Chapter 1

Introduction

I began my 20-year foray into the world of sustainable building as an idealistic and completely inexperienced amateur wanna-be homeowner — just a guy with big dreams, very limited means, and almost no idea of the complexity of the task I was attempting. Armed with one book (and no internet!) and great intentions and expectations, I plunged my family into a long-term adventure that changed all of our lives.

Though I wouldn't trade my personal experience for any other, I will gladly attest to the flaws of my naive approach. In fact, so flawed was this way of doing things that for two decades I have centered my life around helping others find their way to their own dream green home without hitting as many of the snags and making as many mistakes as I did.

There are many times in our lives when we make rash decisions and don't adequately prepare ourselves for a task. Most of the time, making a less-than-ideal choice isn't that big a deal — a poor choice can get chalked up to "live and learn." However, poor choices in home building can be extremely costly, and the results can have real and serious implications for decades to come. When your life's savings and a vast amount of your time and effort are on the line (not to mention large quantities of the planet's current and future resources), "oops" is not a word you want to hear! The world of homebuilding is not a place you want to wander in blind and be directed by hard knocks.

Sadly, I have watched an awful lot of people plunge into homebuilding only to make the same, predictable, costly and demoralizing mistakes that I did. I have seen many homes built well-over budget that also underperformed — never meeting the high expectations their owners had at the outset.

As much as I'd like to be able to offer a "silver bullet solution" that would guarantee quick-and-easy results, I'm afraid there is no fast track, sure-fire method to figuring out how to build yourself the best possible home. I have spent two decades deepening my knowledge of how to make a really good building, and I still have lots to learn. It's a vast subject, and the determining factors are many: climate and site, local regulations, available resources and skills, and, of course, budgets, which vary widely, as do individual considerations of comfort and aesthetics. There is no one "perfect" way to balance all of these factors; each project requires unique adaptations.

The uniqueness and "specificness" of homes — which I believe is essential for making a house into a home — has been largely abandoned for a one-size-fits-all simplicity that suits the needs of the large-scale construction industry but has done a large disservice to humans, the built environment, and the planet. This is not to say that good homes cannot be simple, but rather that the pathways to arrive at a good home design are as varied and many as the number of people who need and want homes.

Challenges and Rewards

We are at the beginning of a major period of disruption in the building industry. Pressures from many directions are forcing important changes in the practice of home design and construction, including more stringent energy efficiency codes, concerns about occupant health, and

the imperative to reduce carbon footprints and change to clean energy sources — all of which are having dramatic effects on how we build. The cost of property, materials, and labor has been on a steep incline for over a decade. It is a constant challenge to find the best ways to meet a reasonable budget target and achieve a high level of performance, and if the intention is to also use the healthiest possible materials, the challenge is amplified. Add in a dash of aesthetics and a fair share of bureaucratic red tape and regulatory hurdles, and you have a serious challenge on your hands.

The effort required to prepare yourself for this particular adventure is great, and the decision to move forward must begin with acknowledging that you are about to engage in a process that will be all-consuming for at least a couple of years. If this idea doesn't appeal to you, don't go down this path. Give this decision the weight it deserves. Put it on par with decisions of the magnitude of changing your career, going back to school, or moving to a new city or country.

But before I discourage you from even considering setting foot on this path, I should mention the incomparable satisfaction that comes from settling down for an evening in a home that you have designed and built for yourself, your family, and your friends. In a world where many of the archetypal "coming of age" moments are absent or watered down, weathering your first literal storm sheltered in your own home is a great and deep satisfaction. And if you can manage to get through that storm with the lightest possible footprint on the planet and the healthiest possible environment surrounding you, the satisfaction goes beyond just a personal achievement and becomes something that will be an integral part of your life and a legacy that will live long beyond your time on this planet.

It's my hope that you can make your project a forward-looking legacy, one that provides you and your family with all that they need while also achieving the goal of sustainable development — nicely defined by the UN's World Commission on Environment and Development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[1]

Section 1

Developing a New Approach

Photo credit: Ed Caldwell

Chapter 2

Decision-Making

Most books about home design jump right into the process of actually putting a house design to paper (or, in the modern context, to a software program). We're not going to get to that stage for a while. Of course, this is an essential part of designing a sustainable home, and it will be covered here in reasonable detail, but designing a sustainable home requires much more than putting lines onto a drafting board in the right order. It needs to start not with *drawings,* but with *goal setting.*

The fact that you are reading a book about sustainable home design indicates that you have an interest in setting a goal for your project that in some way addresses key issues of personal and/or societal sustainability. However, each of us probably means something different when we use such a term — and the words we use may themselves be different. Terms such as *sustainable, healthy, eco-friendly, natural, green, environmentally-sensitive,* and *net zero* are often used — sometimes interchangeably — to describe the kind of better home an owner desires.

