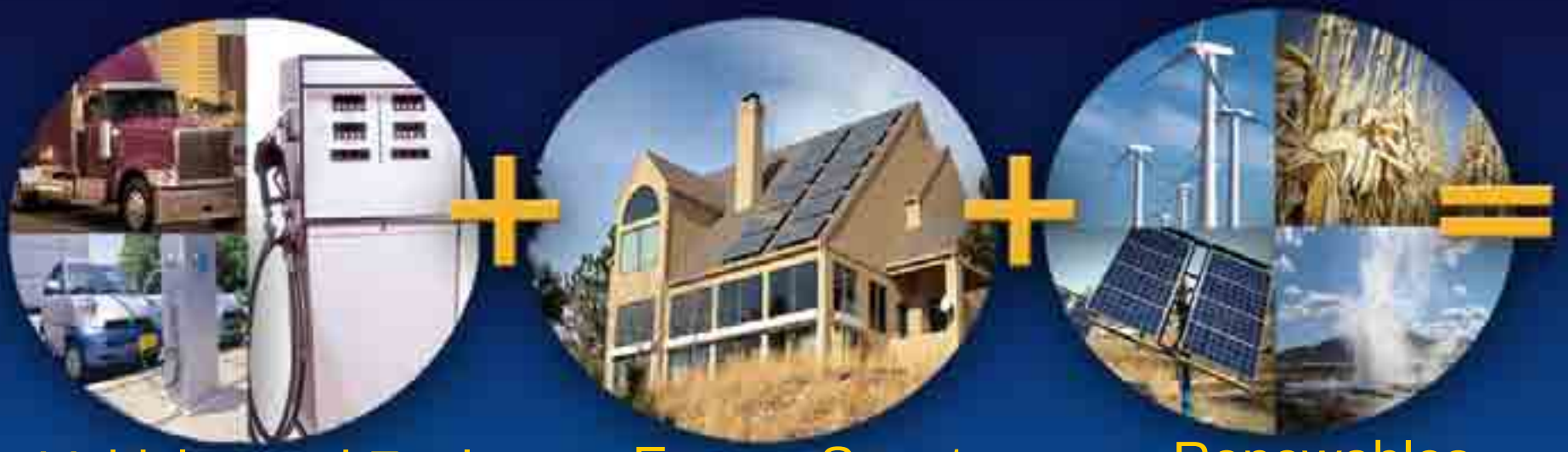
Renewable Communities…

A new way to design.

