Small is Beautiful

U.S. House Size, Resource Use, and the Environment

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Summary

As house size increases, resource use in buildings goes up, more land is occupied, increased impermeable surface results in more storm-water runoff, construction costs rise, and energy consumption increases. In new, single-family houses constructed in the United States, living area per family member has increased by a factor of 3 since the 1950s. In comparing the energy performance of compact (small) and large single-family houses, we find that a small house built to only moderate energy-performance standards uses substantially less energy for heating and cooling than a large house built to very high energy-performance standards. This article examines some of the trends in single-family house building in the United States and provides recommendations for downsizing houses to improve quality and resource efficiency.

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Introduction

Since 1950, the average size of new single-family houses in the United States has more than doubled, even as the average family size has steadily shrunk. More area (square footage) per family member is being used than ever before, and projections are that the trend will continue. As house size increases, so too do the environmental impacts associated with buildings and development: resource consumption increases, the land area affected by development grows, storm-water runoff increases as impermeable surface area increases, and energy use rises. In addition to carrying larger environmental burdens, larger houses cost more to build and operate. For single-family houses, "small is beautiful" in terms of environmental performance.

Because single-family, detached houses account for 63% of total dwelling units in the United States (U.S. Census Bureau, 2001), this study focuses solely on single-family houses. A broader study that examined single-family attached houses, multifamily buildings, and mobile homes would produce somewhat different and probably less dramatic results.

Demographics versus House Size

The U.S. Census Bureau has been collecting detailed information on household size since 1940 and tracking certain characteristics of houses since 1963. Data on houses were collected by the U.S. Department of Housing and Urban Development and other agencies from 1940 to 1963. Average household size in the United States has dropped steadily from 3.67 members in 1940 to 2.62 in 2002. The average size of new houses increased from about 1,100 ft^2 (100 m^2) in the 1940s and 1950s to 2,340 ft^2 (217 m^2) in 2002. Factoring together the family size and house size statistics, we find that in 1950 houses were built with about 290 square feet (27 m^2) per family member, whereas in 2003 houses provided 893 square feet (83 m^2) per family member (NAHB 2003)—a factor of 3 increase. These trends are illustrated in figure 1.

Other trends in American single-family housing have been similar. In 1967, for example, 48% of new single-family houses had garages for two or more cars; by 2002, that figure had jumped to 82%. In 1975, 20% of new single-family houses had 2.5 or more bathrooms; by 2002, that figure had increased to 55%. In 1975, 46% of new houses had central air conditioning; by 2002, 87% had it (NAHB 2003).

Resource Consumption

Larger houses consume more resources—both in construction and during operation. The U.S. National Association of Home Builders (NAHB) estimates the materials used in building a 2,082-square-foot (193-m^2) single-family house to include 13,837 board-feet of framing lumber, 11,550 square feet (1,073 m^2) of sheathing, and 16.92 tons (15,350 kg) of concrete (see table 1).

One would expect that, relative to material use, there would be an economy of scale as house size increased—that material use per unit area of floor area would drop as floor area increased. But that is not necessarily the case, according to Gopal Ahluwalia, the director of research at NAHB. Although NAHB has not compiled data on material use as a function of house size, Ahluwalia believes that, because larger houses tend to have taller ceilings and more features, larger houses may actually consume proportionally more materials. He estimates that a new 5,000-square-foot house will consume three times as much material as the 2,082-square-foot house NAHB has modeled, even though its square footage is only 2.4 times as large (Ahluwalia 1998). Even if Ahluwalia's intuition is not correct and larger houses are more material-efficient per unit area of floor, the higher ceilings and added features in large houses may mean that material use efficiency improvements with increased floor area of a house are not proportionate—that is, that the increased material efficiency one would expect from purely geometrical calculations is not realized.

