ENHANCING LOW CARBON NEIGHBORHOOD THROUGH BUILDING REHABILITATION IN KERMAN CITY OF IRAN

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DEDICATION

Most importantly; I would like to dedicated this thesis to my wife, Azin Bahreini for his sincere love, patience, sacrifice, inspiration, understanding and constant help and encouragement. Also my appreciation to my beloved parents, Hossein Mirzaei and Mahin Khazali for their patience, invaluable supporting, encouragement and praying for me, as well as my brother, Hesam Mirzaei and my sister in low, Matin Bahreini for their valuable help and encouragement. Also I want to dedicate to my wife's family for their constant support and encouragement. I could not have done it without you!

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ABSTRAK

Kajian ini bertujuan untuk meningkatkan kejiranan karbon rendah melalui pemulihan kejiranan sedia ada dengan mengubah sebahagian daripada aspek kejiranan seperti bangunan, pengangkutan, kawasan lapang atau kawasan hijau, dan tenaga (pengeluaran dan penggunaan). Kejiranan sedia ada melibatkan guna tanah dengan jarak yang jauh antara rumah, sekolah, kedai runcit, perpustakaan, jaringan jalanraya, pengangkutan awam, dan lain-lain. Konsep pemulihan kejiranan sedia ada ialah dengan menambahbaik kejiranan melalui pembaikan dan pengubahsuaian komponen kejiranan sedia ada. Untuk menambahbaik kejiranan sedia ada, beberapa peralatan rumah yang menghasilkan tenaga hijau boleh ditambah dan tindakan ini akan mengurangkan penggunaan tenaga. Kawasan hijau merupakan satu lagi faktor dalam meningkatkan kejiranan sedia ada yang mampu menambahbaik alam sekitar di kejiranan sedia ada. Faktor-faktor lain ialah penggunaan pengangkutan awam dan basikal. Pertambahan tempat perhentian bas, stesen basikal dan kemudahan berkaitan dalam kawasan kejiranan boleh menggalakkan orang ramai menggunakannya. Kajian ini menggunakan kaedah soal selidik untuk mengenalpasti tingkah laku masyarakat, masalah kejiranan, dan mencari serta mencadangkan penyelesaian yang bersesuaian. Untuk mengenalpasti faktor-faktor ini, seratus responden dipilih untuk menjawab soalan-soalan. Berdasarkan analisis yang dijalankan, beberapa faktor yang mempunyai banyak kesan terhadap kejiranan telah ditemui. Faktor-faktor tersebut termasuklah kurangnya bangunan hijau atau peralatan yang menghasilkan tenaga hijau, kurangnya kawasan hijau dalam kawasan kejiranan, dan sebagainya. Di samping itu, faktor-faktor lain juga akan dibincangkan dalam kajian ini.

ABSTRACT

This research aims to enhance low carbon neighborhood through rehabilitating the existing neighborhood by improving some part of neighborhood such as buildings, transportation, open space or green space and energy (production and consumption). The existing neighborhood produce a part of land within a determined distance that include house, school, small shops, library, road, public transportation and so on. Moreover, the concept of rehabilitate the existing neighborhood is to improve the neighborhood through repairing and renovating the component of the existing neighborhood. For improving the existing neighborhood, some appliances can be added to houses which will result in green energy production and will cause a decrease in energy consumption. Green space is another factor in improving neighborhood that causes an improvement in the environment of the existing neighborhood. Other factors include public transportation and bicycles. By increasing the bus stops, bike stations, and their facilities in neighborhood people can be encouraged into using them. This research's methodology used questionnaire to find the people's behavioral patterns, problems in the neighborhood, and also to find and suggest suitable solutions. To find these factors one hundred respondents were selected to answer these questions. Based on the analysis performed, some factors that have many effects on neighborhood could be found. These factors include lack of green building or appliances for producing green energy, lack of green spaces in this neighborhood and so on. In addition, other factors will be discussed in this research.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	AUTHOR'S DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xii
	LIST OF FIGURES	xiv
	LIST OF APPENDICES	xvi
1	**INTRODUCTION**	1
	1.1 Introduction	1
	1.2 Problem Statement	5
	1.3 Research Questions	7
	1.4 Objectives of Study	7
	1.5 Scope of Study	8
	1.6 Case Study	9
	1.7 Significance of Study	10
	1.8 Chapter Summary	12
2	**LITERATURE REVIEW**	**14**
	2.1 Introduction	14