Measurable outcomes as the basis of decision-making

It just won't work to begin your home design based on a couple of turns of phrase and a vague notion of what they mean to you. This book is not a treatise on semantics, so we're not going to try to define any terminology for you. Instead, we are going to focus on defining the actual goals that you are setting out to achieve when you use such terminology. Rather than relying on simple taglines, we're going to focus on well-defined goals and measurable outcomes. If you can knowledgeably set the targets you'd like your project to hit, your chances of succeeding are vastly increased.

Understanding Your Objectives

The unique intention of this book is to help you understand, define, and refine your objectives so that you can make informed choices — from initial siting considerations, through personnel decisions, and down to the level of individual material and system selections. It is critically important to acknowledge that your goals can be undermined by poorly informed choices at any stage of your project. If you fail to set appropriate goals at the "meta" level, then the chances of your project succeeding are greatly reduced, and if you do not ensure that each individual choice you make — throughout the process — adheres to the goals you've set, the results will likewise be undermined.

For example, it is the goal of many homeowners to create an energy-efficient home. At the

A good building means different things to different people.

"meta" level, this would involve setting a hard target — for example, meeting current Energy Star or Passive House standards. With this kind of clearly definable goal, it becomes possible to make informed and appropriate design, material, system, and personnel decisions. In this case, the clear goal of meeting a particular efficiency standard would narrow down the selection of design professionals to those trained to meet that standard, and it would help with the selection of insulation materials, doors and windows, and mechanical systems appropriate to meeting the standard. Any choice that would subvert the larger goal is easily discarded in favor of one that harmonizes with the overall intention of the project.

Much of this book is dedicated to helping you set these overarching goals because clarity on the relatively small list of guiding issues greatly simplifies the very large list of decisions that need to be made during a design/build project.

Learning to think "sustainably"

What makes it onto the scales during decision-making, and why?

The mechanics of decision-making are quite straightforward: we weigh up all the pros and cons of competing choices, and we choose the option that has more pros than cons.

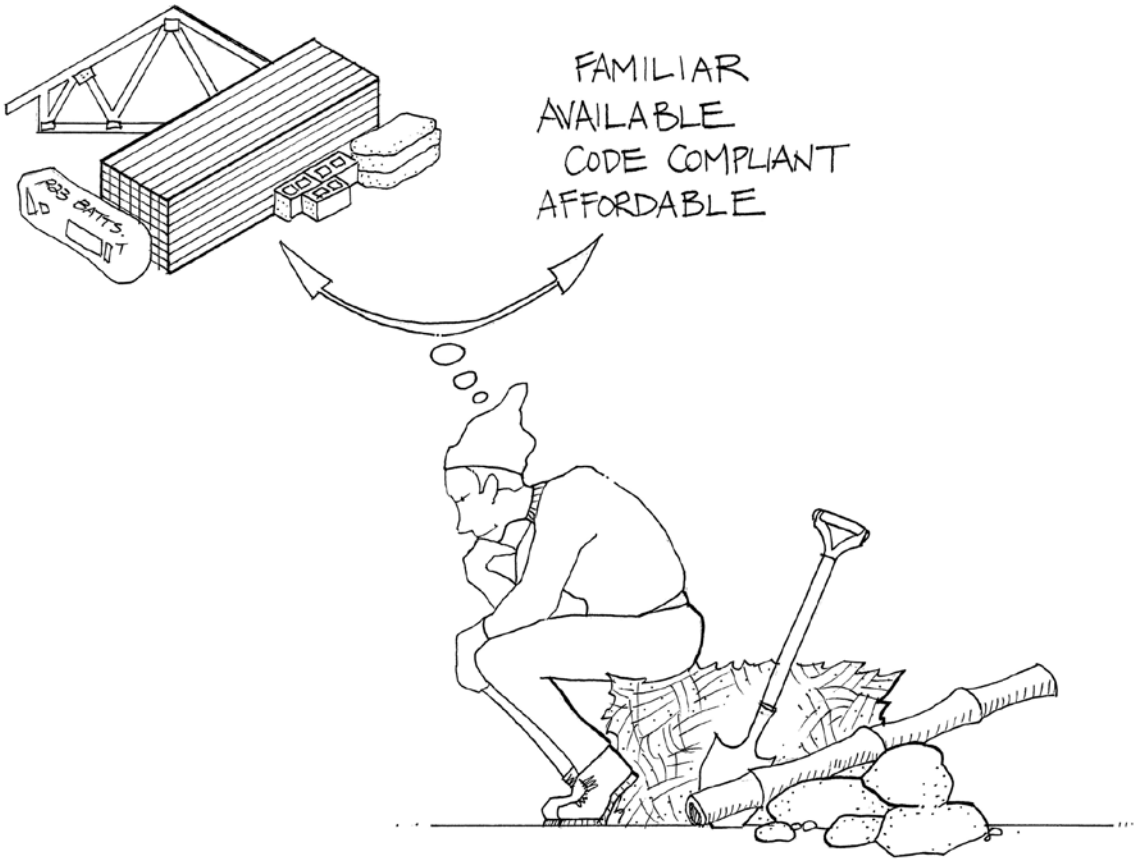
The process is no different when you are aiming to make a sustainable home, but the way in which we draw up the list of pros and cons includes some factors that are very often overlooked. We have to check some deeply ingrained biases if we are going to make the best choices.