The Vision



Vehicles and Fuels

Energy Smart Buildings

Renewables

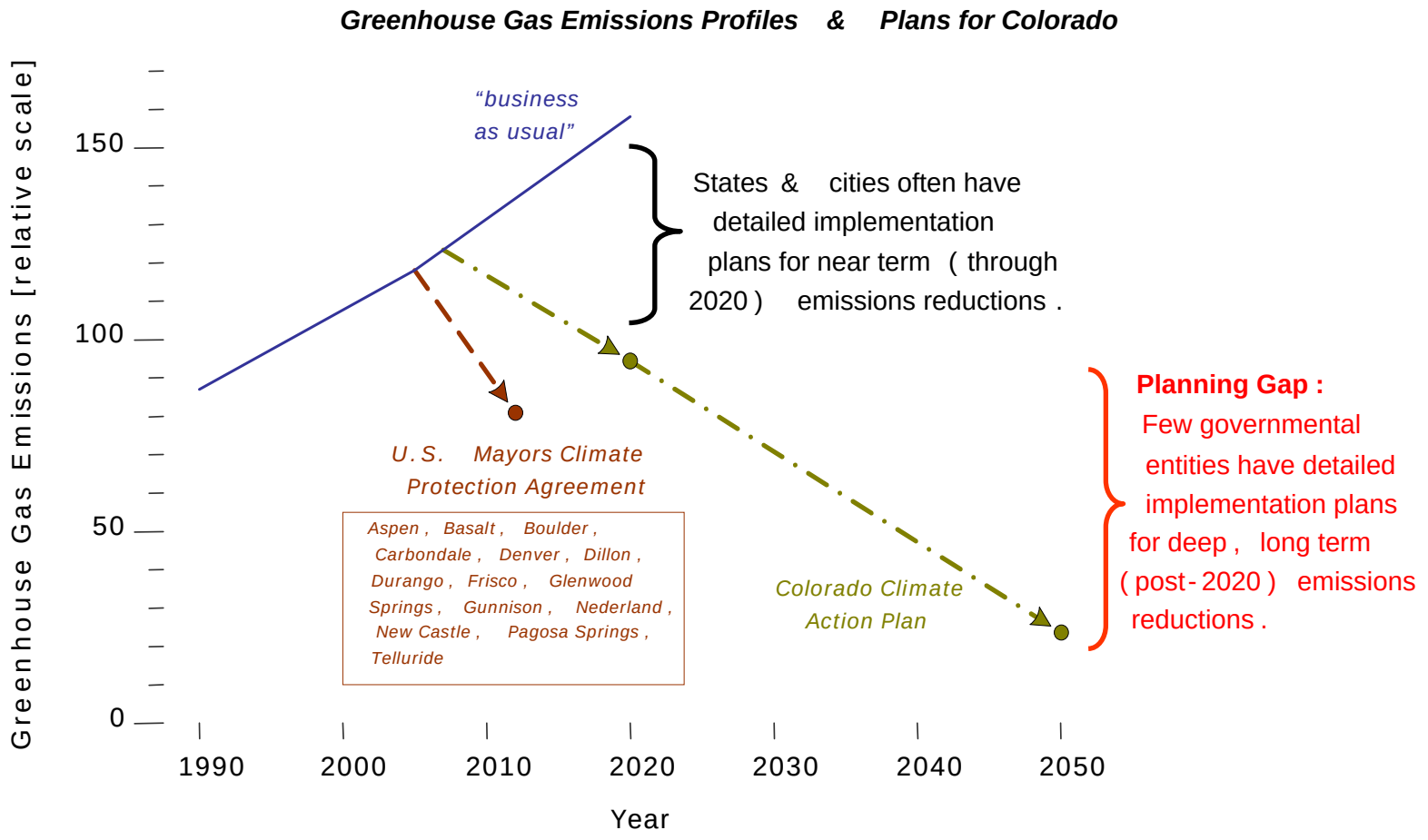
A Renewable Energy Community

Graphic courtesy of: Notice of Staff Workshop on the California Energy Commission's Public Interest Energy Research (PIER) Renewables Program Research, Development and Demonstration Initiative for Renewable-based Energy Secure Communities

Why is this significant?

- Renewable implementation will occur at the state and local level
- Typically planning focus is short term, incremental approaches to reduce conventional energy use
- Incremental approaches cannot be repeated indefinitely
- In many cases, energy growth is increasing at a faster rate than energy savings
- Carbon emission goals will require deeper emissions reduction over the long term
- Incremental improvements made in the absence of a long-term strategy can make deeper savings more costly or impractical.
- Progress will require more complex and integrated decision-making
- Solutions requires a combination of strategies; EERE technologies; linking values to human behavior; new roles for stakeholders and public policy

- The Planning Gap –
What a community needs to do to significantly increase their use of renewable energy and the current reality



To achieve deep savings

- Alignment of strategic partnerships and relationship building around shared set of values and defined goals
- Do “Technical homework”- understand the loads, the drivers, set measurable goals
- Plan for energy efficiency savings plus “a big renewable energy idea”
- Plan should be time phased with interim goals
- Develop a financing plan

High level stakeholders panel

Objective: Build a network of influential people in the community to help with issues that will become roadblock

- Public, private, utility partnership aligned around a shared set of values
- Recognition that traditional roles may changes
  - Electric car manufacturers may get into the home building business
  - Developers may get into the utility infrastructure business
  - The role of the utility may shift from producer of a commodity (electricity) to one of a distributor and managing the flow of electrons based on real time pricing

Understand the community energy loads for buildings, community infrastructure and vehicles

Objective: To fully define the energy picture in order to strategically develop solution

- Run series of parametrics using simulation tools to assess loads
- Use this to “bound” the range of loads
- Use the results to aid in sizing a central plant , define the level of efficiency needed in terms of buildings and transportation systems

