

Avi Friedman

# Fundamentals of Sustainable Neighbourhoods

 Springer

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## Preface

Recent societal transformations have given rise to the need to rethink community and dwelling design. Climate change, aging populations, persistent economic challenges, and new lifestyle trends are some of the factors that bring about an urgent need to plan different neighborhoods and homes.

The catalyst for such changes is also the realization that the development practices that prevailed after World War II, primarily in North America, had been overly wasteful. Such practices led to the consumption of vast amounts of agricultural and forested land, made commuting by fuel-consuming and polluting vehicles more common, and used ample valuable nonrenewable natural resources during the construction and after the occupancy of sprawling homes. It has become abundantly clear that this development path and consumption rate is unsustainable. If continued, future generations will lack the resources to support their own development needs.

Neighborhoods must be regarded as a vital block of society. Their successes will often determine how well a city and even a country will perform. Therefore, the need to include a social perspective in their conception needs to be a part of the planning process. In addition to economic successes and environmental considerations, a mark of a successful neighborhood will be an enriched web of social relations between residents, which serves as another mark of sustainability.

To reverse the current development trends and to achieve many of the goals that contribute to sustainable living, one needs to closely examine the notion of density. When more people live in closer proximity to one another, various services and amenities such as public transit become economically viable. Higher densities are not easy to introduce in places where people are accustomed to single-family homes on large lots. The challenge then becomes how to have higher densities while maintaining the basic draws of lower-density developments such as privacy and open spaces.

This book offers strategies for community design based on sustainable principles. The scale looked at here is that of a place whose size may vary according to location, yet it houses between 10,000 and 20,000 people. The first chapter sets the stage for the ones that follow by describing the roots, evolution, and ramifications of past developments, offering background and casting principles of sustainable development, listing key players in residential development and their potential contribution to attaining sustainability. Chapter 2 outlines principles of places whose

density exceeds 25 units per acre (10 units/ha). It offers yardsticks, forms and planning strategies for denser communities, introduces methods of waste management and district heating, and illustrates those principles using a design of a community.

Chapter 3 looks at how mobility and connectivity in neighborhoods can be planned to render a place more sustainable. By challenging conventional road design and parking standards and by examining how these can better accommodate everyday social interaction, healthy life style, and cost reduction, the chapter aims to introduce guidelines for creating residential streets and parking areas that serve multiple purposes. Chapter 4 offers a guide on how natural attributes should be considered and integrated to support development of sustainable neighborhoods. The subjects include ground related elements, aspects associated with the climatic conditions of the area and a demonstration project.

Higher-density communities are commonly perceived by the public as places with reduced public open spaces. Yet, when properly designed, such projects can have a variety of well-thought out outdoor places that address the recreational needs of all dwellers. In addition, the function that those spaces play and their physical arrangements and locations influence their success, and the character of the neighborhood. Chapter 5 focuses on streetscapes and open and edible lands as a means of defining the aesthetic, social qualities, and the sustainability of a community.

Chapter 6 discusses the desire for public reclamation of the water's edge and proposes sustainable design practices that meet the demands of near-shore residents without compromising public accessibility and enjoyment. Specific techniques elaborate the philosophies for preserving shoreline integrity and present strategies for sustainable form development. The chapter merges community and development objectives to produce holistically liveable shorelines.

Chapter 7 begins by discussing issues related to social capital and focuses on incorporating nonresidential spaces and activities into neighborhoods. By investigating traditional living patterns, the chapter aims to offer strategies for creating mixed-use transit-oriented neighborhoods. Chapter 8 focuses on the dwelling and begins by listing social transformations and applicable solutions that respond to the newly emerging needs in a sustainable way, lists architectural strategies for dense contemporary living, describes methods of construction for energy conservation, and the design of a multiunit demonstration structure for flexibility and adaptability.

This book is meant to bridge a gap between theoretical notions of environmental sustainability in community design and link them to practical examples. It is the hope that the outcome of this text will help guide current urban development practices to a more sustainable course.

Avi Friedman

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## Acknowledgments

Over the years, I have researched, wrote, taught, lectured, and designed sustainable projects. Many assistants and collaborators took part in these endeavours. I have attempted to remember and acknowledge them all. My apology if I have mistakenly omitted the name of someone who contributed to the ideas, text or illustrations that have been included in this book. I will do my best to correct an omission in future editions.