New ideas versus established solutions

When considering new solutions, our approach tends to be one of two extremes. There are those of us who are inclined to accept the promises of a new solution without applying much rigor toward finding out if the promises are true, and there are those of us who tend to dismiss the promises of new solutions, also without the application of much rigor in our examination.

One of the first questions I am often asked when discussing new approaches to building is: "Does [insert name of material or system] *really* work?" This is an entirely appropriate and important question to ask, and it's not unusual that we should have this question when faced with something new. The "new solution paradox" is that we typically *only* ask it of new solutions, and completely fail to question existing, accepted solutions. There is an assumption that the ideas, materials, and systems we use commonly have somehow been "proven" to work, that they have been rationally measured and found to be the best means to achieve a particular end. In the realm of building materials and systems, however, development, testing, and establishment of industry standards have been far from rational and well-proven processes. As most readers of this book are already aware, most of our accepted solutions have not been developed with any coherent ecological principles or human health ideals in mind.

We tend to expect *new* ideas or technologies to live up to *unrealistically high* standards, while at the same time *normalizing* existing ideas or



Familiar expectations often match with familiar criteria.

technologies that are inherently, deeply *flawed*. If we're interested in making improvements in our buildings, it is critical that we hold both "accepted solutions" and "alternative solutions" to the same standards, using the same criteria before coming to conclusions. It is great to try to be objective about the choices we make, but it is essential that we apply the same objectivity to *all* our choices, including those that are so normalized that we don't see them as choices, but as inevitabilities.

Assessing inevitable flaws

There is no such thing as an idea or technology with no flaws. Recognizing this simple point is key to being able to consider new ideas fairly and thoroughly.

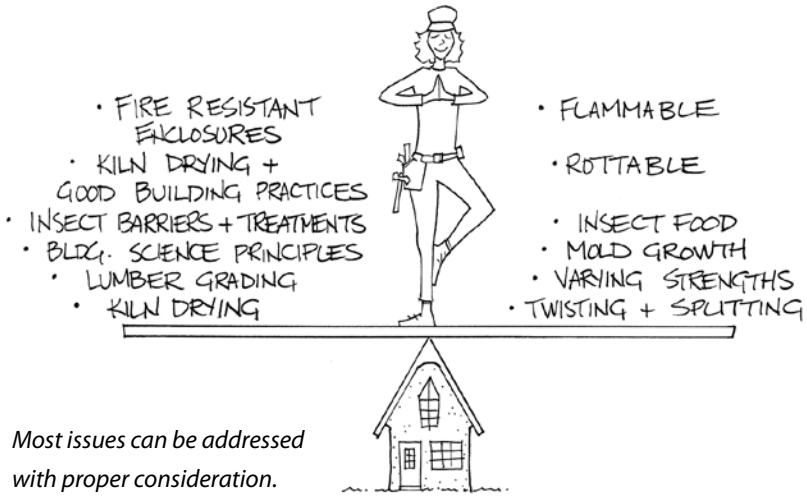
To prepare our minds for considering new building material ideas, it is helpful to think about one of the most trusted materials in the North American construction industry: wood. We rely on structural wood framing for a huge percentage of our residential and commercial buildings, and we use wood for finishes on the interiors and exteriors as well. Yet this trust in wood comes from the fact that its use is "normal" for us. If we were to try to introduce wood as a brand new building material today, it would face an uphill battle. Skeptics would raise all kinds of issues, pointing out that wood:

- Burns easily
- Rots naturally when exposed to moisture
- Is eaten by a wide range of common insects
- Is a great growing medium for mold
- Expands and contracts considerably depending on moisture content
- Twists and splits when drying

- Has strengths that vary widely depending on species and growing conditions
- Has strengths that vary widely depending on milling, drying, and storing processes
- Is often grown far from where it's used

Yet wood has come to serve us very well as a building material; along with its flaws, it also has a wide range of great properties that encouraged us to work to overcome all the flaws. We've now normalized it and built an entire successful industry around a highly flawed material. And though building codes and the lumber industry can provide plenty of data to justify the use of wood for its good points and minimize its flaws, this "proof" of the validity of wood as a building material came long after it had been widely adopted. As with so much of what is "normal" to us today, adoption was based on need, convenience, and field testing, not rational analysis.

Focusing on potential flaws can destabilize a project.



Most issues can be addressed with proper consideration.

Micro vs macro views

When we now attempt to introduce a new material that has even a small number of the very same flaws inherent in wood, we find ourselves up against naysayers who allow the existence of flaws to blind them to the strengths of the new material and the possibilities for being able to overcome any flaws.

Once we recognize that there are no options without some inherent flaws, we need to be able to see these building problems and solutions at two different levels — the *micro* and the *macro*. The vast majority of building-related decisions are viewed at the micro level, and involve assessing choices between competing materials and systems (often in the form of products).

Let's look at one example of how the difference between accepted and alternative solutions and micro and macro perspectives can play out when making building choices: *flush toilets versus composting toilets*. Many homeowners considering a more sustainable home will consider this issue at some point in their decision-making process.

Let's first ask if both solutions "work."

We tend to assume without much questioning that the flush toilet option works. After all, every building in the past half-century has used some version of this technology; we use them every day … so *of course it works*. However, it is unlikely that we have gone through life without experiencing at least one unpleasant backing-up and overflow experience with a flush toilet. In fact, it's likely to have happened several times to

each of us, and it's been an unpleasant situation to deal with, not mention extremely unhygienic. But even such dramatic failures don't lead us to consider that flush toilets *don't work.*

On the other hand, most of us have little or no experience with composting toilets, and our judgment of whether or not this entire range of options "works" will be based on either limited personal knowledge or on the received opinions of others. Proof that composting toilets "don't work" are mostly based on reports of unpleasant odor and a general revulsion at dealing with human waste. These "failures" lead us to conclude that composting toilets don't work.

Of course, we understand there are reasons a conventional flush toilet gets clogged, and we know it can be remedied. It is a malfunction. But it must be remembered that it is a malfunction that is almost 100% likely to occur. And should it be recurring, we will blame the model of toilet (they're not all created equal) or a systemic problem with the plumbing attached to the toilet, but not the entire notion of flush toilets.

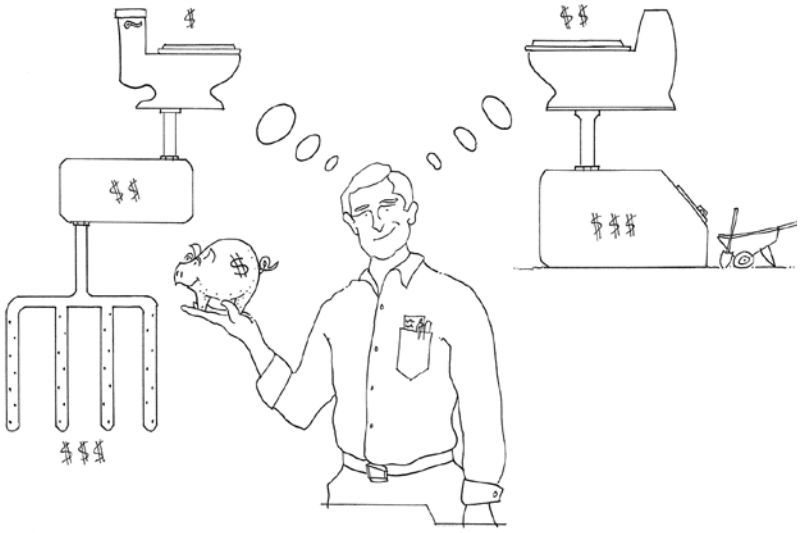
The important thing is to remember that the same is true of the composting toilet — systems that have negative issues are experiencing a malfunction that can be remedied. And systems that experience recurring problems are indicative of a faulty model design or a systemic problem with the use of the toilet. But a few issues with a few composting toilets don't negate the fact that the majority of composting toilets work perfectly well most of the time — just like flush toilets.