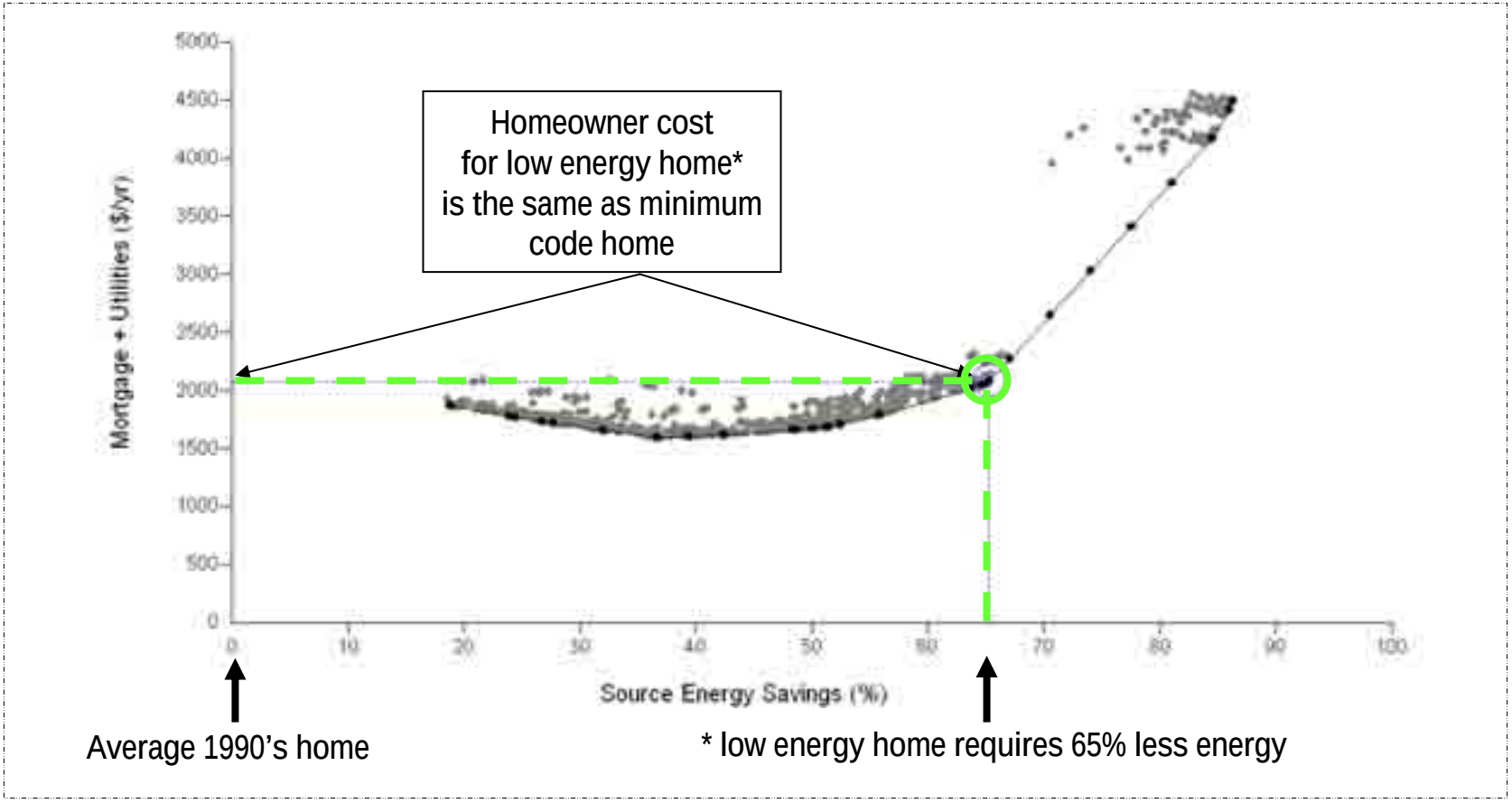
Building strategy

Objective: To understand and to communicate to builders the necessary degree of efficiency and renewable energy to be incorporated into new construction to reach the energy goals

- Run parametrics using simulation tools to assess loads under various scenarios
- Develop guidelines for building energy efficiency and distributed renewable energy systems
- Work with builders to assess options
- Monitor building energy performance to provide feedback

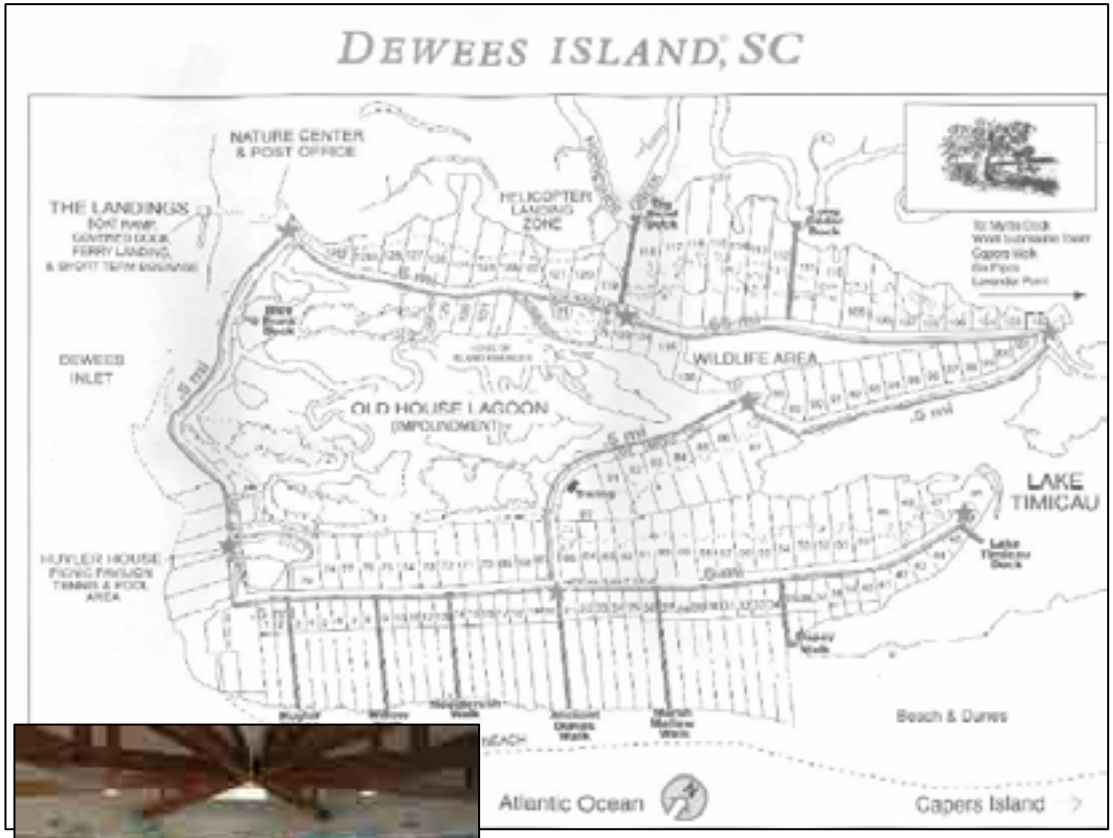
Net-Zero Energy Homes That Are Cash Flow Neutral

- NREL Analysis using BEOpt software for Boulder,CO climate



Example taken from the "GEOS" Neighborhood. Courtesy of Wonderland Hills Development, Boulder Colorado

