighting & Appliances
  - All Energy Star Fixtures & Appliances

Microload Case Study - The Meadows at Oldwick

On Site Energy Generation

- All Electric Systems

  All Energy used can be offset by the On Site Generation

- Solar PV System Installed

  (18) 3060kw Systems (55.08kw Total)

  As of February 28, 2009 72,396 kWh Produced!
  Approximately 108,594 lb of CO_2 emissions saved.

Microload Case Study - The Meadows at Oldwick

So where does The Meadows at Oldwick fall on the Hers Index Chart?

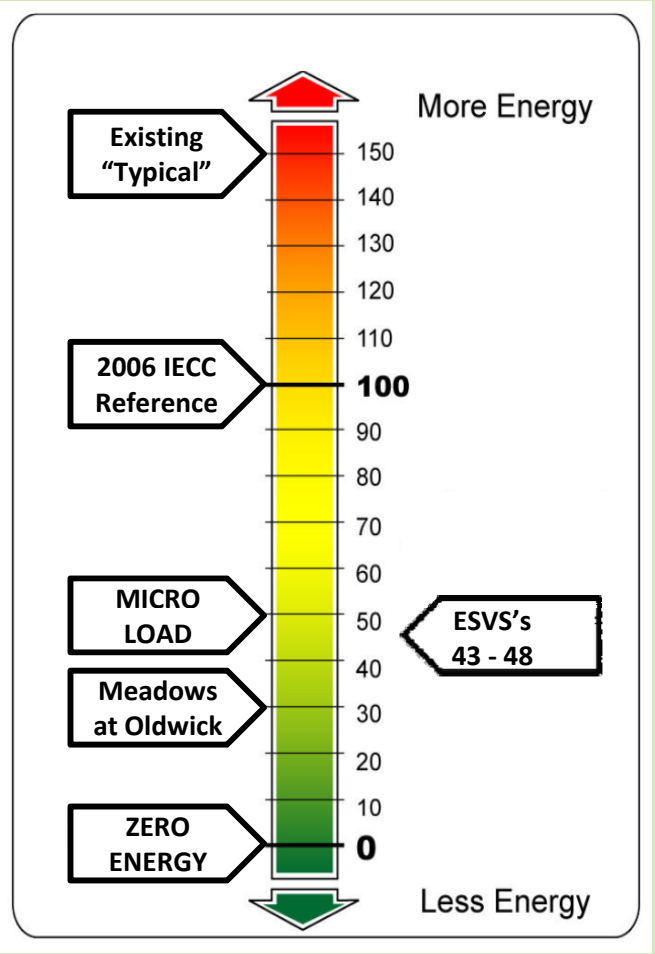
- Energy Star Home Verification Summaries

HERS 43 to 48

- Data Collection for 9 Months Ending FEB 09

501	502	601	602	603	604	701	702	901	902	1001	1002	1003	1004	1101	1102	1201	1202
36	59	40	19	34	32	20	35	18	61	38	2	-9	25	17	21	14	70

HERS Average 29!!



Special Thanks to:

Developer: United Cerebral Palsy
Mr. Brad Kennedy

Architect: Mr. Tim McCorry, AIA

CM/Builder: Integrated Green Technologies

Tetrasomic Design Summary

Fundamental design principles centered around Living Spaces

- Harness the Power of the Elements to reduce Energy Needs
- Mitigate the Impacts of the Human-Element Interaction

Three Simple Phases toward Zero Energy Living Spaces (ZELS)

1 - Living Space Envelope

2 - Energy Demand Systems

3 - On Site Energy Generation

Thank you.

Questions?