The use of lumber, structural panels, and nonstructural panels in new houses from 1950 through 1992, along with figures for total wood use calculated from these data, are presented in table 2 below. As would be expected, total wood use in houses has increased steadily between 1950 and 1992, as houses have grown in

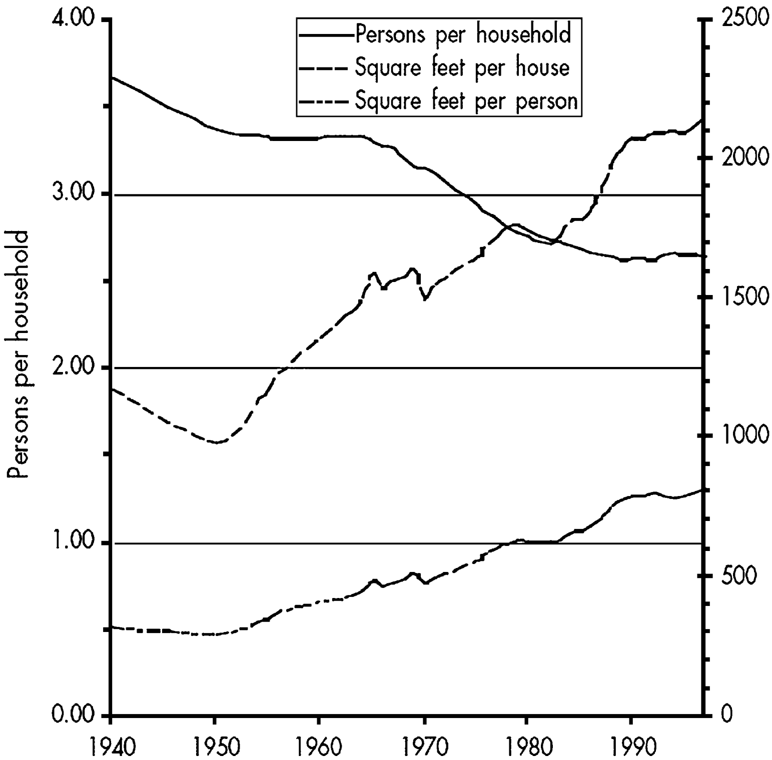

Figure 1 The floor area of new homes is going up although family size is going down. Data from the U.S. Bureau of the Census and the National Association of Home Builders.

size. But when we examine total wood use *per unit of floor area*, we find that it dropped between 1950 and 1970—perhaps due to the substitution of plywood sheathing for board sheathing and the introduction of more wood-efficient roof trusses. Then, around 1970, wood use per square foot of floor area began to increase again, and by 1992 it was up about 12% from the low point. Exactly why this is occurring is not clear; it could result from an increasing use of 2 × 6s instead of 2 × 4s[1] for wall framing, or a shift to more complex geometries.

In general, the energy efficiency of a building envelope (i.e., the structural elements that enclose a building, including the walls, roofs, and foundations) is a function of how well insulated it is, how airtight it is, the exposure of its glazed areas to solar gain, and its area. All else being equal, a house with more surface area will consume more energy for heating and cooling. Thus, a larger house—or one that has more complex geometry—will consume more energy.

Table 3 compares heating and cooling costs for 1,500-square-foot (139-m^2) and 3,000-square-foot (279-m^2) houses. Six different houses were modeled: well-insulated versions of both houses in Boston, Massachusetts, USA and St. Louis, Missouri, USA, and a poorly insulated version of the small house in each city. The houses all have simple geometry. Comparing the large and small versions of the houses with comparable energy features, we find that when the floor area of the house is halved, heating costs are slightly more than halved, whereas cooling costs are reduced by about a third. When the small house with lower energy performance is modeled, its energy consumption goes up significantly compared to that of the energy-efficient small house, but it still uses much less energy than the large house that is well insulated.

A house's smaller square footage does not always mean a comparable reduction in surface area. If one reduces the total size of a house but breaks it into smaller, separate wings and more

Table 1 Materials Used to Build a 2,082-ft^2 (193-m^2) House

Component	Quantity	
	English	*Metric*
Framing lumber	13,840 bd.ft.[1]	32.7 m^3
Sheathing	11,550 sq.ft.	1073 m^2
Concrete	16.92 tons	15.35 tonnes
Exterior siding	3,011 sq.ft.	280 m^2
Roofing	2,841 sq.ft.	264 m^2
Insulation	3,061 sq.ft.	284 m^2
Interior wall materials	5,550 sq.ft.	516 m^2
Flooring[(2)]	2,082 sq.ft.	193 m^2
Ducting	226 linear ft.	69 m
Windows		18
Cabinets[(3)]		18
Interior doors		12
Closet doors		6
Exterior doors		3
Patio door		1
Garage doors		2
Fireplace		1
Toilets		3
Bathtubs		2
Shower stall		1
Bathroom sinks		3
Kitchen sink		1
Range		1
Refrigerator		1
Dishwasher		1
Disposal unit		1
Range hood		1
Clothes washer		1
Clothes dryer		1

