#### **GREEN ECONOMICS**

#### Nea Maloo AIA LEED AP

Showcase Architects & Developers

#### **GREEN---Happiness**

• Which is the happiest country in the world...

• Given a choice of burning money or Saving money, which would you choose?

## HAPPIEST, GREENEST COUNTRY ON EARTH...

- The New economic Foundation
  - Devised an equation that evaluates life expectancy and people's happiness against environmental impact
  - Costa Rica as the happiest, greenest country
  - Dominican Republic at second place, Britain 74<sup>th</sup> rank and us 114<sup>th</sup>
  - Life expectancy of Cost Ricans 78.5 years
  - 85% of country's residents are happy
  - It is not yet industrialized and has nature conserved.

#### **Green Economics**

#### It is the Economics of real world

- The world of work, human needs, the earth's materials
- And how they mesh together most harmoniously.
- Direct focus on meeting human and environment need
- It is about quality
- It is about regeneration----of individuals, communities and ecosystems ---not about accumulation, of either money or material.

#### What is Green Economics?

 Economics of Sustainable
 Development • The three pillars of Sustainability



- The Primacy of Use-value, Intrinsic Value &Quality
  - Economy as a service economy, focused on end-use or human and environment needs.
  - Matter and money is to facilitate regenerative needs, not an end

http://www.greeneconomics.net

- Following Natural flows: sailboat in wind of natural processes, solar, renewable, natural hydrological cycles
- Waste equals Food In nature there is no waste
- Elegance and Multifunctional

- Appropriate Scale: does not mean "small is beautiful" always, every activity has its appropriate scales and impacts others
- Diversity: World is a constant flux, health and stability depends on diversity at all levels of ecosystems

- Self-Reliance. Self-organization, self-Design
  - In an economy which moves with ecosystems processes, importance must be given to local response, design and adaptation
  - Attune with larger processes.

 Participation and Direct democracy Enable flexibility and resilience Human creativity and development

Personal and political, social and ecological go hand in hand

• The strategic role of built-environment, the landscape & spatial design

As permaculturalist Bill Mollison has emphasized, the greatest efficiency gains can often be achieved by simple spatial rearrangement of system components.

Buildings absorb 40% of material and energy in North America.

Conservation and efficiency in building sector will impact tremendously on the entire economy.

## **US Energy Consumption**



Source: Architecture 2030

#### What is green? Green = energy efficiency

Survey of top builders ranking The Importance of "Green Building" Benefits in the Builder Purchasing Decision:



Source: NAHBRC Report: "Implications of the Soft Housing Market for Suppliers of Building Products" 2007

#### **Green = energy efficiencypromodelers**



Source: Professional Remodeler Survey Reed Business Information

#### **Green Vocabulary..**

**Sustainability** – In the context of green building, the term refers to the Earth's ability to sustain its ecological processes. To be sustainable, the Earth's resources must be used at a rate at which they can be replenished. Sustainable buildings strive to meet the present needs without compromising the ability to meet those needs in the future.

**Indoor Air Quality (IAQ)** – Indoor air pollution in homes or commercial buildings usually comes from sources that release gasses or chemicals inside the building. Inadequate ventilation can increase pollutant levels to the point where both short-term irritation and long-term symptoms may develop.

**Carbon Footprint** – A measure of the impact our activities have on climate change. A building's carbon footprint measures the amount of greenhouse gases produced through burning fossil fuels for electricity, heating, etc.

#### **Green Vocabulary...**

Life Cycle Assessment (LCA) – The evaluation of the environmental impact of a particular product that takes into account its entire life cycle, from raw material extraction through production, operation, and demolition.

**Renewable Energy** – Energy generated from resources that are naturally replenished, such as solar, wind, tides, and geothermal energy.

Volatile Organic Compounds (VOCs) – Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

#### **Green Vocabulary...**

**HERS Index** – A scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy-efficient it is.

International Energy Conservation Code (IECC) – Building code established by the International Code Council (ICC) that gives minimum design and construction requirements for energy efficiency. The IECC is a model code that is used by many local code jurisdictions.

**ENERGY STAR for Homes** – ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy to promote energy-efficient homes to potential homebuyers through the recognizable ENERGY STAR label. All ENERGY STAR homes have third party verification that demonstrates a minimum of 15% energy savings over the 2004 IECC.