This book could not have been written without contribution to the research and writing by a highly dedicated team of assistants who participated in several research projects that I directed. They included Daniel Casey, Colin Hanley, Po Sune, Archana Vyas, and Martine Whitaker. The help of the Woodcock Foundation, which sponsored the research that led to this book, is truly appreciated.

The projects depicted at the end of several chapters have been designed under the direction of my colleague, Professor Louis Pretty and I, and by a team of highly capable graduate students whose names have been listed in the Projects Credits List and includes Kalpita Basu, Shuangqing Cao, Xifan Chen, Mingcheng Fu, Nan Haijun, Qian Huang, Nirit Pilosof, Jiantong Wei, and Xiaoliang Zhao.

Many thanks are also extended to those who contributed to the creation of the graphic material that illustrated the chapters. They included Mingcheng Fu, Jing (Jay) Han, Jeff Jerome, and Renier Silva.

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Finally, my heartfelt thanks and appreciation to my wife, Dr. Sorel Friedman, and children, Paloma and Ben, for their love and support.

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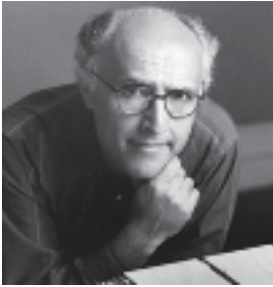
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## About the Authors



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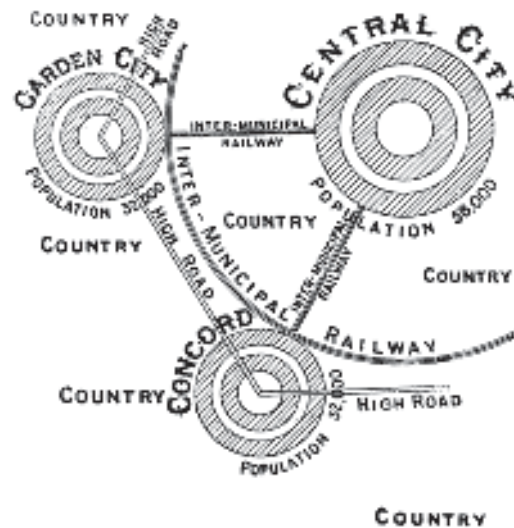
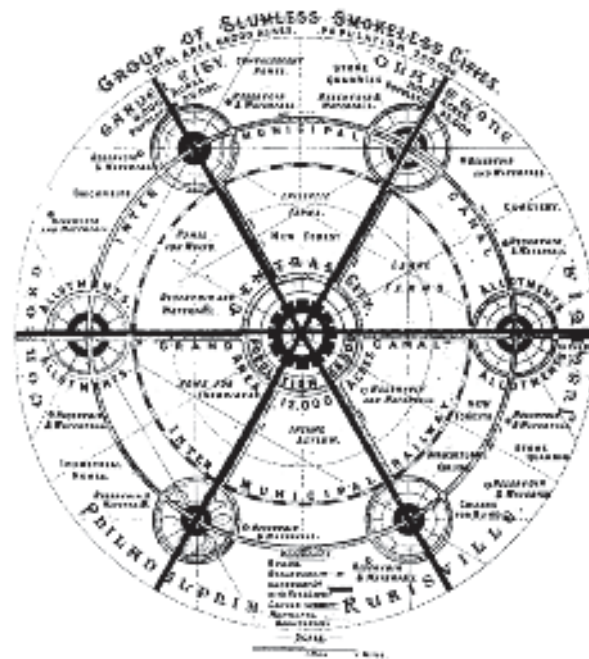
Current modes of community and dwelling design are undergoing rethinking of their philosophy and form. Common post World War II development practices no longer address present and future societal challenges. The need to halt overconsumption of natural resources and explore alternative design and practices is evident. At the turn of the twenty-first century, urban sprawl, with its many, far-reaching negative implications for the society, economy and the environment, requires a fundamental reconsideration and a search for new urban forms. This chapter set the stage for the ones that follow by describing the roots, evolution, and ramifications of past developments, offering background and casting principles of sustainable development, listing key players in residential development and their potential contribution to attaining sustainability.