Source: NAHB 2001.
[1]One board foot equals the volume of a piece of wood with nominal dimensions of 1 ft square and 1 in. thick. With planed wood products, actual dimensions are typically less than the nominal dimensions.
[2]Carpeting, resilient flooring, tile, wood, and so on.
[3]Includes kitchen and other cabinets.

complex geometry, for example, as is sometimes done in custom houses, one may not gain much in the way of energy savings compared to the large box. Along with the greater surface area increasing heat loss and unwanted heat gain, larger houses also generally require longer runs for ducting and hot water pipes. Losses in conveyance of warm air, chilled air, and hot water can be significant.

Quantity versus Quality

With single-family houses, the notion that bigger is better has been a leading driver of the real estate industry. Large houses are a status symbol. Even retirement homes built for "empty-nesters" (couples whose children have left home) are usually a step up in terms of size. Virtually all segments of the American home-buying market are buying the largest houses they can afford (Tulley 1998).

Designer-builder John Abrams of the South Mountain Company in West Tisbury, Massachusetts, USA describes three factors that are driving the popularity of large houses: "First, with less of a sense of community and public life in our culture, the home becomes a fortress which needs to contain everything we need, including multiple forms of entertainment, rather than basic shelter; second, the building industry has been selling 'big is better' and the message has been heard; and third, diminishing craft and design generosity has resulted in sterile homes—people mistakenly think that what's missing is grandeur: more space" (Abrams 1998).

This status quo is being questioned today. Homebuyers are becoming less interested in size than they are in quality. Sarah Susanka's book *The Not So Big House* (1998), which emphasizes a very different approach to house design—one focused on quality, not quantity—is selling extremely well. According to Taunton Press (2003), over 360,000 copies have been sold. Two of Susanka's subsequent books also continue to sell well: Over 240,000 copies of *Creating the Not So Big House* (2002a) and 50,000 copies of *Not So Big Solutions for Your Home* (2002b) have been sold. A residential architect in North Carolina, USA, Susanka argues for space-efficient houses with spaces that will be used. For example, she suggests eliminating the formal dining room in favor of a larger kitchen that provides both dining space and some informal living space (Susanka 1998).

The South Mountain Company has been emphasizing space-efficient houses since its launch nearly 30 years ago. In addition to providing open-plan living/dining/kitchen areas, the company suggests providing built-in furnishings and storage spaces, eliminating single-use hallways,

Table 2 Wood Use in New Single-Family Houses, 1950–1992

	Softwood (bd.ft.)[1]		*Hardwood (bd.ft.)*[1]		*Exterior Sheathing*[2,7] *(ft^2)*		*Interior Panels*[3,7] *(ft^2)*		*Total Wood*[4,5,6] *(ft^3)*	
Year	*Entire house*	*/ft^2 flooring*[8]	*Entire house*	*/ft^2 flooring*	*Entire house*	*/ft^2 flooring*	*Entire house*	*/ft^2 flooring*	*Entire house*	*/ft^2 flooring*
1950	8,080	(8.05)	904	(0.90)	2,960	(2.95)	170	(0.17)	613	(0.61)
1955	8,830	(7.94)	901	(0.81)	3,400	(3.06)	223	(0.20)	671	(0.60)
1960	9,930	(7.83)	914	(0.72)	4,000	(3.16)	351	(0.28)	758	(0.60)
1965	11,300	(7.53)	854	(0.57)	5,240	(3.49)	846	(0.57)	886	(0.59)
1970	10,800	(7.30)	597	(0.40)	5,650	(3.81)	1,160	(0.78)	867	(0.58)
1975	12,400	(7.54)	379	(0.23)	6,650	(4.04)	1,470	(0.90)	986	(0.60)
1980	13,100	(7.54)	424	(0.24)	7,440	(4.27)	1,530	(0.88)	1,060	(0.61)
1985	13,500	(7.56)	540	(0.30)	8,270	(4.62)	1,560	(0.88)	1,110	(0.62)
1990	15,900	(7.63)	759	(0.36)	10,500	(5.03)	1,820	(0.88)	1,340	(0.64)
1992	16,100	(7.70)	821	(0.39)	11,000	(5.25)	1,870	(0.88)	1,370	(0.66)

