Introduction

According to the Department of Energy, residences account for 54 percent of all the energy¹ and 74 percent of water² used in buildings in the US, more than the commercial and industrial sectors combined. A single traditionally built wood-framed house can consume the lumber harvested from one acre of forest³ and can send 2 to 11 tons of construction waste to the landfill.⁴ These activities not only waste resources, they add costs without adding benefits. It's not difficult to see that, with a few simple changes in how we build homes, we can reduce resource depletion and costs at the same time.

Although some architects and builders have been developing and applying green practices for twenty to thirty years or more, the mainstream home building industry and general population of the United States have just begun the transition to more sustainable practices. And even though the green building movement has been getting a lot more press and attention over the last few years, the overwhelming majority of homebuilders still don't understand what it is or how to structure implementation in order to achieve real measurable benefits, including a worthwhile return on investment. Much of the information included in this book was developed to help this movement take root, providing a road map to achieving a truly green home within any budget.

GREEN HOME BUILDING

The authors are both green building consultants with years of residential construction and building science background. Miki Cook spent many years in the design/build, purchasing and estimating cost fields working for one of the original builder members of the Austin Energy Green Building program, the oldest green building certification program in the US. Doug Garrett founded Austin Energy's Residential Energy Conservation programs. In 1996, Doug established the first building science consulting business in Texas, providing building science-based forensic investigations, diagnostics and design consultations for clients and homebuilders across the nation. Over their careers, both have witnessed far too many project goals abandoned due to budgetary constraints. This book was written to provide a different approach to green building, from start to finish, with proven strategies and methods to achieve all of your goals and stay on budget.

Whether you are a homeowner, architect or a homebuilder reading this book, we hope you engage the methods discussed to build (or remodel) affordable, high-performance, healthy homes. Even if you are buying an already-built home (or even a condo in a high-rise), by gaining an understanding of the strategies presented in this book, you will be better able to recognize the green potential of all the properties available in the market. You will also be able to analyze those properties for any opportunities to further improve their performance and benefits. This book is about making informed, educated decisions in order to achieve your long-term goals, and about understanding the synergy of how each decision affects everything else.

We're All Green with Envy!

Green is everywhere; everything is green. This is not far from the truth these days. It's difficult to pick up a magazine without the cover story providing some insight into how to green your lifestyle, or turn on the television without seeing an advertisement for some company's efforts to minimize the environmental impact of their manufacturing operations. For the most part, the truth is that almost all green products are really only some *shade* of green, depend-

ing on their embodied energies, the toxicity of their contents and the value of the benefits that they provide.

Green homes themselves come in shades of green and are likely to perform accordingly. Green building programs that provide verification of green-built homes vary widely in their mandatory requirements for certification or the à la carte credits offered to achieve levels of higher recognition. Two projects with the same level of certification could have chosen significantly different methods in achieving it. And those methods, if not implemented to provide synergistic performance improvements, may actually do little to provide measurable benefits.

Even production builders who build the same plans repeatedly throughout a neighborhood to the same set of specifications will see each home perform differently, based on its orientation and, of course, the occupant's lifestyle choices. It is fairly safe to say that every green home is different. In fact, in some cases, using the term "green" may only describe individual features in the home, not the home itself.

Many builders will claim their homes are green and may offer a variety of reasons. A group of builders from a rural area of the country was once heard promoting their twenty-year-old heritage as green builders, as one of them had recently read that a handful of their regional methods were considered green. Their lumber was harvested from within 500 miles, they installed kitchen and bathroom vents that exhausted 100 and 50 cubic feet per minute (CFM) respectively (industry product standards), and to save money, they had been buying concrete made with fly ash. It didn't matter that they did not install energy-efficient windows, use less toxic building materials and only offered carpet and vinyl flooring to their customers. Obviously, the term "green" is being stretched here.

What Is a Green Home?

In general, green is based on the concept of sustainability. The most commonly accepted definition of sustainability refers to our ability to meet our needs in the present without compromising the ability of future generations to meet their needs. The truth is that we are using up resources on this planet at an alarming rate, not sustainably—everything from fossil fuels to fresh water to forests and food resources—and in doing so, we are endangering the delicate balance of nature. We are impacting climate and ecosystems by overharvesting and polluting, leading to events that eventually may threaten our own survival. The effect of these practices has already devastated many important natural resources globally, including our rainforests, farmland and wildlife habitats.

The reality is that we have already begun to see the impact from overexploiting our natural resources on our health and economic well-being. With an exploding world population, it is easy to see that these issues may reach staggering proportions within our own lifetimes, some escalating at such an alarming rate we may see major impacts within only a few years. Green building is not just for future generations, it protects our own quality of life.