#### **GREEN LABELS**...



Homes that earn the ENERGY STAR\* prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency. www.energystar.gov

#### A Green Home Begins with ENERGY STAR Blue

#### What should home buyers look for first in a green home? Energy efficiency is the place to start.







NAHB Research Center

#### Lifecycle cost

#### • LIFE CYCLE COST = RECURRING + ONETIME COST

 INCLUDES – PURCHASE PRICE + INSTALLATION COST + OPERATING COSTS + MAINTENANCE + UPGRADE COST + REMANING VALUE AT END OF OWNERSHIP

#### **Affordability Example**

	Co	onventional onstruction	Con Key PA	struction with TH Upgrades*
Base Price	\$	225,000	\$	230,813
Downpayment		50,000		50,000
Mortgage Total		175,000		180,813
MONTHLY PAYMEN				
30 Yr @ 6%		1,106.12		1,142.86
Homeowners Insurance		100.00		100.00
Utilities		152.25		102.50
Total Monthly Costs	\$	1,357.37	\$	1,345.36

|--|--|--|--|--|

Home built to 2000 IECC Specs	PATH Home Specs Est	imated Costs for Upgrade
13 SEER heat pump	15 SEER heat pump	\$1,500
Conventional water heater	Tankless water heater	\$385
Code double-paned windows	ENERGY STAR® qualified windows	\$250
R-19 fiberglass ceiling insulation	R-19.8 sprayed foam ceiling insulation	\$1,586
R-11 fiberglass wall insulation	R-14.4 sprayed foam wall insulation	\$757
R-11 fiberglass floor insulation	R-18 sprayed foam floor insulation	\$1,261
Refrigerator/clothes washer	ENERGY STAR qualified refrigerator/cloth	es washer \$74

#### How do we select system...

- Cost= Monthly energy cost and Annual Maintenance cost
- Fossil fuel furnace burns money
- -waste energy

- PAYBACK OF SYSTEM
- EFFICINCY
- CASH FLOW
- OPERATING COSTS
- SYSTEM LIFE SPAN
- Average the initial cost of geo-thermal – recovered 3-5 years

## **Renewable Energy..**



- Biofuel
- Biomass
- Geothermal
- Hydropower
- Tidal Power
- Wave Power
- Wind Power

#### Geothermal Energy: The World's Greenest Heating and Cooling System

- An <u>EPA study of energy efficiency</u> concluded geothermal energy is the most environmentally friendly heating/cooling system.
- The United States National Renewable Energy Laboratory concluded that geothermal energy is more <u>efficient and cost-effective</u> compared with conventional residential systems.
- Available <u>everywhere in the United States</u>, geothermal energy can be found underground virtually anywhere.
- Geothermal cost savings can be increased by <u>geothermal</u> <u>energy incentives</u>, available from federal, state, local, and utility sources.

#### **Federal Tax Benefits**

#### • Residential Energy tax credit

- Geo thermal units installed from 2009 –onetime tax credit of 30% of total investment.
- No limit to credit amount for 2009 and beyond
- Can be used in more than one year
- Can be combined with solar, wind and energy efficient upgrade

## **GEOTHERMAL LOOPS**



#### **Horizontal Loops**

Often used when adequate land surface is available. Depending on geothermal system needs and space available, pipes are placed in trenches that range in length from 100 to 400 feet.



#### Vertical Loops

The ideal choice for a geothermal heat pump when available land surface is limited. Well drilling equipment is used to bore smalldiameter holes from 100 to 400 feet deep.

## **GEOTHERMAL LOOPS**



#### Pond (Lake) Loops

Very economical to install when a large body of water is available for use by the geothermal heating and cooling system. Coils of pipe are simply placed on the bottom of the pond or lake to capture the geothermal energy.



#### **Open loops (Well-Water Systems)**

In ideal conditions, an open-loop application can be the most economical type of geothermal system. These use groundwater from a well as a direct energy

#### **Case studies – Trenton, NJ**

- 2,000 sq ft home
- 3 bed rm, 2-bath, living, dinning, family room and Kitchen
- Dry bulb temperature 70 degree in Winter
- Wet bulb temperature 75 degree Fin summer
- 1 therm = 100,000 Btu = 1 CCF
- Domestic hot water is included on the use of a desuperheater
- Electric water heater for the geothermal heat pump systems and air to air and oil systems.
- 6¢/kWh, 60¢/therm or ccf of gas, or \$1.00/gal oil or propane),