It starts with sustainable land use planning……



The underlying principles of Dewees are that: -

- Development and environment are natural allies
- All development & building should occur in the context that all resources are limited
- Communities and buildings can be resource providers not just resource users
- Land is a stewardship role for future generations
- It is less expensive short and long term to build in harmony with the environment
- Communities are planned for people and technologies are to be supportive not dominant
- Environmental education is an essential "first step" in the rediscovery of our intuitive sense of integrating with the environment

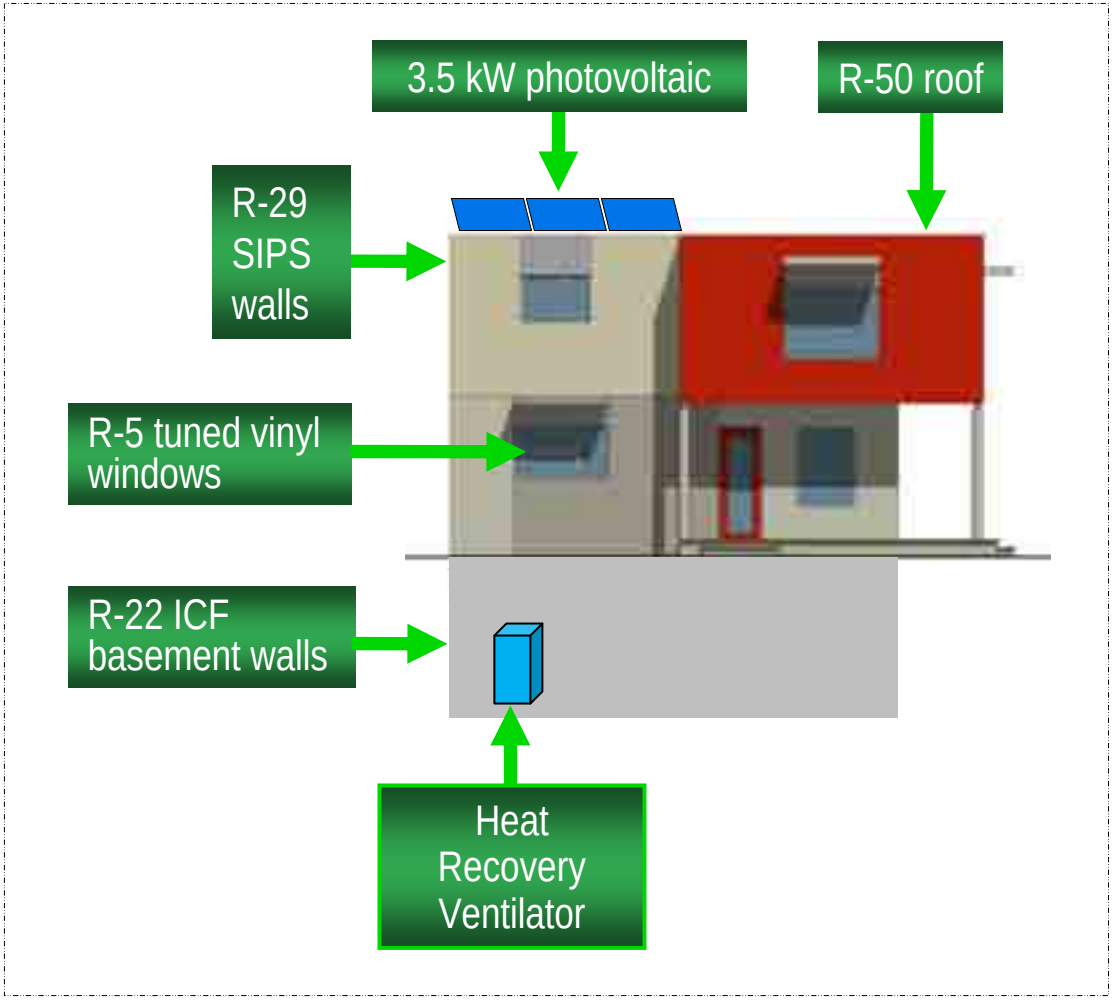
New communities-Community form and orientation matter

Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

- Comparative development patterns in urban Denver
- Optimizing density with solar access designed (required) for entire neighborhood and individual lots
- Utilizes unique features of Colorado's climate
- Sensible features take advantage of 300 sunny days per year: open homes for winter sun, shade against summer heat

Passive solar: optimal orientation for winter heat (open south) and summer shade (covered east and west) achieved with master orientation

Integrated (Efficiency plus renewable energy) Design of Homes



Heating Season Gain/Loss	MMBtu/yr
Ceilings/Roofs	2.2
Above Grade Walls	5.6
Foundation Walls	4.2
Windows/Skylights	-1.0
Infiltration	3.9
Internal Gains	-11.8
Other	5.1
Total	8.2

Heating Peak Load	KBtu/Hr
Ceilings/Roofs	1.1
Above Grade Walls	2.6
Foundation Walls	2.0
Windows/Skylights	2.1
Infiltration	1.7
Other	3.2
Total	12.7

Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

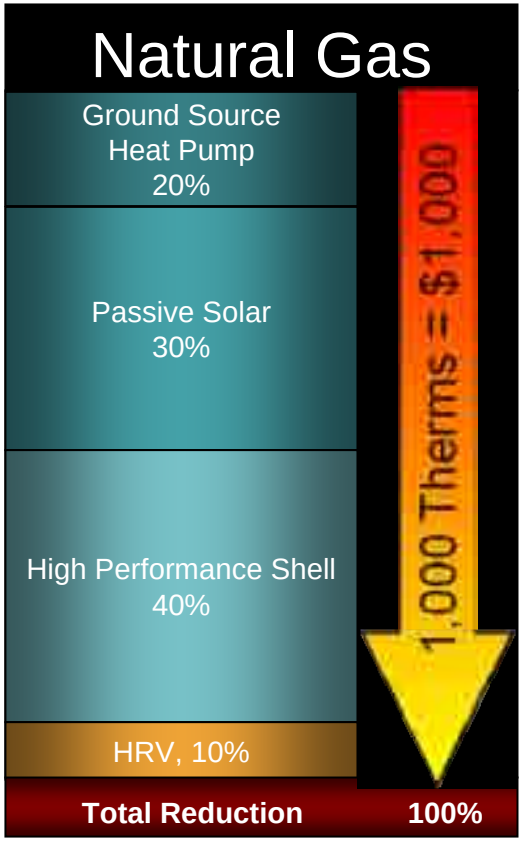
New Neighborhood Example

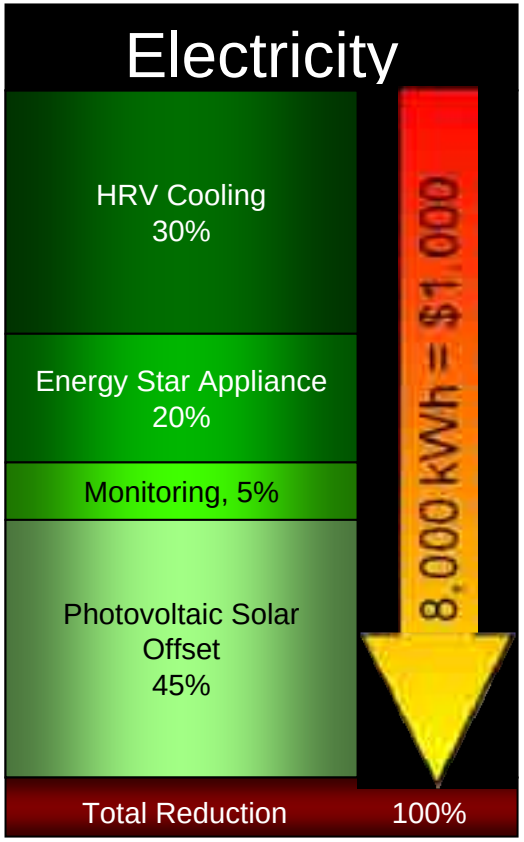
Solar Photovoltaic Meets All Electrical Needs with 3.5kW of Installed Capacity Per Home

- Each unit will have 3.5 kW of solar photovoltaic panels
- 1.0 kW is dedicated to the GSHP system
- The remaining 2.5 kW used for domestic electrical needs

Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

Example Approach to Zero Energy Homes





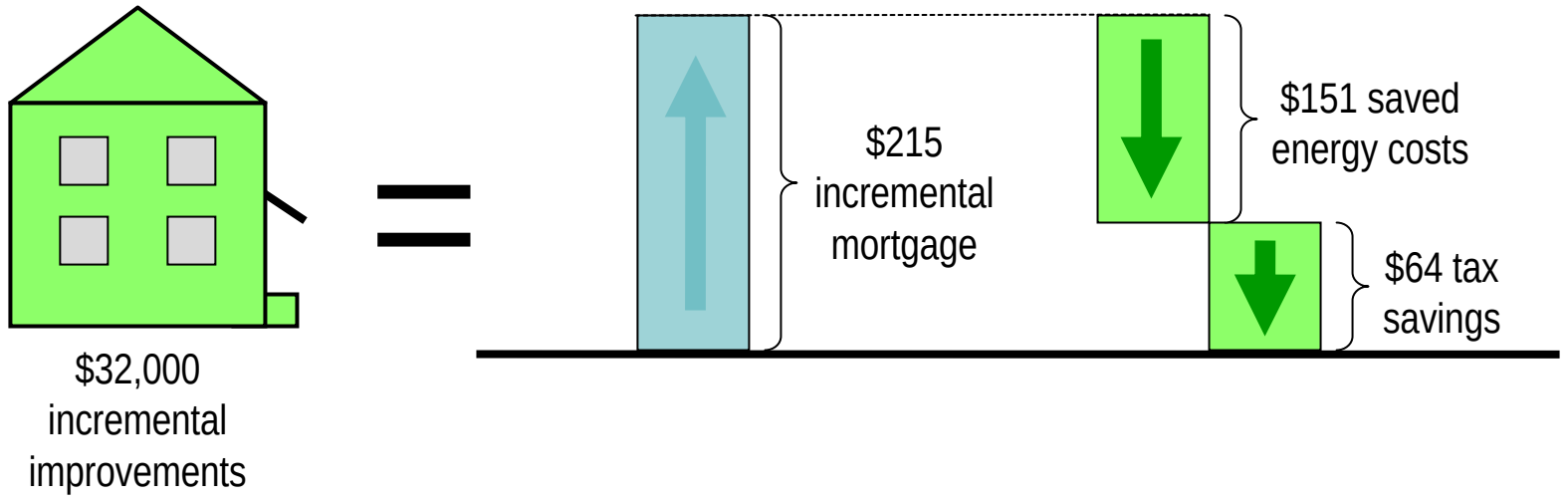
Objective: Build Net Zero Energy Homes…. Now!

Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

Design: Net-Zero Energy Homes That Are Cash Flow Neutral

- Reduced utility payments offset increased mortgage costs

Incremental monthly cash flows of technology improvements



Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

Transportation Infrastructure

Objective: Develop a community wide approach to transportation planning

- Pedestrian
- Plan to include neighborhood electric vehicles \a fleet of power assisted bikes
- Plan for PHEV ready
- Access to mass transportation

Vehicles Can Be Part of the Home Package

Toyota Dream House

Plug-in vehicle in a Japanese Home

Net Zero Energy Canadian Home

What types of vehicles are in a Renewable Community?

- Electric Vehicles + Bi-directional plug-in
- Hybrid Electric Vehicles + Plug-in
- Fuel Cell Vehicles + Plug-in
- CNG/LNG Vehicles + home refueling
- Clean Diesel / biodiesel
- Car share program
- Others…

The Central Plant

Objective: Identify a strategy to design and build a central plant for a community powered by renewable energy

- Define options in terms of technology and costs
- Develop RFP
- Develop policy and financing approach
- Facilitate implementation

Energy supply- Various approaches to community-based renewable generation

Distributed or Rooftop PV Systems

Pro	Con
• Consumers in homes with PV tend to conserve more • No line losses • For new construction, the cost of the home's PV can be included in the homes construction cost and therefore in the mortgage	• Individual maintenance • Home layouts need to consider orientation for PV

Central Systems Serving Community

Pro	Con
• Lower cost than distributed PV • Can be 1-axis tracking PV which produces 30% more energy than fixed PV • Could be wind, biomass, etc. • Central O&M and performance monitoring • Can double as an amenity (such as shading a parking structure) • Maintained by technology experts	• Transmission and distribution losses • May require land (unless installed on top of parking or other structure) • Metering to credit individual homes can be more difficult

Energy Supply - Distributed or Central?

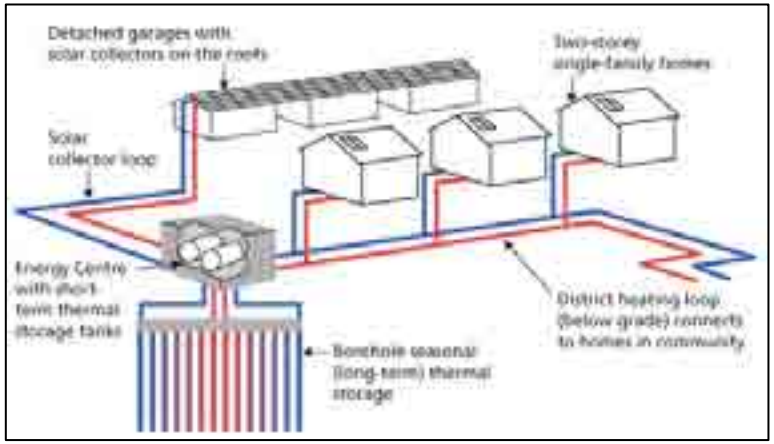
Integrated design

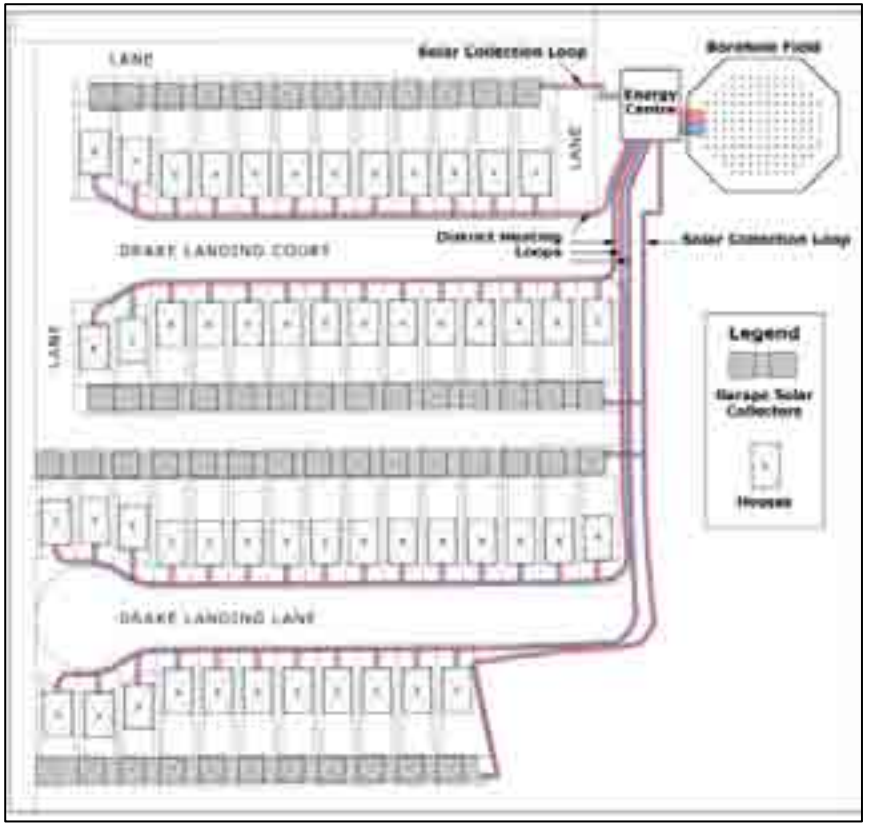
Objective: Position communities for “smart grid” ; tie together a range of technological and behavioral issues that will “make or break” the zero energy aspect of the community