A truly green home should deliver real benefits in terms of the amount of energy and water it requires to operate over its lifetime. It should be built using durable materials and methods, so there is less maintenance and longer periods between major repair cycles. It should provide a comfortable shelter for its occupants, one with fewer environmental pollutants that affect their health. And it should place less of a burden on our community and our planet, not damaging ecosystems or requiring the creation of massive new infrastructure to support it.

A key concept employed throughout this book comes from a relatively new field of housing research called building science. Building science studies and views the house and all of its components as parts of an interactive, integrated, holistic system. The mantra of building science is: "the house *is* a system." Building science recognizes that changing one aspect of how a home is built changes the entire system, and often other aspects of the home must be changed in response. The big value added is that this can be done while improving your comfort, reducing maintenance head-aches and costs and at the same time putting a lot of monthly utility dollars back into your pocket. It also recognizes that the right way

to build is what is right for your particular climate zone, not some one-size-fits-all approach.

How Can I Build an Affordable Green Home?

Section One of this book provides an easy-to-follow outline of "Ten Steps to an Affordable, Healthy, High-Performance Home," approaching the various green features and strategies as to how they impact the cost of housing. In order to truly achieve housing affordability, we need to look not only at the initial construction budget, but also at other costs that can be attributed to our total cost over the lifetime of the home. We all anticipate that energy and water costs will continue to rise in the future, as will material costs for the maintenance and repair of homes over their lifespan. Additionally, a failure to address indoor air quality can lead to health issues that increase our medical expenses, and we've all seen the direction healthcare costs are going.

Also, where we build homes can have significant impact on not only our land costs, but also the costs associated with community services. Green developments have a lower impact on our community, the environment, ecosystems and wildlife, and thus lower our costs associated with those. Choosing the right location for your green home can greatly influence your total cost.

Green building promotes resource efficiency, but you should not assume that every green home is resource efficient. It just makes sense that the more resources you use, the more the home costs to build and operate. So, for an affordable green home, it is imperative that you don't use more resources than you need to, either during construction of your home or in its operations once you've moved in. Efficient use of resources means obtaining the maximum benefit from the least amount of resources. We will look at both the materials and how we use them to keep our green home affordable.

Green materials and systems can improve the energy efficiency and indoor air quality of our homes and, to some extent, help to conserve water. But oftentimes, the focus is solely on materials and systems, without recognizing that basic design improvements made early in the process could have achieved far superior efficiencies. This add-on approach to building green is typically what adds costs to projects and is the main reason that those homes fail to deliver the benefits that we expect. We will look at the building as a whole and how to achieve synergistic results.

This is not to say that high-performance systems are not a worthy piece of the puzzle. This book will discuss the benefits that mechanical systems can provide and how these systems should be incorporated into your project so that they provide true benefits. So, unless you believe that green buildings must encompass every new technology available on the market today, wherein "new technology" most often translates to more expensive, you can use the strategies discussed in this book to build a *real* green home with *real* green benefits affordably.

The fact is that much of what we now understand about building science has shown us that the old passive strategies that we used before we had expensive systems to keep us comfortable give us the edge that we need to take high-performance homes to the next level. These strategies are discussed throughout the book and provide the foundation for Section Two of this book, "Getting to Zero," taking us beyond the green-built home, exploring the opportunities to zero-out energy, water, resource depletion, greenhouse gases and costs. If you can incorporate these strategies into your project, they provide both initial and long-term benefits and address our uncertainties related to future energy, water and natural resource availability, environmental contamination, and housing affordability. Any discussion of green building would not be complete unless we consider that we are stewards of the ever-changing landscape of sustainability.

We're not saying that you cannot spend a lot of money building green. The truth is that you can spend a lot of money on any kind of building. If you choose expensive systems, fixtures and finishes, you will spend more money no matter what type of building design, systems, products or construction methods you use. Unless you integrate the design, construction materials, methods and sys-

Introduction

tems into achieving synergistic performance, only time will tell if that added expense will deliver real benefits and if the return on investment (ROI) is justifiable. Our goal should be a return on investment for all cost premiums of no more than 15 years.

This book is not just a collection of green strategies that you can pick and choose from in order to build or remodel a green home. It is about the specific process that you can use to achieve a truly green home for the same total cost of ownership as a traditionally built home. This includes many green strategies that can be incorporated into your project that cost nothing. It includes green strategies that reduce the total cost related to your housing choices, including your property taxes and commute expenses. But mostly, this book is about green strategies that you can use to lower your base construction costs in order to fund recommended highperformance upgrades to lower maintenance and operation costs and protect your family's health. We really want you to learn about these; we want green building to be affordable. Because when it is affordable, its benefits are understood and you realize that you can actually make green building work for your project, then there will be no reason not to do it. And when you apply these methods to your project, and your neighbor applies them to his, and the same contractors are working for everyone and learn that these methods work well on every home, they will just become the way that we build all homes. This is our goal for this book: to bring affordable green building methods mainstream.