#### **Case Study-Trenton NJ**

System Type	Efficiency	Total	Annual	Sample Annual Costs
		Kwh	Ccf/gal	
Geothermal	3.5 ton 1 speed	10,857	0	651
	4.0 ton 2 speed	10,061	0	604
Air-air	12 seer	19,604	0	1,176
	14 seer	18,261	0	1,0961
Gas	80%/10seer	4,860	1,286	1,063
	90%/12seer	4,480	1,106	932
Oil	80%/10seer	10,310	694	1313
(w/wlwc DHW)	90%/12seer	9,930	694	1290
Propane	80%/10seer	4,860	1,399	1,691
	90%/12seer	4,480	1,203	1,472

## **Energy lost**

#### A Significant Source of Heat Loss in Homes Is Due to Poorly Designed Walls (Not Ceilings)



5% Ceilings
17% Doors & Windows
17% Above Grade Walls
38% Air Infiltration
23% Basement

#### With a Insulated Basement, 67% of Heat Loss Is Through Above Grade Walls and Infiltration



Source: High Performing Wall Systems, NAHB-RC

#### **Case studies**



 Without Exterior Insulated Sheathing, Conductive Heat Loss Can Sometimes Be Seen

# **25% of typic**al stud wall is non insulated and studs act as thermal bridging



## **Building envelope**



- Structural Insulated Panels
- Structural Insulated sheathing SIS

#### **Increase insulation**

- 2x4 Wall @ 16" OC
- <u>R-13 Batt Installed</u>
- Label: 13.0
  Actual: 9.0
- 2x6 Wall @ 24" OC
- <u>R-19 Batt Installed</u>
- Label: 19.0
- Actual: **13.0**

#### **2x4 Wall +** ½" **SIS (R-3)** <u>**R-13 Batt Installed**</u> Label: 13.0 + 3.0 = 16.0

Actual: 12.0 (33% Increase)

#### 2x4 Wall + 1" SIS (R-5.5) R-13 Batt Installed

Label: 13.0 + 5.5 = 18.5 but... 13+5 = 19 (by Energy Code) Actual: **14.5** (12% Increase) Lumber Saving: ~30%

#### **COST- Chicago, IL** High efficiency gas and heat

Installed
 Costs –
 With \$350
 Annual
 Energy
 Savings\*,
 SIS™ Short
 Payback
 Periods or
 Savings
 When Used
 With
 Regular
 Foam

OSB with House wrap	\$1460
OSB: \$6.25/sht x 100 sheets	\$625
HW (installed): \$385 + 0.14/sq ft x 3200sf	\$835
SIS™ Full Wrap (\$265 Add)	\$1725
<sup>1</sup> ⁄₂" SIS™: \$16.00/sht x 100 sheets	\$1600
Tape (installed): \$1.25/sht x 100 sheets	\$125
1/3 SIS™ + 2/3 Foam (\$92 Savings)	\$1386
<sup>1</sup> ⁄₂" SIS™: \$16.00/sht x 35 sheets	\$560
1/2" Foam: \$10.5/sht x 65 sheets	\$683
Tape (installed): \$1.25/sht x 100 sheets	\$125

#### **COST- Chicago, IL** High efficiency gas and heat

 Installed Costs – With \$285 Annual Energy Savings\*, SIS™ Short Payback Periods or Savings When Used With Regular Foam

2x6 w/ OSB with House wrap	\$2365
OSB: \$6.25/sht x 100 sheets	\$625
HW (installed): \$385 + 0.14/sq ft x 3200sf	\$835
R-19 adder over R-13	\$260
2x6 adder over 2x4	\$545
1" SIS™ Full Wrap (\$140 Savings)	\$2225
1" SIS™: \$21.00/sht x 100 sheets	\$2100
Tape (installed): \$1.25/sht x 100 sheets	\$125
1": 1/3 SIS™ + 2/3 Foam (\$595 Savings)	\$1770
1" SIS™: \$21.00/sht x 35 sheets	\$735
1" Foam: \$14.0/sht x 65 sheets	\$910
Tape (installed): \$1.25/sht x 100 sheets	\$125

#### **Structural Insulated sheathing**

- Environmentally friendly
- Structural shear wall compliance
- Significant insulation value
- Superior moisture resistance

![](_page_36_Picture_5.jpeg)

#### **STRUCTURAL INSULATED PANELS**

![](_page_37_Picture_1.jpeg)

- SIP PANEL BUILDING ARE 66% MORE ENERGY EFFICIENT THAN STANDARD FRAME CONSTRUCTION
- 2 <sup>1</sup>/<sub>2</sub> TIMES STRONGER THAN STANDARD BUILDING MATERIAL
- CUTS FRAMING TIME BY 2/3RD
- STRONGER AND STRAIGHTER
- BETTER BUILDING SYSTEMS