- Zero energy community design of power distribution\infrastructure will be breaking new ground (new roles for developer and utility)
- Issues such as storage, billing etc. are new
- Tie a community wide energy education with the school curriculum, and creating a strong neighborhood sense of place

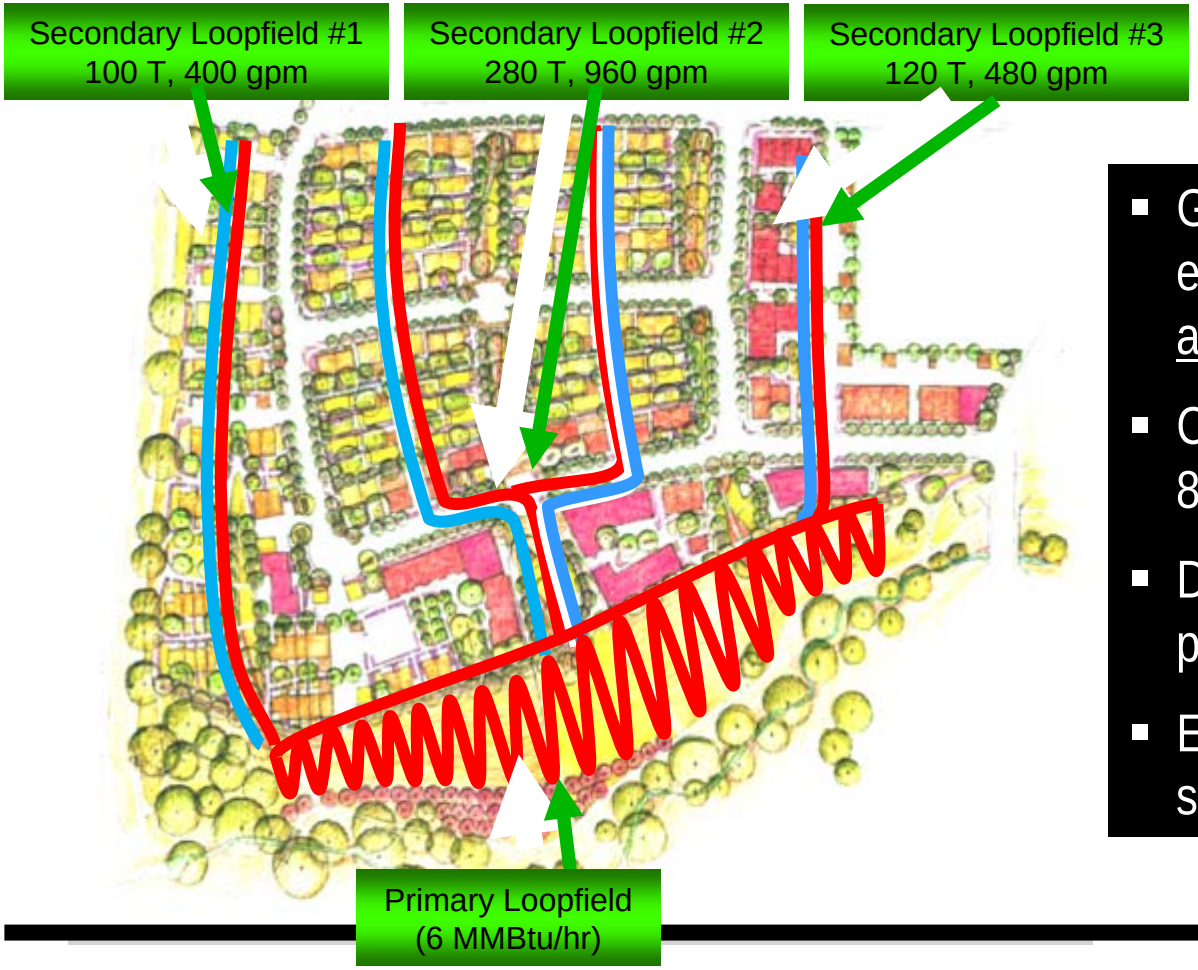
Community with microgrid, using GSHP and Solar Thermal