This does not mean that we are promoting cookie-cutter-style homes. On the contrary, we want to introduce an approach that can be used on any style home, and any size. These strategies can be applied to any budget, from low-income housing to luxurious highend custom homes, in order to achieve a high-performance green home within that budget. Note that the models and case studies presented in this book present fairly modest dimensions and cost. As you will see early on in the text, we do promote methods and materials to save you money and right-size your home based on your needs. Some would question whether large homes can even

be considered green. Our hope is that those who build large homes will still build them using methods that result in efficient use of resources and healthy environments.

Regardless of what price point of home you are planning to build, we hope that you incorporate as much as you can from this book into your plan. By approaching your project from this perspective, you should realize all your green goals within the same total cost of ownership over time as a traditionally built home. Hopefully you will be able to share with your friends and family ways that they might also be able to do this.

In many cases we will suggest tradeoffs, showing how you can save money in one area of construction and then use those savings to improve another area, at little or no net cost. We believe that green building must first be green from an economic perspective. For you and your family, it is critical that your new green home or renovation be affordable to build and cost effective to operate.

Green should not be beyond anyone's reach; it should not be what takes you over your budget. If we all accept responsibility for what we can do, we will make a huge, valuable contribution to the continued transformation of our society as a whole to living more sustainably on our fragile planet. Throughout this book, the strategies we describe will save you money either in initial construction, lifetime operations, or both. In addition, we've highlighted "No Cost Green" strategies or product selections that provide green benefits without any additional cost to your project. These are identified in the text by the icon below. And most importantly, look for the "Key" symbol. It identifies those strategies that are key to achieving major savings in your construction budget. These are the most critical overall to attaining your goal of an affordable green home.





SECTION ONE

Show Me the Money Ten Steps to an Affordable, Healthy, High-Performance Home

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CHAPTER 1

Location, Location, Location

For most people, selection of a building site is usually based on proximity to the area where they want to live, their budget and/or how much flexibility they have in building design. The location that you choose should match your needs for access to community amenities, work, good schools for your children, and/or your lifestyle goals. Too many times people make poorly thought-out decisions, such as building large, luxurious homes on acreage outside of town only to abandon them within a couple of years, realizing that they hate the commute to work every day.

Just as often, people buy undeveloped sites in established infill areas only to discover that these sites were never built on because of poor soils, drainage issues or development restrictions pushing development costs above neighborhood home values. Most people do not know enough about building to determine cost variances associated with site abnormalities. Sites with steep grade or poor soils may mean that engineering and installing the foundation will be cost prohibitive. If the site is heavily treed, it may be subject to city ordinances that prohibit the removal of large trees that just happen to be located within the allowable build area of the site. So it might be difficult to fit the home on the site or you may have to take expensive measures to prevent roots from damaging the foundation over the long term. Some sites have expansive clay soils, which can cause foundation problems, while other sites are so rocky that they cannot support the vegetation that will be needed to shade the structure, much less any kind of landscaping. If your goal is to put a solar photovoltaic system on your home, some sites in dense urban areas might not have enough sun exposure, due to trees or proximity to neighboring structures, to support that feature. If possible, it is best to have your builder or architect review the site before you make an offer to buy to be sure it will accommodate the size and type of home you intend to build.

You should also research any future growth, development and planning studies available for your area. As communities and regions struggle with population migration issues, you'll want to know that your decision to build and live in those areas will be a worthwhile investment in the long run. A recently published study¹ indicates that, by the year 2050, 90 percent of the US population is expected to live in dense, urban areas (current 2010 census indicates we are already at 82 percent). There have been reports in the media that the expected volume of baby boomers retiring is going to create a glut in the housing market² as they attempt to unload the large homes supported by their working incomes for smaller, active retirement lifestyle accommodations. In fact, the average home size is expected to shrink back to mid-1990 levels by the year 2015, as more families lose ground in their battle for wage increases.³ All of these news items indicate a trend toward higher-density, urban, mixed-use developments. Certainly cities are going to have to come up with creative solutions to address these challenges.

But the truth is, if you are still thinking of moving to the suburbs, you are not alone. Many fall prey to the false impression of cheaper land and lower rural tax evaluations. You should recognize, though, that as growth continues to move outward, so must infrastructure and services. And when enough people move outward, commercial development will follow to address the demand for support services and amenities. Before long, roadway construction will need to be upgraded or expanded to accommodate the volume of commuter vehicles; new schools, ball fields and hike-and-bike trails will be built; and strip shopping centers will line the highway. So even if property taxes are cheaper initially, that is probably not going to continue to be the case in the future. Some call this progress. Green building refers to it as sprawl, and the truth is that much of it is not sustainable.