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### 1.1 A Look Back

One can trace the development of contemporary suburban communities to ideas put forward by theorists like Robert Owen and Charles Fourier at the turn of the eighteenth century. Building self-sufficient communities was at the heart of their vision. The relationship between built environments, their natural context and the linking of small towns with large urban centers via public transportation were some of the main features of their schemes. One of the earliest planning concepts was Ebenezer Howard's *Garden City*, which described a city in a garden (Fig. 1.1). Although Howard's ideas were not realized until 1903, when Raymond Unwin and Barry Parker planned the city of Letchworth, UK, illustrated in Fig. 1.2, his work offered the first definition of contemporary planning (Edwards 1981). The city center, according to Howard would radiate out from a central park, followed by commercial amenities, then residential area surrounded by a greenbelt to form a town–country relation. The center would be complimented by structured wards, joined among themselves and with the center, and the distant city by means of rail lines and roads

**Fig. 1.1** Howard's proposal of a Garden City offered a relation between a Central City and the surrounding country

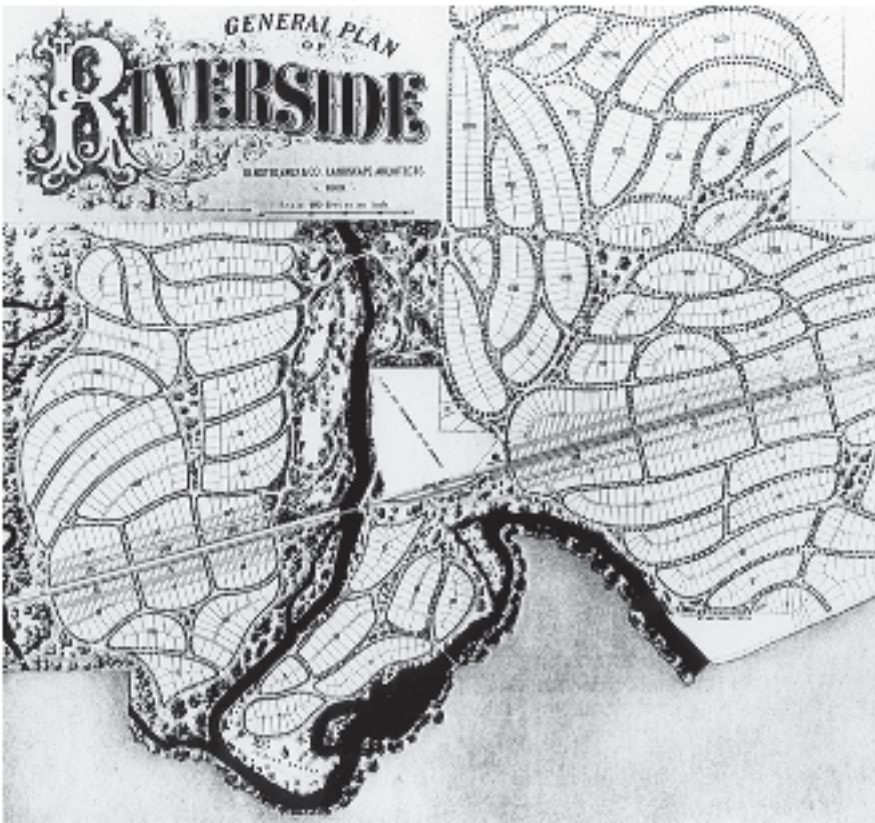


network. Green space was segregated from residential areas, but outdoor civic places, such as the Grand Avenue, were integrated with the community plan. The streetscapes were dominated by a radial grid and the open space was not as natural as originally envisioned (Girling and Helphand 1994).