Source: McKeever 1994.
[1]One board foot equals the volume of a piece of wood with nominal dimensions of 1 ft square and 1 in. thick.
[2]Exterior sheathing includes plywood, oriented-strand board, and fiberboard.
[3]Interior panels include hardwood plywood, hardboard, and particleboard.
[4]1 square meter (m^2) = 10.76 square feet (ft^2).
[5]Total volume for lumber is calculated using an estimate of actual sizes (1.5" × 3.5"), not nominal sizes (2" × 4").
[6]To convert to cubic meters (m^3) from actual lumber sizing, multiply by 0.0016.
[7]Data for sheathing and panel products is normalized to a 3/8-in. (9.5-mm) thickness.
[8]To convert square feet to square meters, multiply by 0.093.

Table 3 Comparative Annual Energy Use for Small versus Large Houses

House	Location	Energy Standards	Heating (MMBtu)[1]	Cooling (MMBtu)	Heating Cost[2]	Cooling Cost[3]
3,000 ft^2	Boston	Good[4]	73	19	$445	$190
3,000 ft^2	St. Louis	Good[4]	61	29	$378	$294
1,500 ft^2	Boston	Good[4]	35	13	$217	$131
1,500 ft^2	St. Louis	Good[4]	29	20	$181	$198
1,500 ft^2	Boston	Poor[5]	48	12	$297	$124
1,500 ft^2	St. Louis	Poor[5]	40	21	$247	$206

Note: Energy modeling done in 1998 by Andy Shapiro, Energy Balance, Inc. (Montpelier, VT) using REM/Rate residential energy analysis and rating software, v.8.41. Consistent human behavior assumptions are used for all of the modeled houses.
[1] 1 million British thermal units (MMBtu) = 1,055 megajoules (MJ, SI).
[2] Heating costs assume natural gas at $0.50 per therm (1 therm = 100,000 BTU = 105.5 MJ).
[3] Cooling costs assume electricity at $0.10 per kWh (1 kWh = 3.6 MJ).
[4] Moderate houses have R-19 walls, R-30 ceilings, double-low-e (U = 0.36) vinyl windows, R-4.4 doors, infiltration of 0.50 ACH heating and 0.25 ACH cooling, and R-6 ducts in attic. R-value is a measure of resistance to heat flow; R-19 is comparable to RSI-3.3 in the metric system. "Low-e" refers to low-emissivity coatings that allow sunlight through, but block long-wavelength heat radiation. "ACH" refers to "air changes per hour," a measure of how tight the building envelope is.
[5] Poorly insulated house has R-13 walls, R-19 attic, insulated glass vinyl windows, R-2.1 doors, infiltration of 0.50 ACH heating and 0.25 cooling, and uninsulated ducts.

designing multiple uses into rooms, and utilizing often-wasted attic and low-roof space (Abrams 1998).

Legal and Regulatory Issues with Building Small

Zoning regulations, restrictive covenants (i.e., provisions in the deed for the property that restrict the way the property may be used by the owner) and design standards for specific subdivisions, and even mortgage banking requirements[2] can significantly limit options for creating small, space-efficient, single-family houses. Some municipalities establish strict limits on how small a house can be. Though less common than in the past (due in part to lawsuits that have challenged their constitutionality), such regulations still exist. In the suburbs around Atlanta, Georgia, USA, for example, Fulton County specifies a minimum heated floor area of houses in most of its zoning districts. For single-story houses, these minima range from 850 to 1,800 square feet (79–167 m^2); for two-story houses, they range from 1,100 to 2,000 square feet (102–186 m^2) (Wakefield 1999).