Building new-or even sustaining existing-infrastructure for uncontrolled development is going to be difficult, if not impossible, except where planning addresses hubs of targeted growth corridors. We simply cannot afford to build and maintain an ever-expanding infrastructure to service every new "affordable" outlying development that springs up. Many cities around the country have partnered with their neighbors to create regional authorities to collaborate on long-term solutions that will enable them to stay ahead of these problems. By defining these target corridors, they are able to minimize traffic congestion caused by cross-area commutes from bedroom communities to work centers. Sustainable developments will have to be defined by planning and development boards that look at integrating employment centers, residential housing, parks and recreation both within the urban core and in suburban areas. To assure long-range sustainability, both affordability and diversity will have to be key components of these planned communities.

This is not to say that farmsteads are going by the wayside. On the contrary, there are also current trends toward communitysupported local agriculture. We expect this form of agriculture will lead to increased activity for community-shared gardens, with many new opportunities in urban and suburban areas for smallscale organic cottage food industries. This will include continued efforts in the city structure of the future for developing vertical farms and embracing rooftop real estate for growing the food of those buildings' occupants.

Smart Growth

You can easily find new community resources (banks, churches, schools, retail, medical and other personal service providers) when you move to any new neighborhood, but finding them within walking distance, a feature offered by many of the new mixed-use

"master planned" developments, offers even further savings on commuting expenses and time and other factors that impact your quality of life. In the best-case scenario, your location would be in a mixed-use development that includes all of the resources that your family will need: community services (fire, police and emergency) and recreation within walking or biking distance; alternative (car share) or mass transit (bus, commuter trains) that connects to other dedicated hubs. Since many cities are mandating Smart Growth⁴ developments with these sustainability features, you should think about how well your investment will hold up in a location that does not.

Living in a master-planned development also means you get more amenities because the cost is shared by the community. This includes the cost of installing utility lines and roadways, open space, parks, recreational facilities including swimming pools, dedicated pedestrian and bicycle trails, libraries and community buildings and gardens. There is definitely a revival in interest in neighborhood support, with sharing of interests and responsibilities. Homeowner associations help assure properties are maintained and values are protected. To check the walkability of any site you are considering, visit walkscore.com. And, finally, when choosing your site, think about which one will contribute the most to your living enjoyment, building performance and ease of homeownership.

This chapter is dedicated to recognizing the opportunities and challenges associated with site selection. It is important to recognize that, although some sites may offer obvious advantages over others, sometimes if we think outside the box we can overcome challenges and still achieve our goals.



Analyzing Your Building Site

Green building uses strategies that embrace patterns in nature that create opportunities for cost savings. By incorporating passive strategies to utilize sun paths, capture prevailing breezes and water runoff, we can reduce dependency on mechanical systems. This allows us to design a comfortable home and only use those systems to augment nature as needed. To make the best of what nature has given us, we must analyze the microclimate of our location. How you build depends on where you are building; local climate dictates your best building practices. Climate is not just about region, though—it can be very site specific!

Whether you are selecting a lot in a subdivision, a condo in a high-rise, or a large plot of land, there are a few aspects of the building site that you should consider. We will discuss some basic building science in this book, so if you are not able to achieve a comfortable understanding of these concepts, then this is the point at which you should hire a building designer who can provide expert advice on which location might offer the best passive benefits, considering these three principles:

- 1. The sun rises in the east and sets in the west: the basis for passive solar strategies.
- 2. Hot air rises: the basis for natural ventilation strategies.
- 3. Water runs downhill: basis for water management strategies.

These three natural laws and how they exist on your site can create challenges or opportunities for building your green dream home. Unfortunately, land developers who plan lot orientations and plat lots cut out of large parcels of land do not normally put much thought into how those plot plans contribute to good home orientation. So, what to do if the building lot faces the wrong direction or has its long sides running on an undesirable axis? These circumstances are definitely where a good green architect proves their value. Designing for the site is never more critical than in these situations. If you already have a less than ideal building site, a good designer can find creative ways to take advantage of or overcome orientation issues.

The Sun Rises in the East and Sets in the West

Selecting a site that has good solar orientation is one of the best strategies to lower your home's operating costs. To determine the best way to orient your house based on this sun path, you need to



FIGURE 1.1. Determining the best orientation for the house on your site.

figure out where you are on the planet. In the northern hemisphere, the sun is *never* in the northern sky, and it is either high in the sky (in the summer) or low toward the southern horizon (in the winter).