Drake Landing, Canada





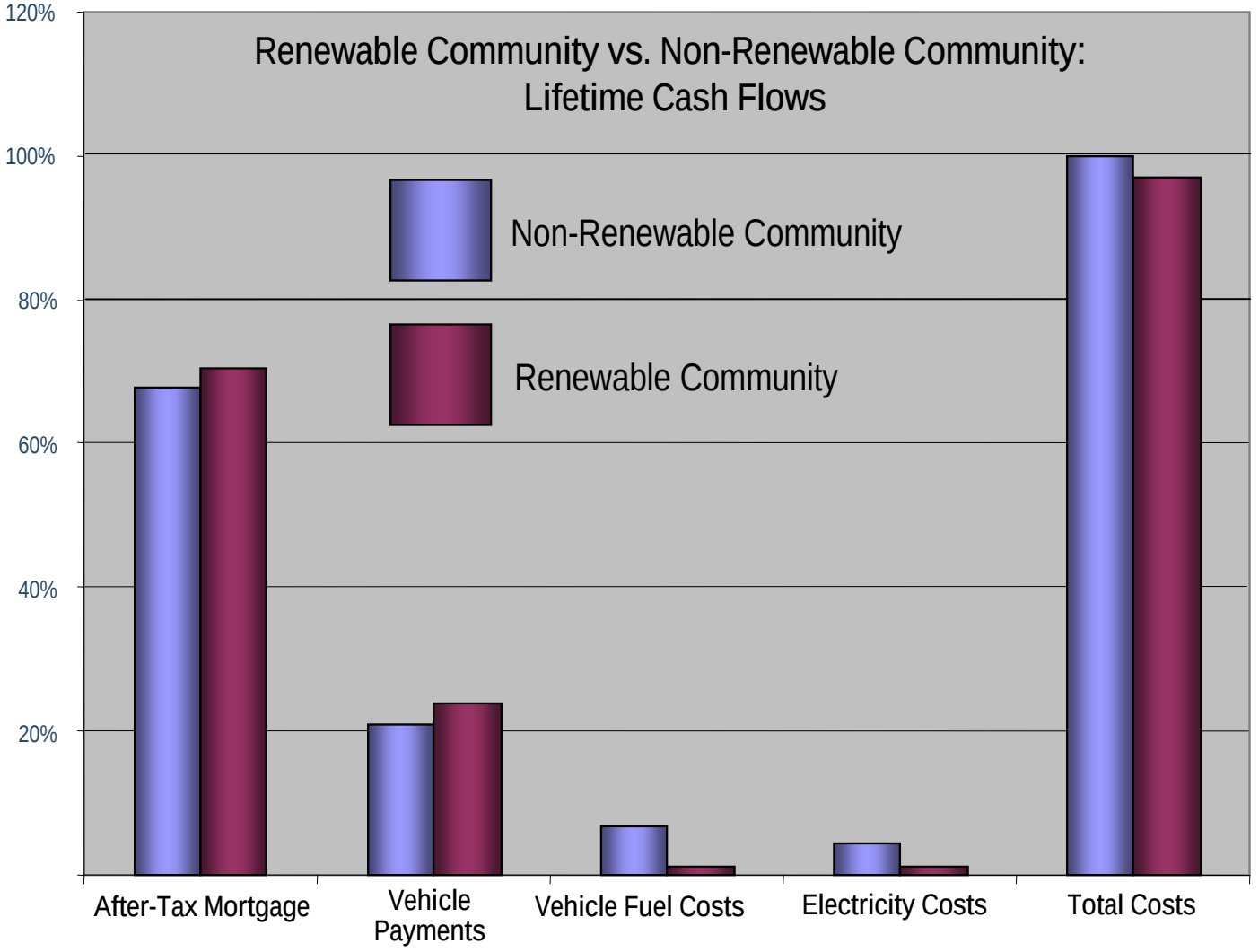
Integrated Infrastructure for thermal loads



- Geo-exchange system delivers energy for conditioning heat and domestic hot water
- Centralized loopfield has 800,000 ft of conduction piping
- Decentralized heat pumps produce hot water (COP = 3)
- Entire system powered by PV system (≈ 450 kW)

Slides courtesy of GEOS Neighborhood, Wonderland Hills, Boulder, CO

From a Consumer's Point of View: A Renewable Community Can Cost Less Than a Non-renewable Community!



Lessons learned from other communities

Imperative to persistently educate all involved on life cycle cost of energy in buildings

- Efficiency first, then renewables
- Consider all renewable resources; cost varies tremendously depending on resource and incentives
- Optimize at the system level
- Fully embraced and learn to use “Green” as an economic development tool
- Cultural change is required. Prepare for it and address it
- Financing assistance (information and/or cash) is as important as technical assistance

Ideas to Enable People and Businesses to do the Right Thing

Enabling Regulations

- Net Metering
- Interconnection Standards

Enabling Programs

- Package information in a way people understand and know how to take next step!
- Make it easy for people to do the right thing

Transportation Ideas for Communities

- Get commitments from anchor fleets to use alternative fuels and advanced technologies
- Implement a purchasing policy for the City\County that requires purchase of alternative fuel and advanced-technology vehicles
- Purchase neighborhood electric vehicles for use in the city (i.e. building inspectors and meter readers)
- Secure contract for alternative vehicles service and maintenance business
- Explore availability of CNG and propane vehicles
- Determine local E85 and biodiesel pricing strategies and their potential impact on the success of alternative fuels.
- Continue to pursue alternative fuel supply options and contracts with local biofuel producers.
- Solicit grants or donations to cover the initial cost of upgrading the existing fueling infrastructure

Establish Minimum Standards for Renewables and Buildings

Policy Changes

- Establish Strong Building Codes
  - Current IECC for Residential
  - Current ASHRAE Standard for Commercial
- Establish Comprehensive Standards
  - RPS – Renewable Portfolio Standards
  - EPS – Efficiency Portfolio Standards
  - FPS – Fuel Portfolio Standards

Strong Leadership is Crucial

Need a strong driver / motivator

- Economic
- Security
- Visibility

Need buy-in from the government, the businesses, the people

Early Adopters are Critical

Lead By Example

- If the community is behind the effort, then the community needs to show the way

Success stories

- Shows Proof
- Validation of results

A comprehensive integrated efficiency and renewable energy strategy requires