**Fig. 1.2** Unwin and Parker design of Letchworth, UK, was based on Howard's Garden City proposal

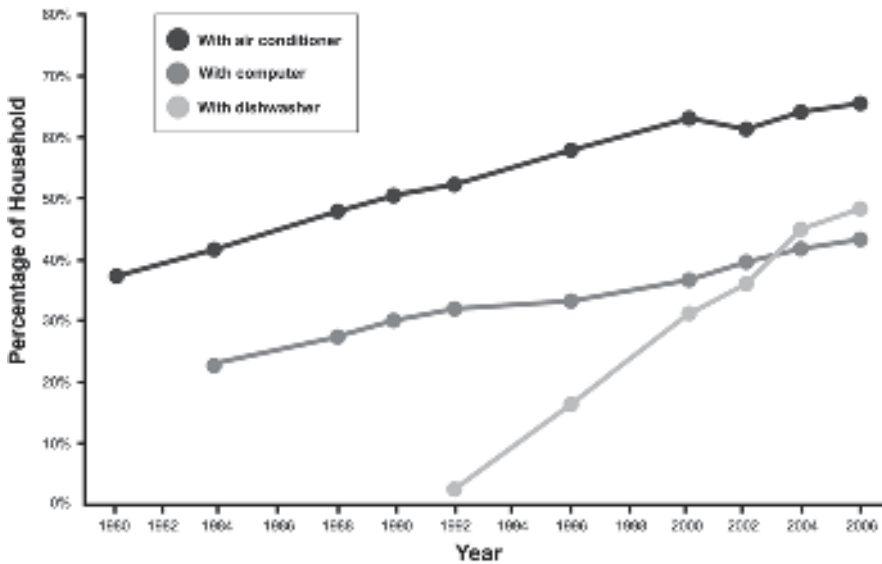
Some of these ideas were put into practice with the move to the countryside that began at the turn of the nineteenth century. Wealthy city dwellers purchased large tracts of land in scenic areas near lakes, river shores, and forested areas on which they built summer homes. Some regions with intense migration saw outgrowth of the city's urban grid to the outskirts. However, the planners of most newly designed communities included nature like components in their plans. Neighborhoods such as Riverside, Illinois, planned by landscape architects Frederick Law Olmsted and Calvert Vaux in 1869, were thought to be more organic with swats of green areas separating clusters of dwellings (Fig. 1.3). In them, a railway line acted as the main mode of transportation and common open space was more dispersed and widely accessible than in Howard's plan. The master plan did not emphasize the houses, but rather the naturally flowing curves of the tree-lined streets framed by foliage (Southworth and Ben-Joseph 1997).



**Fig. 1.3** Landscape architects Frederick Law Olmsted and Calvert Vaux's design of Riverside, Illinois, US was organic with swaths of green areas separating clusters of dwellings

This residential development model eroded in the middle of the twentieth century. Post World War II suburbanization cast a new paradigm in urban planning. The need to house a large number of people away from over-crowded cities, coupled with the popularity and availability of the private motor vehicle, as well as advances in house construction, spurred a massive expansion around urban hubs.

There were many ramifications of such practices, and the environment was one of the main casualties. Forested and agricultural land was cleared to make room for tract developments with wide roads. Public parks and private lawns were covered with sod that needed large quantities of fresh water during dry summer months. The homes themselves swelled in size. Strict bylaws mandated large setbacks, footprints, and proportions that bared no resemblance to earlier building patterns, and heritage structures were completely ignored or demolished. Neighborhoods, detached from vernacular context, soon started to resemble each other. Developers and homebuyers produced and consumed domestic space much like any other product. The design of homes became more intricate and complex, resulting in the



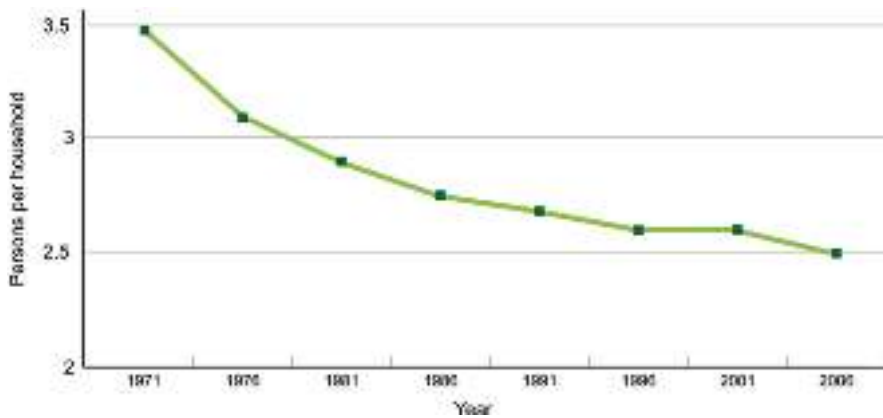
**Fig. 1.4** Energy consumption in the USA increased as a result of growth in the number of appliances per household

use of many natural resources, of which lumber was the main. Once built, the homes used excessive amount of energy to keep warm in winter and cool in summer as illustrated in Fig. 1.4, vast amount of fresh water and generated waste with damaging consequences on local and indirectly on global environments.