We'll take a rectangular box design to illustrate the best design for passive solar benefits. To achieve the best orientation of your home on the site, you'll need to determine the sun path across the site, from east to west. Once you have charted the sun paths, you will need to determine if it is possible to design the home on the site with the long walls of the rectangle running east to west ("eastwest axis").

It is important to recognize that the correct orientation of your house isn't limited to which side of it faces the street. Which walls are the long or short walls will depend on how you design the home for the site. This could mean the front is a long wall if your site is facing south, or if your lot faces west, it could mean that the side wall facing south is now the focal point of a courtyard. Or maybe the house faces north and the back patio has large overhangs that serve as a passive solar feature. But if the site is on the north slope of a hill, having good solar orientation for your home is going to be a concern. The point is to make the best use of your site by designing for it.

Hot Air Rises

Hot or warm air is less dense, causing it to rise above denser, cooler air. To take advantage of this phenomenon, look for a site that is in the path of natural wind currents. Take a few minutes to visit the National Resources Conservation Service website⁵ to find data on the prevailing wind direction and average wind speeds for your area. Determine whether the topography of the site is going to promote airflow or prevent it. Is your site flat or on a hill? If it is on a hill, it's best to build on the side of the hill facing the direction that the wind comes from. So if your area's prevailing breeze is out of the south, you should be looking for either a flat building site unobstructed from the south, or the south slope of a hill. You don't want to build a house on the opposite slope of the hill, where stagnant air will trap heat or cold pockets, not allowing it to move on.

Water Runs Downhill

Next, look for natural drainage patterns when investigating potential building sites. If you take a close look at the topographical map of the building sites below, some of the lots have low spots in the middle, probably about where a house would sit. Having water coming downhill toward your home's foundation from all directions, even with the slightest slope, is not the preferred drainage plan and can lead to lots of costly problems in the future. If this is your situation, it will require designing alternative drainage routes and installing stormwater management controls.

In Chapter 8, we'll discuss the importance of managing stormwater onsite. For now you just need to make certain that you are selecting a building site where it will be possible to establish positive water drainage away from your foundation. Verify that the site does not have flooding or access issues, or is not in a valley shaped like a bowl, making it impossible to manage stormwater drainage, or at the least, very expensive.



FIGURE 1.2. Site topography: Water flows downhill.

To take this concept a little further, though, it's important to note that water also runs down a roof and down the wall and basement assemblies too. So in designing the home, make sure you establish a drainage pattern that provides a path to get water off and away from your home in rain and wind-driven storm events. Thinking ahead at this early point in the process will pay off many times over later in money saved on basement and foundation water management and on maintenance to repair water damage to your home.

Your site management plan should include effective temporary (i.e., during construction) erosion controls and stormwater management. You don't want to lose your valuable topsoil that is exposed during the construction of the home. Silt fencing has long been recognized by building codes for meeting temporary erosion control standards, but other more natural materials work as well. Many green builders use straw bales to line the lot.



Other Considerations for Site Selection *Risk Assessment*

At this point, it is important to do a risk assessment of your building site. Areas prone to flood, earthquakes, tornados or hurricanes, or even pests like termites can incur considerable structural damage over a building's lifetime. We like to think that most of the new buildings being constructed will stand at least 75-100 years, but sustainable construction teaches us to think in terms of hundreds of years. So, in analyzing certain risk possibilities, think in terms of what events are likely to occur over that time span. Hence the relevance of terms like "100-year flood," for example, when considering if the site is in a flood plain. It does not mean the event will happen one hundred years from the time that you build. Take a moment to think about the last time such an event did occur at the site. It might be that the odds are stacked against you: the event might be likely to occur sooner rather than later. If the area has seen increased development and impervious cover, you can expect more floods even with less rain in the future. Regardless, plan and design for such events, and specify materials and methods to mitigate any damages that they might cause on your site.

Many areas now allow development in flood plains, mandating stormwater management plans to mitigate damages and taxpayersubsidized flood insurance for when those expected flood events occur. In essence, this means that we are committing the resources of the future to rebuild what we expect to be destroyed. And as this would be a reoccurring concern in these areas, it will also continue to be a losing proposition.

Some risks, like termites, are not assessed by historic frequency. Termites migrate in colonies, often having been introduced to an area on building materials (or even firewood) brought in from other parts of the country or world. The US Forestry Service map designates areas of the United States in terms of termite risk, from "none to slight," "slight to moderate," "moderate to heavy," and "very heavy." After determining which area you are in and what your risk tolerance is, it's best to plan accordingly during design and



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construction to minimize damages from this risk. Materials and methods to address with various risks are discussed in Chapter 4.