Far more common than minimum house size regulations in municipal zoning ordinances are restrictive covenants established by developers for specific, privately controlled subdivisions. In the La Marche Place neighborhood in the 3,400-acre (1,400-ha) Wooded Hills subdivision in Little Rock, Arkansas, USA, for example, single-level houses must be at least 2,600 square feet (242 m^2) and multilevel houses at least 3,000 square feet (279 m^2) (Chenal Valley 2003). In the Spring Glen subdivision in Medina County, Ohio, USA, the minimum heated square footage of houses (exclusive of garages, finished basements, porches, etc.) ranges from 1,800 to 2,600 square feet (167–242 m^2), with a provision for reducing the square footage by up to 10% if the developer deems that "the design is unusually good and is or will be compatible with other houses in the development" (Spring Glen 1997).

Mortgage bankers can also *in effect* specify minimum house size for new houses by mandating ratios of house value to land value. Secondary mortgage markets often have a rule of thumb that the lot should not be worth more than 30% of the total value of the real estate (Foley 1999). Thus, on an expensive lot, homeowners are required to build expensive, and therefore often large, houses. Appraisals (which assess the value of the a house for financial or taxation purposes) for small houses also run into difficulty when all the houses in a particular area are very large and the appraiser cannot find small comparable houses. This issue does not apply at the high end of the real estate market, where land values commonly exceed house values.

Examples also exist of both zoning regulations and restrictive covenants on subdivisions that specify *maximum* house size. Many municipalities effectively limit the *footprints* of houses on small lots by specifying the maximum coverage of the lot. This restriction is generally governed by storm-water concerns, but particularly with small infill lots,[3] it can have a big impact on house size. Cupertino, California, USA goes much further by restricting house floor area to a maximum size of 6,500 square feet (604 m^2)—less in areas of significant slope or smaller lots (Cupertino Municipal Code 1999).

Santa Cruz County in California, USA, and several communities in Chicago, Illinois, USA suburbs also have maximum house size regulations. In the Chicago area the regulations are addressing a trend referred to as *mansionization*, in which houses are often designed to fill the maximum available footprint of a lot—overwhelming the neighborhood scale.

In the environmentally focused Dewees Island subdivision in South Carolina, USA, maximum house size has been established by covenant at 5,000 square feet (465 m^2) (Knott 1998). Given that this is a luxury development, with most 2-acre sites selling in the $400,000 range, but some as high as $850,000, this restriction on house size is highly unusual. So is the fact that there are no minimum floor area or footprint requirements. Developer John Knott suspects that they have lost a few sales because of these standards, but in general he thinks that property owners feel relief at the maximum size limit—they don't have to "keep up with the Joneses." The average-sized house at Dewees is 2,600 to 2,700 square feet (242–251 m^2), with the smallest just 1,200 square feet (111 m^2) (Knott 1998).

Another influence on house size in the United States has long been capital gains tax policy. Until recently, when an American family sold a house it had to buy a new house of equal or greater value within 2 years to avoid capital gains tax on the appreciated value of the house that was sold. That policy often resulted in people moving into larger houses, especially empty-nesters moving into areas with lower real estate values. Since that policy changed in 1998, U.S. citizens are no longer taxed for capital gains on the first $250,000 value ($500,000 for a couple) for a primary residence, so the incentive for moving up into larger houses to avoid capital gains taxes is gone or significantly reduced in most cases.

Selling the Concept

Even without any regulatory or financing impediments to building compact houses, convincing others of their benefits can be challenging.

Clients often have preconceived notions of how large a house they need, often because a friend's house of that size seems to have the features that the client wants. A different understanding may be reached if the clients focus on their housing needs and expectations. Visiting high-quality, compact houses may also influence their views. It may also be possible to convince clients that, by keeping the square footage down, they can end up with a higher quality house. Rather than using up the budget to create the largest, most impressive house possible, many designers today recommend creating smaller houses with a higher level of finish quality and added amenities. "A house that favors quality of design over quantity of space satisfies people with big dreams and not so big budgets far more than a house with those characteristics in reverse," says Susanka (1998, pp. 4–5). She argues that a good house designer should suggest to clients that, for a given budget, they reduce square footage to allow high-quality detailing. Fine carpentry detailing, granite countertops, hardwood floors, labor-intensive but soulful salvage materials, and quality architecture can be far more impressive than sheer size.