In addition, private cars become the chief means of commuting between suburban subdivisions, the city, and local nonresidential amenities whose integration within those neighborhoods was economically prohibitive. Despite the fact that many suburban developments were built as edge cities, with their own commercial and industrial centers, the large city remained the main hub. In recent decades, ownership of private motor vehicles has increased substantially, while the use of public transit has steadily decreased. The ramifications are not only long lineups on highways during rush hours, but also a continuing need to build or expand new and existing roads. The environmental ramifications are also staggering. Carbon dioxide emissions have been recognised by scientists as one of the major causes of global climate change. The social cost of building highways is also significant, as public funds have to be withdrawn from already stretched-out health and education systems for example.

Social transformation is another argument for a need for a new thinking about residential design. The demographic makeup of some nations is rapidly changing, and the number of people that are commonly referred to as nontraditional families is growing. Couples with no children, single-parent families, and singles contributed to the reduction of household size in Canada for example (Fig. 1.5). These families, although interested in suburban living, do not necessarily wish to reside in a huge hard to maintain home.





**Fig. 1.5** Average household size in Canada 1971–2006

Another demographic trend that is likely to accelerate and merit a sustainable mind-set, is the greying of the population as illustrated in Fig. 1.6. As people live longer, the large single-family home may not be their ideal retirement dwelling due to higher maintenance requirements and physical challenges like stairs. Increased demand for smaller homes in higher density arrangement is likely to occur. This trend is expected to increase in the coming years with the retirement of the “baby boom” generation. These societal transformations bring about a need to propose and implement practices for the development of new communities and the retooling of existing ones to better respond to current and future concerns.

New challenges is making decision makers recognize, that old practices needed to be abandoned and new ones based on novel paradigms put in place. Sustainable residential planning reduces reliance on cars by encouraging pedestrian activities and a mix of commercial and residential land uses. Alternative building products and construction methods that consume fewer natural resources are becoming widespread. Attention is being paid to constructing better-insulated homes that consume less energy, and positioning houses to maximise passive solar gain. New lifestyle trend such as the proliferation of digital communications and the rising popularity of working at home have also reduced travel time.

Earlier in the twentieth century, sustainable development practices were largely ignored, but alarming scientific evidence and public concerns makes it timely to chart a new course. A catalyst for adopting a new direction is the rate at which land for development is being consumed. Therefore, the need to increase dwelling density is strikingly clear. The intention of this book is not to ignore the positive attributes that draw people to the suburbs in the first place. Affordability, proximity to nature, and having a single-family home with a backyard should be the foundations upon which future development decisions should be based. These aspects should be kept, yet transform and used with care in denser settings.

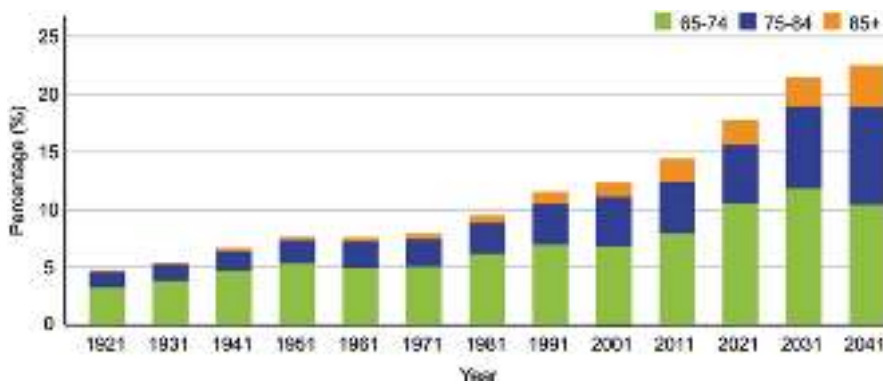


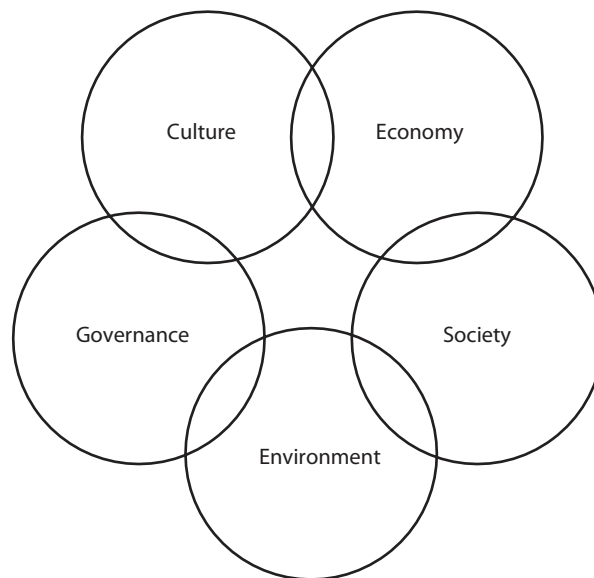
Fig. 1.6 Seniors by age groups as percentage of the total Canadian population 1921–2041