Site History

In choosing a building site, be aware of areas that have been subjected to pollution contamination. The Environmental Protection Agency's Brownfield⁶ and Superfund⁷ Programs require that identified disposal-contaminated areas are cleaned up before redevelopment can take place. Note the term "identified," as numerous sites have not been officially inspected and recorded, so be certain to look closely at the site and ask questions on its history. Only in recent history have we had regional legal landfill sites, so prior to that, and still in some areas, waste disposal has been by whatever means humans come up with.

Weather and Soil Stability

Construction methods and costs will vary considerably based on the stability of soils on your site. Planning for the changing stability of soil structure that can be caused by storm events can add complexity and cost to your project. Consider the site's accessibility in winter storms and during heavy stormwater events and the longterm costs associated with those issues.

California has areas prone to mud slides, the Mississippi River basin is prone to severe flooding that can sweep homes right off their foundations, frost heave results in tens of millions of dollars in damage every year in cold climates, and the Gulf Coast has drought-prone areas with expansive clay soils that face a continual threat of foundation problems. Working with professionals can help assure that your home is constructed with features to help minimize damages from the events likely to occur over its lifetime.

Protecting the Environment

Selecting a building site also requires us to analyze the impacts of developing that site on the environment. It is important to think about what the site will look like after we have completed our project. For example, imagine how the added impervious cover (concrete foundations, driveways, and other hardscapes) might increase stormwater runoff, causing erosion and limiting onsite infiltration. Other considerations affecting the environment include:

Keeping our Water Resources Safe: Anything that we do that impacts how water drains off the site might impact our neighbors and neighboring ecosystems. In many areas, we are now allowing development in the critical recharge areas of our surface water systems and groundwater aquifers. We do this even while knowing that the resulting pollution from stormwater runoff will carry lawn chemicals, fertilizers, pesticides and auto pollutants into the water our families will drink tomorrow. Just because these areas are now allowing development does not mean that we, as informed consumers, should support this effort. When you perform your due diligence investigating potential building sites, if you find issues like these, you should choose wisely.

Protecting Prime Farmland: Food shipped from around the world is generally grown on large production farms in soils that have

been depleted of their natural nutritional value and that often use synthetic chemical fertilizers and pesticides. These foods must be harvested before they are ripe and often use chemical processes⁸ to artificially ripen them in transit to our grocery store. The nutritional value of food has declined as a result of these practices. Additionally, this combination of industrialized food production and imported produce has contributed to the decline of small-scale farming as a profitable enterprise in the US.

It is unfortunate that much of our prime farming areas have been consumed by sprawl. This is due to the fact that many of our cities were located near the richest soil and most profitable farming areas in their region. Developers seeking cheap land to attract entry-level homebuyers have found that some of the least expensive land available is that farmland. At the same time, corporate commercial farming is driving small family farms bankrupt. Communities need to create incentives to conserve our suburban agricultural land to grow local, organic foods to keep us healthy. In the meanwhile, you can do your part by not buying a building site in one of these developments.

To make up for the farmland already lost to expanding development, we need to provide conservation areas of land in the urban core, from our own back yards to community gardens. To support this effort, we need to create organic waste management structures in our communities to provide natural, organic fertilizers for this purpose. These efforts are part of the core foundation of sustainable communities. We will talk more about how you can contribute to this effort in Chapter 13.

Where Did Nature Go? Talk to anyone in the town that you live in and ask them what that place was like just 25 years ago. If you can find someone older, ask about 50 years ago. You will no doubt hear that, of course, there were far fewer people and "I can remember when the outskirts of town was much closer in than it is now." You will hear stories of places that aren't there any more, places people used to go that were natural. Inevitably, you will hear people talk about land that's in the city now that used to be a large farm, where their father took them picking fresh produce in bushel baskets for canning as a child. How many of our current grocers shelves boast ingredients that are so local?

Many developers purchase land dense with tree cover only to completely clear it so that they do not have to deal with potential lot buyers who want to save this or that tree or have to work around a tree that's in the way. The wildlife that once lived there has been completely displaced. Even now, some of our neighborhoods are overrun with wild deer because their territories have been turned to suburbs. Then we even move into the greenbelts to put in golf courses for lifestyle communities, and push wildlife to the limit on space. And we consider them nuisances! Why is it that we humans think we own and control nature? Stewardship is a far better ethic in our opinion.

Those developers, and ultimately homebuyers, still do not recognize the long-term consequences of this approach. We have seen species go extinct from destruction of habitat, while other populations explode from destruction of predators, both at the hand of man. Now we find ourselves forced to designate wildlife sanctuaries to protect birds and butterflies from loss of their migratory habitats to development.

We need to remember that we are part of a great food chain that starts with the smallest creatures and works its way up to us. We, and the meat that we eat, both eat plants. Plants depend on the worm that feeds the bird that fertilizes the soil that grows the plant.