So, at this point, we can identify "micro" level flaws with both systems that can produce unpleasant encounters with human excrement. Next on the comparison list is likely to be cost. Here, it would seem that the flush toilet is the clear winner, as effective composting toilet systems appear to be many times more expensive. But before the flush toilet is declared the

It is possible — and even likely — for both flush toilets and composting toilets to malfunction at some point. One doesn't work better than the other, but they have different means and reasons for malfunctioning.

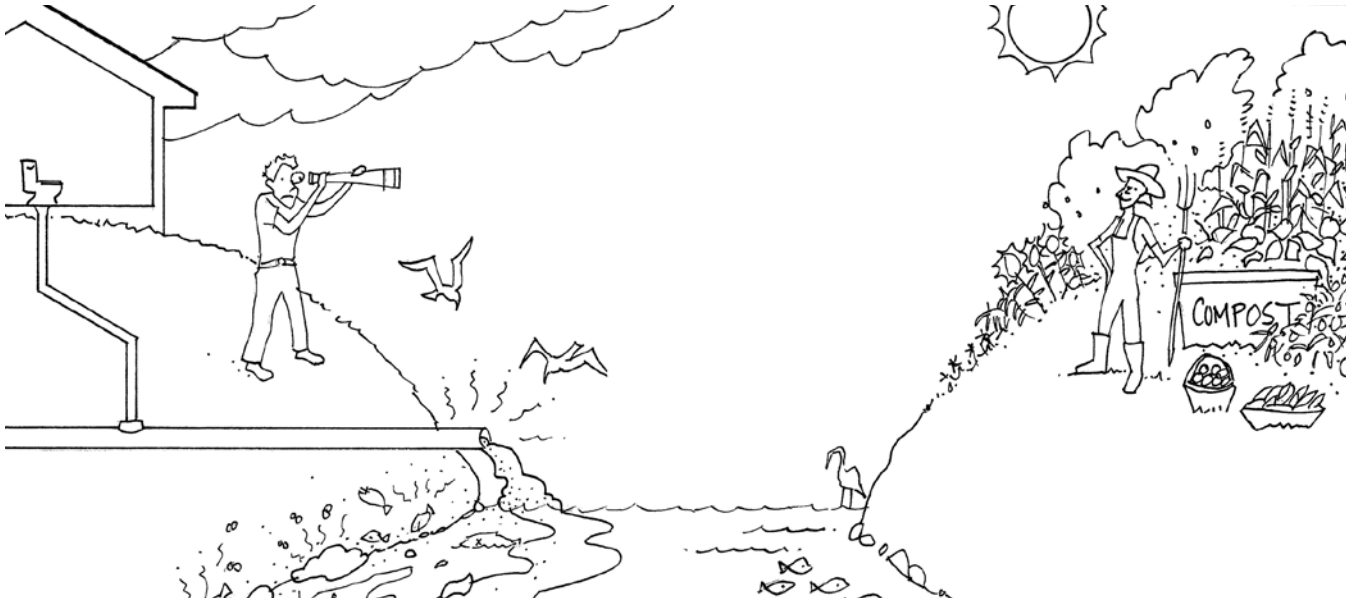
clear winner on this point, we have to look at the complete system costs for both. While a flush toilet unit is not very expensive, a full cost accounting would need to look at the costs for a septic system (in rural areas) and sewage connection fees and ongoing water/sewage charges in urban areas. The elimination or drastic reduction of those costs will likely put the composting toilet system in a similar cost bracket, especially if long-term costs are factored in.

Full-system costing must be used to create fair comparisons for budgeting.



Now comes the important step for the sustainable builder. We must move our focus from micro concerns like functionality, form, and cost and look at the larger ecological implications of our choices. Often, these implications are not immediately obvious and rarely used as a point of comparison, but it is crucial to include them if our intent is to make choices that are better for ourselves, our children, and the planet.