Specific design strategies being used to create smaller houses that satisfy homeowner needs are presented in the list in Appendix 1. On the regulatory side, remaining zoning ordinances that mandate large houses should be eliminated, and zoning regulations should be revised to prohibit or discourage design standards or covenants in private developments that mandate large houses. Restrictions in private developments that specify maximum dwelling size should not be prohibited or discouraged. Rather, regulatory incentives should be developed that encourage such restrictions.

Final Thoughts

A great deal of attention is paid to material selection and energy detailing in creating environmentally friendly ("green") houses. Designers, builders, or owners of these houses seek out recycled-content building materials, low-embodied-energy materials, or natural materials. Advanced framing techniques reduce wood use. Well-insulated walls and ceilings, high-performance glazings, and efficient equipment reduce energy consumption. But far too often, the more important consideration of size is overlooked.

A 1,500-square-foot (141-m^2) house with mediocre energy-performance standards (R-13 walls and R-19 cellings)[4] will use far less energy for heating and cooling than a 3,000-square-foot (28-m^2) house of comparable geometry with much better energy detailing (R-19 walls and R-30 ceilings) (Shapiro 1999). Downsizing a conventionally framed house by 25% should save significantly more wood than substituting the most wood-efficient advanced framing techniques (24"-on-center studs, single top-plates, two-stud corners, elimination of cripple studs at windows, etc.) for that house. And it is easier to reduce the embodied energy of a house by making the house smaller than by searching for low-embodied-energy materials.

In considering space requirements in houses, storage requirements should be considered. Anecdotal observations show that Americans have more belongings than used to be the case. Thus, spaces need to be designed not only for the people using those houses, but also for the many belongings those homeowners own. A shift toward smaller houses may also necessitate some degree of change regarding possessions. This issue has not been addressed in this article.

Building small is not easy. To make small houses work well requires understanding the needs of homeowners and then fulfilling those needs with careful design. Simply using off-the-shelf house designs may not adequately account for the specific needs of a family. Fortunately, a number of excellent resources on compact house design are available, some of which include floor plans and elevations. To ensure success with small, resource-efficient houses, however, builders should involve a designer, preferably one with experience in compact house design. And both builders and designers should spend enough time with clients to adequately explain the benefits of smaller houses.

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Notes

1. 2×6s and 2×4s are wooden framing members used in house construction. The 2×6 and 2×4 are nominal dimensions of the boards which represent the size before planing. So, a 2×4 is nominally 2 inches by 4 inches but its actual dimensions are approximately 1.5 inches by 3.5 inches.
2. Mortgage banking refers to the provision of loans for the purchase of houses. Mortgages can include requirements as to the character or changes to a house that are permitted, in order to preserve the financial value of the house in case the homeowner defaults on the loan and the bank reclaims the house to pay off the loan.
3. Infill lots are created by subdividing larger lots in developed neighborhoods to allow new houses to fill in between existing ones.
4. R-value is a measure of resistance to heat flow; R-19 is comparable to RSI-3.3 in the metric system.

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Appendix 1: Strategies Designers Use to Create Small Houses that Work

Consider alternatives to single-family houses. Multifamily houses, attached houses, and cohousing (a development system in which people own their own houses, but the community collectively owns common buildings; vehicles are typically excluded from pedestrian areas of the development) can allow much denser development and the combining of functions to eliminate redundancies. Multifamily housing is arguably the most resource-efficient housing option available.

Evaluate space requirements very carefully. Work with clients to carefully examine both current and projected requirements. How large is the family? Will it likely grow? Might it shrink? Is there—or might there be—a home office? How important is cooking? Do clients entertain a lot?

Provide open-plan for kitchen/dining and living area. Separate, formal dining rooms are rarely used today. The same is true for separate, formal living rooms. Family members and guests prefer to spend time in the kitchen—provide for that in the design. In many cases it also makes sense to extend this open layout to the living area, so that one space serves all three functions.

Avoid single-use hallways. Design houses so that circulation areas serve additional functions—circulation through the living/dining area, or hallways that also serve other functions—library space, for example, or (with adequate separation) laundry.

Combine functions in other spaces. By combining functions in certain rooms, space can be optimized. For example: combine a guest bedroom with a home office; provide for both television viewing and music functions in the living room; put the laundry equipment in the mud room (an entryway used for storing outerwear).