We are all interdependent for our survival. This reminds us of a John Muir quote, "When we try to pick out anything by itself, we find it hitched to everything else in the Universe." It is also important for our own health that we still have places, albeit nature preserves or just little backyard sanctuaries or pocket parks, where we can still commune with nature, smell fresh air, see butterflies and hear birds sing. This topic will be discussed further in Chapter 8.

Payback on This Investment

To get a true picture of site costs and site value, we need to look at the larger picture. We use fossil fuel resources every day for commuting from our homes to our work or other activities. When we build in remote areas, we dedicate resources to construct and maintain (forever!) roadways, utility services and other services. Then we use even more fossil fuel resources to travel to the same activities because the commute is now much longer. This is one of the reasons that green building practices promote high-density, mixed-use urban infill developments.

Sprawl forces us to take on bonded indebtedness to pay for new roads, schools, water and sewage treatment facilities and new power transmission lines. This new bonded indebtedness will take years, if not generations, to pay off, with no end in sight for our continued thirst to add more! Our existing urban core infrastructure was built and paid for long ago at a much lower initial cost. Much of that infrastructure is now at least 25 years old (and some of it 75 years old) and in need of maintenance and repairs, but since our tax revenues are committed to pay off these newer bonds, funds are not available to do this. Many cities now face serious groundwater contamination from old leaky sewage and water delivery pipes they no longer have funds to maintain or repair. By increasing density in existing urban areas rather than creating more sprawl, we can take dedicate new bond funds to maintaining and updating existing facilities, addressing the additional service load capacity and reducing the waste.

The same is true for utility and emergency service providers. With high-density urban development, service providers can focus investments to increase the capacities within their existing territory, and servicing higher densities means that they are able to spread that cost over a larger customer base. But as developments get more spread out, providing services to the same population requires more investment in delivery systems and personnel, passing those added costs on to all of their subscribers. Sometimes developmental fees are charged directly by utilities or municipalities to these rural developments for the costs of adding additional infrastructure. But ultimately, the costs of adding more support and emergency services associated with sprawl, and conversely the cost savings associated within increased urban density, are reflected in the tax base of the community. Property taxes, sales taxes, or whatever form your local jurisdiction chooses to pass on these costs as well as portions of the federal income taxes paid by working taxpayers nationwide, all contribute to fund federal financial road and infrastructure assistance programs. However they are paid for, these costs will affect the bottom line of your total home budget. Not only now, but for as long as you own your home, even after the mortgage is paid off.

Let's look at some of the potential pitfalls for the long-range return on investment (ROI) potential for your affordable home in the country versus the urban infill bungalow:

- Gasoline prices are expected to soar to \$7-\$8/gallon in the next couple of years. Along with wear and tear on your automobile, what does that do to your household budget? What do you think those costs will look like in 10-20 years? How about 40-50 years? Will those homes be abandoned then because the cost of commuting will no longer be feasible?
- 2. Populations are growing, more and more people are moving to the cities, often into the ever-expanding sprawl developments. Suburban sprawl creates long-distance commutes to work centers, shopping and recreational facilities, and is recognized as the main culprit for excess automotive travel and traffic congestion. How many hours a day will you be willing to spend commuting? What is that time worth, and what other activities are you giving up because of being robbed of that time?
- 3. Think about the impact on air quality related to pollution from urban traffic automotive exhaust. Stormwater runoff carries automobile oil and gas waste from roadways into surface and groundwater supplies, again affecting drinking water quality. And we all share the impacts of air and water pollution on our health and healthcare costs. Reducing the frequency and duration of automotive travel is key to reversing this trend.
- 4. Public service budgets are stretched to limits, the baby boomers are reaching retirement and will further strain Social Security and Medicare resources, meaning taxes are going up. Some municipalities and other government entities are already cutting spending on nonessentials, like non-critical maintenance. Where's the money going to come from when your roads and utilities need maintenance or repairs?

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GREEN HOME BUILDING

On the other hand, if we choose an urban infill location for our home, in a high-density, mixed-use community with dedicated pedestrian and bicycle transit alternatives that connect us to retail, medical and other personal service providers, schools and recreation, with mass transit options for when we need to commute, we minimize our impact on the community and the impact that the concerns listed above have on our quality of life. More and more cities are investigating building mass transit alternatives for commuters, since fossil fuel supplies are diminishing quickly, traffic problems are getting worse as urban populations increase, and these same cities are under scrutiny as being non-compliant with air quality standards set by the Environmental Protection Agency (EPA). While the cost of building and maintaining these transit systems would create additional tax burden on the entire community or region, it would be far less than the cost associated with uncontrolled sprawl and unbridled sources of air pollution.