#### **STRUCTURAL INSULATED PANELS** 2500 SQ FT SINGLE STORY HOME

LABOR	STICK FRAMING	SIPS
ROUGH FRAMING SNAP LINES, PLATE, FRAME, PLUMB&LINE, SET TRUSSES, ROOF SHEET	12 Days	8 DAYS
ROUGH TRADES/EXT WALLS Electrical/drill studs, framer, Insulate walls/ceilings	5 Days	0
ROUGH INSPECTIONS Exterior shear Insulation Inspection	2 Days	0
Total	19 Days	8 days

## Sips –Further cost savings

- Note: Eleven days saved between snapping lines and drywall installation.
- Note: Additional time saved not having bowed walls or drywall cracking.
- Note: Days will vary with size of home and weather conditions.
- Reduced drywall cracking as house settles less with SIPS panels
- Half the amount, if not more, of left over lumber waste material
- Energy savings for home owner
- Finish trades require less time dealing with bowed walls (Tile, Cabinets)
- A possible reduction in crane rental time when using roof panels instead of trusses
- A possible reduction in hardware, such as hold downs, when using wall panels

## SIPS

- Framer
  - 4 Days saved on labor \$27.00 per hr. \$864.00
  - 3 man crew instead of 5 (1 Day) \$27.00 per hr. \$432.00
  - 1 Day saved Furring walls \$27.00 \$216.00
  - 2 Days saved shear panels \$27.00 \$432.00
    - Total = \$1,944.00
- Electrician
  - 1 Day saved drilling studs \$12.00 per hr. \$96.00
    - Total = \$96.00
- Insulation
- Money saved not installing in ext. walls \$800.00
- Money saved not installing in ceilings \$600.00

• Total = \$1,400.00

• Approximate savings per unit Total = **\$3,440.00** 

## **FRAMING COSTS OF SIPS**

- Sip panels will typically cost about five percent more than conventional framing
- Per builder/architect Lance O'Donnell framing costs are running between 20% and 30%
- of building costs.
- We will us 25% for an average.
  - \$110.00 per sq. ft. times 2500 sq. ft. = \$275,000.00
- Divided by 25% for framing costs = \$68,750.00 (\$27.50) sq. ft.) Sticks

#### - \$115.50 per sq. ft. times 2500 sq. ft. = \$288,750.00

- Divided by 25% for framing costs = \$72,187.50 (\$28.88 sq. ft.) SIPS
- Per Unit

- Framing cost for sips \$72,187.00 (25% of overall cost)
- Framing cost for sticks \$68,750.00 (25% of overall cost)
- Difference in framing cost \$ 3,437.50 (per unit)
- Building Cost
  - \$278,437.50 (cost with sips)
  - \$275,000.00 (cost without sips)
  - \$3,437.50 (difference is framing cost)
  - \$3,440.00 (savings in labor & material per page 2)
  - \$ (2.50) (breaking even)
  - \$ (1,200.00) (down sizing from a 5 ton to a 3 ton HVAC unit)
  - \$ (1,202.50)
  - \$ (700.00) (savings in wasted lumber plus hauling)
  - \$ (1,902.50) (overall savings per unit)

#### **Structural Insulated Panels BASF STUDY**

	SIP Energy Efficient Home	Conventionally Constructed Home	Home Owners Pocketed Savings
5 Years	\$2,464	\$5,647	\$3,183
10 Year	\$5,463	\$11,552	\$6,089
15 Years	\$9,111	\$17,742	\$8,631
20 Years	\$13,549	\$24,246	\$10,697

#### Water

So-called "free goods" such as sunshine and fresh air may be of more real worth than most economic goods. – Walter J. Kohler, 1934

## WHY CONSERVE WATER?

- Less than 1% of the world's freshwater supply is accessible for human use
- Nearly one billion people in the world lack safe drinking water.
- Between now and 2015, the world's population is expected to increase every year by 74.8 million
- By the year 2013, at least 36 states in the U.S. antic regional or statewide water shortages
- Americans use an average of 70 gallons of water indoors ever day per person – enough to fill 1,120 drinking glasses

#### **Conserve Water...**

Toilets account for 25% of daily water use in the U.S.

- One-half of all toilets in U.S. homes are older, less efficient models
- 1.6 billion gallons of water are wasted in the U.S. every year because of inefficient toilets
- One leaky faucet, leaking at a rate of 60 drips per minute, wastes over 2,000 gallons of water annually

![](_page_46_Picture_5.jpeg)

#### Water Efficiency

- Use of plumbing products, the average American can reduce his or he water use from 70 to 43 gallons.
- A family of four would save 39,000 gallers of water gallons of water per year.