Provide built-in furnishings and storage. Provide built-in furnishings and storage areas to better utilize space. For example: storage cabinets and drawers built into the triangular space beneath stairways; bench seats built into deep window sills; library shelves along stairway walls; and display cases built into wall cavities. Sailboat design demonstrates one end of the spectrum with highly efficient space utilization.

Provide adequate storage. The desire for a big house may be driven by inadequate or poorly planned storage in the clients' existing house. If possible, visit the clients' existing house to examine their current storage systems. Begin planning for built-in storage early in the design process, and try to utilize spaces that would otherwise be wasted. Small windows in walk-in closets can make those spaces more inviting and better used.

Make use of attic space. A tremendous volume in most new houses is lost to unheated attic space. Instead, insulate the roof and turn attic spaces into living areas—making use of skylights and dormers to bring in light and extend the space. Scissor trusses permit high levels of insulation to be provided in the roof, but avoid the use of large-dimension lumber. Having some rooms extend right up to the roof (cathedral ceilings) often makes sense, because variation in ceiling height can make small spaces feel larger. Even if a standard uninsulated attic cannot be avoided, at least design easy access and provide convenient storage areas so that the space can be utilized.

Avoid turning bedrooms into living rooms. The "master bedroom suite," increasingly provided in large, upscale suburban houses, is actually little used. Even the wealthiest people use bedrooms primarily for sleeping and dressing. Keep them relatively small to avoid wasted space.

Provide acoustic separation between rooms. A small house will be more acceptable if there are no common walls between bedrooms. Closets can help provide this separation. Also consider insulating interior walls and providing staggered wall studs for acoustic isolation.

Provide connections to the outdoors. Providing linkages to outdoor and semioutdoor spaces will both create a more pleasant house and make a compact house feel significantly larger. Careful placement of windows and glazed patio doors will increase the visual connection with the outdoors even during winter and inclement weather. Tall windows that extend down close to the floor help extend spaces to the outdoors.

Create outdoor living space through thoughtful landscaping. Carefully landscaped patios, decks, woodland sitting areas, and small lawn areas encourage the use of the outdoors as additional living space during good weather.

Provide a variety of ceiling heights. Create spaces with varying ceiling heights to make a house feel larger, even if this reduces somewhat the actual usable floor area in a house.

Provide natural daylight and carefully placed artificial lighting. Try to provide natural lighting on at least two sides of every room to provide a feeling of spaciousness. Incorporate some natural and artificial lighting where the light source is not readily visible to make compact spaces feel larger. Uplighting (using light fixtures that shine upward to illuminate the ceiling) also makes a space feel larger.

Provide visual, spatial, and textural contrasts. Contrasting colors, orientations, degrees of privacy, ceiling heights, light intensities, detailing, and surface textures can be an important design strategy for creating satisfying spaces that feel larger than they really are.

Use light colors for large areas. Most walls and ceilings should be light in color to make spaces feel larger. Use dark colors only for contrast and accent.

Keep some structural elements exposed. Structural beams, posts, and timber joists should be left exposed, creating visual focal points and texture. Be careful not to let these elements overwhelm the space, however; too many exposed timbers can make a space feel smaller.

Make use of interior windows. Transom windows above doorways and interior windows that allow natural light from skylights to be distributed into adjoining rooms can make those spaces feel larger.

Design spaces for visual flow. Careful building design can make small spaces feel larger by causing the eye to wander through a space. A continuous molding line that extends throughout a house somewhat below the ceiling can assist with this visual flow. Continuity of flooring and wall coverings can also tie spaces together visually. With very small spaces, provide diagonal sight lines that maximize the distance and the feeling of scale.

Provide a focal point for each room or space. Each space should have one particularly attractive or interesting building element, feature, piece of furniture, or work of art—a focal point for occupants.

Provide quality detailing and finishes. By limiting the overall square footage of a house, more budget can be allocated to the detailing, materials, and finish quality to make a house special. Minimizing house size may also be a way to include some of the "green" building materials and products that cost more (natural granite countertops, linoleum, certified wood flooring, top-efficiency appliances, etc.).

Design for flexibility and change. A small house should be adaptable to changes—changes in family size, changes in lifestyle, changes in health of the occupants, the addition of a home-based business. A flexible house design will permit future modifications with low impact, and it will obviate the need to build big "just because you don't know what the future will hold."