When we choose sprawl development, taxes might initially be less expensive than for property in an urban locale, but your additional commute time and expenses alone should offset those savings:

Do the math for a working couple:	
Taxes on urban infill home valued at \$380,000	\$8,000/year
Drive 6 miles round trip to work @ \$0.50/mile (2 cars, gas, maintenance)	\$1,500/year
Combined urban expense	\$9,500/year
Taxes on home in rural subdivision valued at \$250,000	\$2,400/year
Drive 30 miles round trip to work @ \$0.50mile (2 cars, gas, maintenance)	\$7,500/year
Combined rural expense	\$9,900/year

Taxation

Let's take a closer look at the cheaper property taxes. Suburban or rural bedroom communities still provide much of the workforce for their urban "mother" city. As this type of development grows,

taxes must be increased to support infrastructure (roads, utilities, emergency services and especially educational facilities) that must be provided. Eventually those bedroom community tax rates catch up to their urban counterparts. This is because urban dwellers typically pay a smaller proportionate share of costs due to their higher density.



All Things Considered

So, thinking about where you are going to live should include consideration of its future affordability. Do not wait until gas prices are \$6.00-\$7.00 per gallon, or there are not enough hours in the day to fight traffic to shuttle your active family around in gridlocked traffic, and you see your investment value deteriorating due to these and other changing market conditions. You will be glad to have done your homework and made a better informed decision for your home's location.

Hmm, still can't decide? Before we go any further in choosing your location, we recommend that you take a few minutes to reflect on your life in terms of where the daily activities of your life occur geographically:

- 1. Look at a map of your city and mark an **X** at the general locations where you and your spouse go to work. If you and/or your spouse works from home or is not employed, do not mark your home location. Only mark locations where you must commute to work. If you are an outside salesman and travel a territory, mark the outline of your territory on the map.
- 2. Mark the location of each of your children's schools. Again, if any of your children are home-schooled, do not mark the location of your home.
- 3. Mark the location of other fixed-place activities that any member of your family is committed to. Only count places that, due to some contractual obligation, cannot be easily changed. Do not include the grocery, park, fitness facility, or shopping mall.
- 4. Mark the proximity of any close family relatives that provide vital contributions to your families' schedule.

Now it's time to determine the best location for you to live. To do this, ask yourself these questions:

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- 1. Is there an acceptable location halfway between you and your spouse's employment?
- 2. Are there schools close to this better home location that would offer the same quality of education as those you marked in 2?
- 3. Is this better home location more convenient to the extracurricular activities you noted in 3?
- 4. Would moving to that better location negatively impact the family support you recognized in 4?
- 5. Would the move to the better location have an overall positive effect on your family's time and schedule?
- 6. If it is a more expensive neighborhood, would the cost savings of less commuting (gasoline, wear and tear and time) be enough to offset it?

A couple of colleagues did this analysis, one with a 6-mile roundtrip commute and the other with a 24-mile round-trip commute. At \$3.50/gallon for gasoline alone, over a 5-day work week, 50 weeks/ year, the latter pays \$787 more in fuel at 20 miles per gallon. Based on that alone, the mortgage payment on the closer home could be \$65 more per month and the owner would have an extra hour every day not fighting traffic. Based on a reasonable wear-and-tear cost of \$0.50/mile on the automobile, the second colleague spends \$2,250 more every year for their work commute alone, or \$187.50/month that could go towards a higher mortgage payment and more free time. That adds over \$253/month to a higher mortgage payment for an urban home.

To sum it up, here's a breakdown of the additional costs for rural living versus urban living:

- Cost of building and maintaining roadways for commuting/ connection from suburban to urban area
- Cost of installing and maintaining utility lines to rural development (phone, cable, water, electric, gas)
- Cost of gasoline for commuting and accelerated wear and tear on automobile from faster accumulation of miles spent commuting
- Value of your time spent commuting, mental and physical strain driving *X* hours per day

- Cost to build, staff and maintain fire, police, trash and emergency facilities to service rural areas
- Cost to build support services (convenience stores, gas stations, schools, childcare, churches, etc.) to service rural development
- Cost to build amenities (recreation, parks and green space, etc.) to support rural development
- Cost to install and maintain mass transit to service rural development (bus, commuter rail)
- Pollution related to high volume of commuter traffic from rural areas to urban areas, cost of cleanup, higher insurance premiums and healthcare costs
- Loss of valuable agricultural land, wildlife habitat, and nature areas to rural development

We hope that you have read this chapter before you begin your search for a suitable building site. If not, we suggest that unless you are retired, work from home or won't be commuting daily to work from your site over 15 miles one way, you should consider postponing your build until you are in a position to do that. Or, if you could not pass up the current buyer's market and low interest rates, you could still build now and rent it out to others who would be homebased until you yourself are able to stop the daily commute.