The flush toilet, viewed through this lens, is an ecological disaster. For private septic systems, the numbers are discouraging. "According to the US EPA, failure rates for on-lot sewage systems across the country are reported at 10 percent annually."[2] This means that millions of systems are leaching noxious quantities of contaminated effluent into surface- and groundwater supplies. These numbers indicate that within ten years, almost all systems will experience failure, and failure results in the pollution of our collective water supply. The numbers aren't any better for municipal sewage systems. The Sierra Legal Defense Fund's 1999 Sewage Report Card states: "Over one trillion liters of primary or untreated sewage is collectively dumped into



The macro comparison of flush toilets versus composting toilets shows a vastly different impact on human health and the planet. If these issues are important to us, then there is a clear winner in this comparison.

our [Canadian] waters every year by the [21] cities evaluated in this report. This volume would cover the entire 7800 kilometer length of the Trans-Canada Highway to a depth of nearly 20 metres — six stories high."[3] With ten times the population, US sewage dwarfs this volume. In addition, trillions of liters of treated water are used to flush all our toilets and create all this sewage, and this too has significant ecological and financial effects. Clearly, this accepted solution is not much of a solution when viewed on the macro level.

Composting toilets, when working properly, make compost that can be used to amend soil. A search of the database of The Center for Disease Control in the United States does not turn up any evidence of a single human illness attributed to composting toilets. The Center undertook a study of composting toilets at a national park in Arizona, and found that workers who clean and maintain the composting toilets were "more at risk for extreme heat, bee and scorpion stings, spider bites, and hantavirus from rodent nests and feces" than from the composted waste they were dealing with.[4] At the very least, composting toilets present a lower risk to the environment than the sewage created by flush toilets, and at best they have a positive impact in the rebuilding of soils.

Technologies develop the longer they are in use. Some sustainable building technologies are in the "Model T phase" —functional but not developed and refined. There is no reason to think that they will not reach the "self-driving phase" as they become more popular.

Being an early adopter

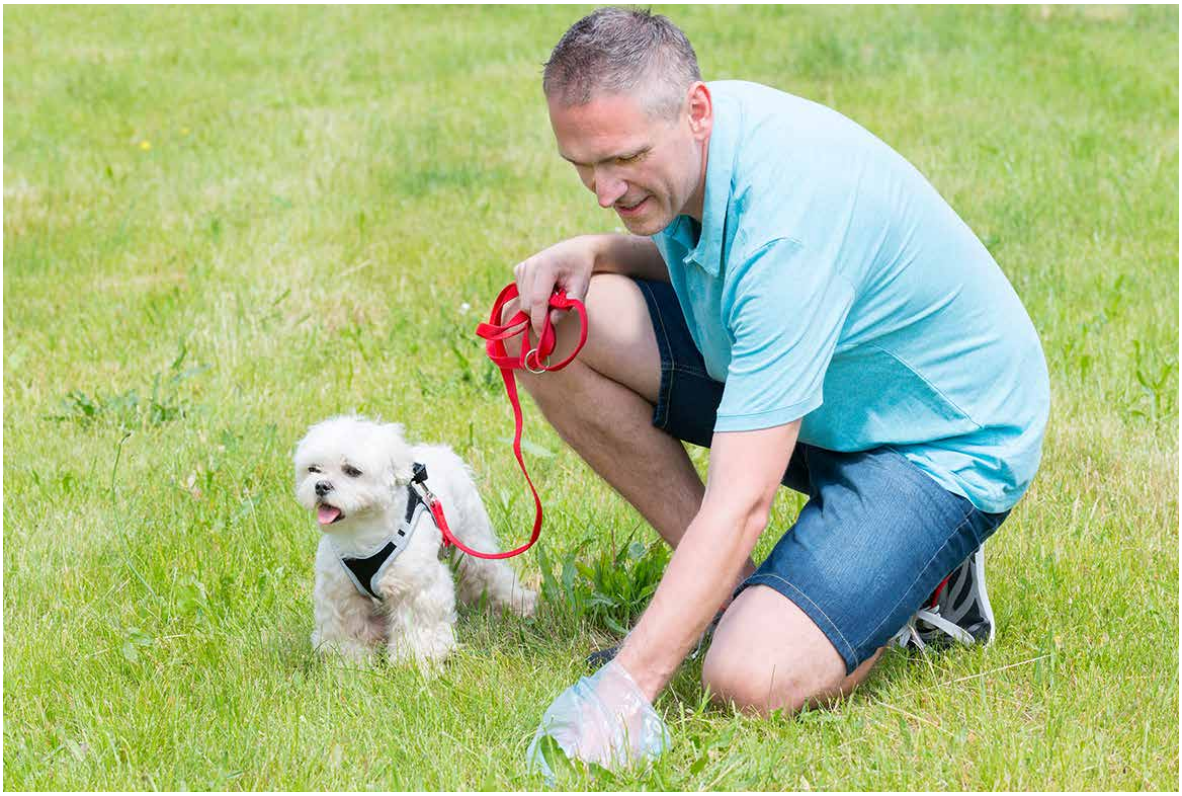
Widening our outlook to include macro considerations like environmental impact will probably lead us to choices that are not yet mainstream options. It is important to remember that new ideas and technologies do not leap out of the gate fully formed and perfectly developed. It is wise to consider where a particular option may be situated in terms of its development arc, and to understand where we may or may not want to intersect with that arc. There are definitely rewards for diving in and being among the earliest of adopters of a particular material or system, but there are also drawbacks. Early in the development phase expect higher costs, less availability, and the need to undertake some troubleshooting to make things work right. As the idea develops, cost and availability tend to improve, as do ease of installation, functionality, and maintenance requirements.