## 1.2 Sustainability; Principles and Components

The notion of sustainability was introduced in the mid 1970s as a result of the recognition that current development practices had caused environmental harm. Theorists like Schumacher in a book called *Small is Beautiful* (1973) warned of actions that, if pursued further, could among others endanger the delicate balance between people and nature. Years later, this reflection led to the establishment of several international initiatives that attempted to outline specific remedial actions. The World Commission on Environment and Development (WCED), also known as the Brundtland Commission, is probably the best-known international initiative of them all. In a report called *Our Common Future* (WCED 1987), the commissioners defined sustainable development as “development that meets the present need without compromising the ability of future generations to meet their own needs.” A conceptual approach, whereby every present action has to be taken while considering its future effect on the environment, was put in place.

When broken into subcomponents, it becomes clear that five main aspects influence the functioning of a community (Fig. 1.7). The first is society itself: the residents on their demographic makeup and chosen lifestyles. The second is the economic vitality of a place, since financial failure of an initiative will cause the enterprise to cease to exist. The third factor is the environment itself on its many facets including the built components and nature. The fourth aspect has to do with the cultural characteristics of a community and their effect on social attitudes. The last element to affect sustainability is governance. A community, to a large extent, depends on its leadership when it comes to decision-making and their implementation. Only when these aspects are considered and a balance is struck between them, one can also take the future into consideration, how sustainable development is attainable.

**Fig. 1.7** Five key aspects likely to contribute and influence the sustainable functioning of a community



When an attempt is made to diagnose the root cause that led to poor suburban planning practices, ignorance of the inner workings of these pivotal issues can arguably be one of the reasons. Mainstream developments are often regarded as a *product*, rather than a *process*, where a range of aspects are being systematically explored and manipulated. The process, the key issues and the relations among them are illustrated below with four general principles. When followed, these principles can guide the conception of a sustainable residential community.

### 1.2.1 The Path of Least Negative Impact

*The path of least negative impact* is meant to argue that a decision maker of any planning endeavour needs to choose a process that will leave the smallest negative footprints on environmental, societal or economic aspects affecting or affected by the project. At the process outset, impact assessment will be undertaken to ensure that decisions made during the planning stage will have short or no long-term disruptive ramifications on those issues.

The negative effects of a project on nature were touched upon above. Yet, a project can also have unwelcomed economic ramifications. A high-priced luxury project in a neighborhood, made of low-income rental units may trigger gentrification, conversion of properties into high priced condominiums and force economically volatile residents out. Also, poorly constructed homes, for example, may stigmatize its occupants and cost more to heat and cool. If a development is constructed by a government authority, taxpayers will have to foot the bill throughout the project's life.



**Fig. 1.8** Solar powered homes in Alkmaar, the Netherlands

### 1.2.2 Self-Sustaining Process

When a development is planned, minimizing the project's initial impact would preferably be a priority. The project's lifecycle can also be viewed as a *self-sustaining process* of resources and activities. Metaphorically, one can regard the energy that was used in the project's conception and building as a generator of additional sources to power its existence and even contribute to the creation of additional similar projects. The self-sustaining principle is applied to each of the subcomponents that makeup sustainable approaches to design and were listed above.

When the homes are designed and constructed to include photovoltaic panels or solar collectors, energy generated through them can power the house and avoid reliance on public utilities (Fig. 1.8). Similarly, when rainwater is gathered, purified, and converted into drinking water, the home will have the means to be self sustaining. When excess energy or water is produced, they can potentially be used for communal needs. Additional stored energy, for example, may power streetlights. A similar analogy can be made when the project's economic performance is studied. Successful projects will attract occupants that will lead to the rapid sale of units, whose profit will be invested in initiating other projects. A self-sustaining initiative can also benefit from a proper mix of dwelling units. When a project offers homes to young families and residences to seniors, a self-sustained social network is put in place. When needed, the young can care for their older family members who live in the same community.