## **Conservation of Water**

#### 3900 Gallons of Water is equivalent to

- 2,000 showers or

![](_page_48_Picture_3.jpeg)

![](_page_48_Picture_4.jpeg)

- 1,950 loads of laundry of
- 4,300 dishwasher cycles or
  - a lifetime of drinking water for 3 people
  - or
  - hundreds of

![](_page_48_Picture_10.jpeg)

## WAYS OF WATER SAVINGS

![](_page_49_Picture_1.jpeg)

1. Choose Faucets with Water-Saving Aerators and save more than 14,700 gallons of water each year.

![](_page_49_Picture_3.jpeg)

2. Use Water-Conserving Showerheads or Hand showers and save over 7,700gallons of water each year.

![](_page_49_Picture_5.jpeg)

 Install High-Efficiency Toilets (HET) and save up to 16,500 gallons of water each year.

NOTE: Based on average usage of a household of four. Courtesy: Kohler industries

#### **Conservation of Water**

## Choose Faucets with Water-Saving Aerators and save more than 14,700 gallons of water each year.

Based on average household of four, each using a faucet 8.1 minutes a day, 365 days a year

Gallons per minute gpm	Likely if you built your home was built	Savings in gallons per vear (gpy)
3.0	Pre 1980	
2.75	1980 to 1993	2,900 gby from 3.00 gpm
2.2	1994 to present	5,900 gpy from 3.0gpm 2,900 gpy from 2.75gpm
1.5	present	17,700 gpy from 3.0 gpm 14,700 gpy from 2.75 gpm 11,800 gpy from 2.2 gpm

#### Water conserving showerheads or hand showers

#### Save 7,700 gallons of water

![](_page_51_Picture_2.jpeg)

Based on average household of four, each showering once a day for 5.3 minutes, 365 days a year.

Gallons per minute gpm	Likely if you built your home was built	3
5.0	Pre 1980	0
2.75	1980 to 1993	1
2.5	1994 to present	1
1.75	Optional since 2006	2

Likely if you built your home was built	Savings in gallons per year (gpy)
Pre 1980	0
1980 to 1993	17,400 gpy from 5.00 gpm
1994 to present	19,300 gpy from 5.0gpm 1900 gpy from 2.75gpm
Optional since 2006	25,100 gpy from 5.0 gpm 7,700 gpy from 2.75 gpm 5,500 gpy from 2.5 gpm

## **High efficiency Toilets**

- Save upto 16,500 gallons of water
- Based on average household of four, each flushing 5.1 times a day, 365 days a year.
- Courtesy: Kohler industry

Gallons per minute gpm	Likely if you built your home was built	Savings in gallons per year (gpy)
5.0	Pre 1980	0
3.5	1980 to 1993	11,100 gpy from 5.00 gpm
1.6	1994 to present	25,300 gpy from 5.0gpm to 1.6 gpm 14,100 gpy from 3.5gpm to 1.6 gpm
1.28	Optional since 2006	27,700 gpy from 5.0 gpm 16,500 gpy from 3.5 gpm

#### **Eco-estate – Case Study**

- REUSE MOVING EXISTING HOUSE
- USE OF GEOTHERMAL
- USE OF SIPS
- USE OF WATER EFFICINCY
- USE NATURAL DAYLIGHT
- USE OF FIBER CEMENT SIDING

![](_page_53_Picture_7.jpeg)

#### **Eco-estate -SIPS**

![](_page_54_Picture_1.jpeg)

![](_page_54_Picture_2.jpeg)

#### **Eco-estate –geothermal**

![](_page_55_Picture_1.jpeg)

#### **Reuse of Buildings....**

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PROPOSED NEW HOUSE

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S REUSE OF EXISTING OF DEVENAT

DEXISTING TREES SAVED

BRICES CHANEY

#### WHY RAZE WHEN YOU CAN SAVE

![](_page_57_Picture_1.jpeg)

![](_page_57_Picture_2.jpeg)

#### Resources

- http://en.wikipedia.org
- NAHB Research center
- PATH
- DEP
- <u>www.dsireusa.org</u>
- www.businessdictionary.com
- <u>www.kohler.com</u>
- www.savewateramercia.com
- http://tristate.apogee.net/geo/gdfcroc.asp
- www.dow.com
- www.sips.com
- http://www.greeneconomics.net/what2f.htm