The "Yah, but..." response

Early in the development phase of new ideas and systems, there are many naysayers. The "*Yah, but*..." response is a common means of acknowledging that a new idea has some merit, but dismissing it based on its current state of development. To illustrate, we can continue using the composting toilet versus flush toilet comparison. It would be easy to dismiss the notion of widespread use of composting toilets as being an idea with positive possibilities, but impractical to consider as a mainstream option.

This outlook ignores the trajectory of all developing ideas, which start as good ideas and then move into prototype and testing phases, followed by small-scale market penetration and, in some cases, widespread adoption. Composting toilets may have limited appeal because of inherent revulsion about dealing with human waste. However, it is possible to imagine the feasibility of service contracts for removing composting toilet contents and handling them at a central facility in much the same way that we currently handle solid waste and household recycling. Commitment to a better idea is what spurs the development of practical solutions — the notion of recycling came before the invention of coordinated neighborhood pickups in specialized trucks.

The "Yah, but" outlook also ignores the ways in which social mores can influence development of ideas. In many parts of North America, we applied laws and a high degree of social pressure to induce dog owners to pick up their animals' feces from lawns, parks, and sidewalks. In a matter of a decade, this social pressure resulted in a new norm, one in which dog owners get "up close and personal" with their animals' waste (in a way that is much more visceral and off-putting than dealing with a composting toilet!). If we seriously undertook a social plan to make it inexcusable to foul our waterways with human waste, we could achieve the same type of result.



If it's possible to convince people to do this, it's possible to get people to deal with clean and simple humanure composting.

Doing things better not the same as doing better things

Throughout history we have collectively refined ideas and technologies, even those with significant hurdles (such as the automobile, with the vast infrastructure required to support its use and its devastating toll on humans and the environment). We're good at improving the micro-considerations, but generally terrible at intentionally setting macro-goals.

In the realm of building materials, cement followed the standard development arc. Early cement products were extremely labor- and fuel-intensive and far from reliable, but the benefits of having a quick-setting material that is easily formed and potentially strong encouraged us to work through all kinds of issues to arrive at this moment; the modern cement industry now offers well-formulated products that are widely available and cost-effective. Many of the "alternative solutions" presented later in this book are at the beginning of that same development curve; this doesn't make them impractical or impossible to implement, but it does require an acknowledgement that there is improvement to come in the future. The day may not be that far away when a builder can order a highly specialized clay plaster or clay floor mix from a local batching plant and have it delivered and placed with the same degree of mechanization as concrete! This is already true in Japan; it could just as easily happen here.

Personalize the solution

Looking at building solutions through a wider, ecological perspective can radically change how we consider our options on an individual basis. But each homeowner and builder will have their own unique outlook and therefore make different choices. In the next section of the book, we will look at developing a personalized list of specific criteria, and attempting to keep the widest possible perspective on the impacts our choices might have on ourselves, our children, and generations to come.

There is no reason that ecologically friendly, clay-based building materials can't be produced, delivered, and used with the same efficiency enjoyed by concrete materials.