### 1.2.3 Supporting Relation

Another keystone of a sustainable project is the relationship between its pivotal parts. When a *supporting relation* is established, attributes of one component can propel activity in another. Influence between disciplines and effects of one on the other will in turn create a supporting system. A design that seeks to leave the light environmental footprints on the site will see, fewer trees cut and might become a marketing success. The project's economic outcome may benefit clients who will be attracted to the project due to its "green" image. A supporting relation was, therefore, established between environmental and monetary interests.

The use of lower cost products made of recycled materials may help address environmental concerns, but also give developer a price advantage over competitors and benefit the project financially. Building smaller homes in a denser configuration, for example, will result in a reduction of urban sprawl. It will also save on cost of land and infrastructure that, when transferred to an end user will produce affordable housing. Municipalities will benefit by ensuring a supply of housing that will help keep their young, first-time homebuyers in the community and create a much-desired social and demographic continuum.

### 1.2.4 A Life Cycle Approach

The mark of a good decision-making for a sustainable system is a project's ability to sustain itself throughout its entire lifecycle. Be it through each of its components or their interrelation, the conception and construction needs to ensure that the original attributes of the project will be of value, years later. Contributions made in part of the process, although appreciated, will have a lesser impact than those made throughout. If the project is well conceived and economically successful, homeowners will be more likely to invest in maintenance and upkeep, replace old windows, for example, which will contribute to energy savings. A well built home will save its owner expenses on maintenance and operation in the long run. The longer the useful life of a project can be stretched, the better it is.

A *life cycle approach* sees the built environment subjected to an ongoing change and evolution. The process' elasticity and ability to adapt to various emerging circumstances is one of its key attributes. When a product has a finite life, it will be of lesser value than one that can be refurbished and reused. When dwellings are designed for adaptability and can easily be modified to the needs of subsequent occupants, obsolescence and demolition are prevented. A similar view needs to prevail when codes and bylaws are enacted. They ought to provide a framework for action, yet not restrict the introduction of amendments and changes when times and circumstances require that they be introduced. These principles will be further elaborated and referred to when discussion of various projects will be made below.

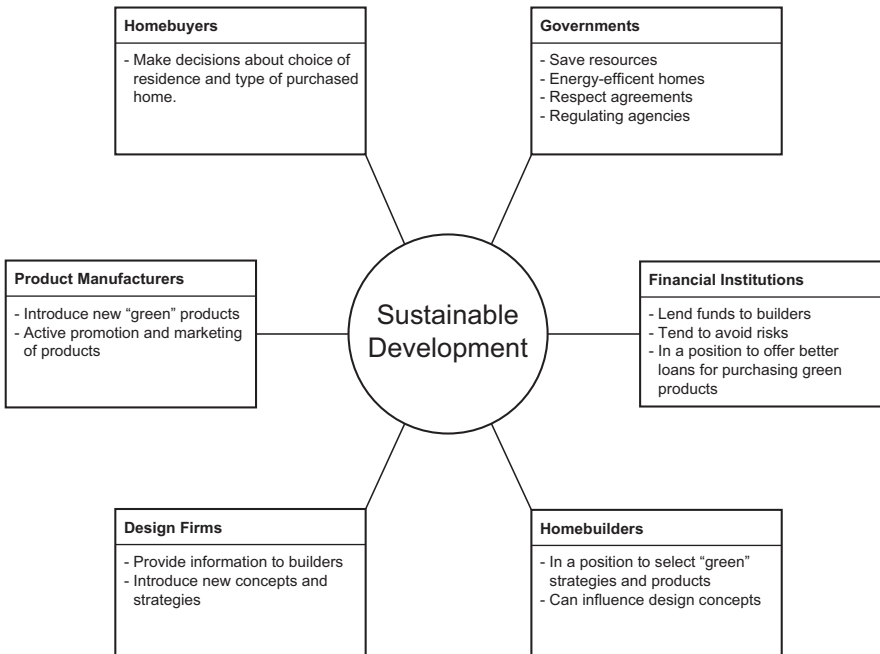
### 1.3 Influencing Participants

Building sustainable communities and dwellings requires participation and contribution on the part of all players throughout the project’s lifecycle, as illustrated in Fig. 1.9. This section recognizes each key player’s motive, and, at times, barriers to the building of a residential development based on sustainable principles.

#### 1.3.1 Governments

All levels of government are, both directly and indirectly, involved in housing their citizens. Another obligation is to manage natural resources efficiently and to contribute to the adoption of sustainable practices at the local level. It is, therefore, in the best interest of any government to see that its citizens are not only housed adequately, but that the resources used in the construction and upkeep of the homes are well managed. With the growing importance of negotiated environmental protection agreements, governments must also meet international obligations to keep emission levels within set limits.

For example, in North America, governments traditionally play a modest role in homebuilding. The act of building is left to the private sector. When govern-



**Fig. 1.9** Building sustainable communities and dwellings requires participation and contribution on the part of all players throughout the project’s lifecycle

ments do build, they produce dwellings known as public or community housing. Regulation is the primary tool through which authorities control environmental performance of its manufacturing, transport, and building sectors. Different levels of governments set building code standards and zoning laws that exercise control over the end product. It is, therefore, one of the key avenues through which the residential development industry can be affected. Lobbying for change of code standards is the main avenue to achieve sustainability.

### **1.3.2 Financial Institutions**

In a privately managed housing sector, such as that of North America, financial institutions play a critical role. Rarely are residential projects constructed with the builder's own funds. The main objective of a lender is to decrease the risk associated with the loan. Financing experimental projects with untested technology will not be commonly attempted. Bankers want to make sure that funded projects or their parts will last and will not fail while the bank has still owed money. Several financial institutions that hold themselves to a higher "green standard" are now offering loans with reduced interest rates to support environmental projects.

### **1.3.3 The Homebuilder**

A housing project may be initiated by a nonprofit or for-profit organization. The nonprofit sector can either be a government-run agency or a nongovernmental organization (NGO). A government-run project uses public funds to create public or community housing. The project will be not only funded initially, but will be managed or financially supported through its lifecycle by its initiators or their representatives. NGOs have no legal affiliation with any level of government. The organization can, however, benefit from a subsidy program provided by a government agency. The NGO may organize itself in a variety of legal structures. It can be a cooperative, for example, whose members are affiliated based on their ideological beliefs.

When a nonprofit organization undertakes a project, funding sources will likely be governmental. A condition to lending may be that the design holds itself to a higher environmental standard. NGOs, such as cooperatives, are also often motivated by their care and respect of an environmental issue. It is likely, therefore, that the many facets of sustainable design will be included in such a project.

A for-profit developer can be any private sector firm that sets to develop, build, sell, or rent housing. It can be a land development company that purchased, subdivided, and made land into lots for sale to builders or to be built upon by the development company itself. Despite the fact that construction practices have changed in recent years, the for-profit sector still has a short-term objective to sell homes and invest the profits in another project. Building practices or components that benefit

the environment, yet are costly, time-consuming to install, and have a long payback period may not work in the interest of private builders. Attempts to offer them will be made when and if they can assist in the marketing of the home. The number of “green builders,” nonetheless, has increased, and many are demonstrating that building communities based on sustainable principles are contributing to their bottom line.

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## 1.4 The Design Firm

In design firms, planning, architecture, and engineering provide vital knowledge to developers about strategies and technologies for achieving sustainability in the community or the unit levels. When such firms are engaged, they tend to be the principle source of information about new products to make the home energy or resource efficient, for example. However, design firms are not always asked to participate in a common residential project. Small building firms often tend to use old drawings or engage a technician rather than a licensed design consultant or architect. Builders are also reluctant to get involved in the design process due to the ethical implications. Often, designs are changed on site without advance notice or design fees are held back. Large development companies, however, tend to employ consultants and their input is commonly made in large projects.

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## 1.5 Product Manufacturers

Manufacturers and suppliers form a vital part of the building process. For the most part, they are the only participants in the homebuilding industry with sizeable investments in facilities and production equipment. But their greater, more important role has been in the development and promotion of new products that contribute significantly to resource and energy efficiency, for example.

One such product is the prefabricated roof truss, which changed the way roofs on wood-frame buildings were constructed and saved significant amounts of material and labor. Another notable example of significant savings in labor and wood is the plywood board. It altered the way roofs and exterior walls, as well as interior subfloors, were constructed by enabling coverage of large surfaces without using solid sawn lumber.

Products, tools, and new technologies are continuously invented. Some inventions hold promise, but they require time to be accepted by mainstream builders before they will generate the economy of scale that contributes to resource savings. Builders and investors must be cautious, however, as past experience shows that a “miracle product” has sometimes resulted in failures that necessitated replacement or additional expenses.



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