	2.2	Low Carbon Neighborhood	14
		2.2.1 Concept of Low Carbon Neighborhood	15
		2.2.2 Component of low carbon neighborhood	16
		2.2.3 Principles of low carbon neighbourhood	19
		2.2.3.1 Green Land Use Management	19
		2.2.3.2 Energy management	20
		2.2.3.3 Transportation Management	21
		2.2.3.4 Waste Management	22
		2.2.3.5 Building Management	23
	2.3	Rehabilitation approach to enhance low carbon	24
		2.3.1 Concept of rehabilitation	24
		2.3.2 Concept of rehabilitation neighborhood	25
		2.3.3 Experience of Neighborhood Rehabilitation	26
		2.3.4 Approach to rehabilitation of neighborhood	28
	2.4	Conclusion	29
3		**RESEARCH METHODOLOGY**	**30**
	3.1	Introduction	30
	3.2	Research design	31
	3.3	Structured interviews	32
	3.4	The Survey Questionnaire	32
		3.4.1 Questionnaire	34
		3.4.2 Defining the objective of the survey	34
		3.4.3 Observation Techniques	34
		3.4.4 Secondary Data Compilation	35

Technique

3.4.5 Field Work 35

3.5 Data collection procedure 35

3.6 Sampling procedure 36

3.7 Data Analysis 37

3.8 Interview Analysis Approach 37

3.9 Study area 38

3.10 Conclusion 41

42

4 ANALYSIS AND FINDING

4.1 Introduction 42

4.2 Description of the Sample Data Collection 42

4.3 Demographic Data 43

4.3.1. Gender 43

4.3.2 Age of respondents 44

4.3.3 Educational level 45

4.3.4 The Nature of Job 45

4.3.5 Level of income 46

4.3.6 Land ownership 47

4.3.7 The number of years that respondents are living in the neighborhood 48

4.4 Characteristics of neighborhood 50

4.4.1 Knowledge 48

4.4.1.1. Knowledge of Low Carbon Neighborhood 49

4.4.1.2. Knowledge of benefits of Low Carbon Neighborhood 49

4.4.2. Building condition in neighborhood 50

4.4.2.1. Type of House 50

4.4.2.2. Age of Building 51

4.4.2.3. Floor space 51

4.4.2.4. Number of rooms in neighborhood's house 52
4.4.2.5. The consumption of fuel for heating and cooking 53
4.4.2.6. Electrical Appliances using in the Houses 54
4.4.2.7 Comparison between last prices of Electricity, Gas and Water bills 55
4.4.2.8 The appliances which producing Green Energy in neighborhood's Building 55
4.4.2.9 Existing garden in neighborhood's house 57
4.4.2.10 Existing tree in garden 57
4.4.2.11 The number of trees in garden 58
4.4.2.12 Willingness to rehabilitate building 59
4.4.2.13 The reasons of respondents' opinion 60
4.4.3.Transportation condition in neighborhood 61
4.4.3.1. Existing bus in the Neighborhood 61
4.4.3.2. Time Distance to reach to the bus stop 61
4.4.3.3. Times of using public transportation in a day 62
4.4.3.4. Using bicycle 63
4.4.3.5. Reason of using 63

		bicycle	
		4.4.3.6. The ways to encourage using bicycle	64
		4.4.3.7. Mode of transportation used by family members	65
		4.4.4.Opinion about Green Spaces, Parks and Streetscapes	65
	4.5.	Conclusion	67
5	**RECOMMENDATION AND CONCLUSION**		**68**
	5.1	Introduction	68
	5.2	The summary of finding	68
	5.3	Conclusion	69
	5.4	Recommendation	71
REFERENCES			**74**
Appendices A-B			78-111

LIST OF TABLE

TABLE No.	TITLE	PAGE
2.1	Action to Achieve to low carbon neighborhood	18
4.1	Showing the educational level statistics of the respondents	45
4.2	Showing the nature of job statistics of the respondents	46
4.3	Statistical values the number of years that respondents are living in the neighborhood	48
4.4	The rate of income based on educational level	49
4.5	Statistical values of respondents according to Knowledge of Low Carbon Neighborhood	50
4.6	Statistical values of respondents according to knowledge of benefits of Low Carbon Neighborhood	51
4.7	Showing the statistics of age of building	52
4.8	Showing the statistics of floor space respondents house	53
4.9	Showing the statistics values of fuels consumption for heating in neighbourhoods' house	53
4.10	Showing the statistics values of fuels consumption for cooking in neighbourhoods' house	54
4.11	Percentage of Electrical Appliances using in the Houses	56
4.12	The statistics values of appliances which using for producing Green Energy in the Building	59
4.13	The statistics values of willingness to rehabilitate building	64

4.14	The statistics values of Reason of using bicycle	65
4.15	The percentage of mode of transportation used by family members	66

LIST OF FIGURE

FIGURE No.	TITLE	PAGE
1.1	Kerman City of Iran	9
1.2	Shows Emam Jome Neighborhood	10
3.1	Kerman, Iran	38
3.2	Shows Emam Jome Neighborhood	39
3.3	Shows Emam Jome Neighborhood	39
3.4	Shows Emam Jome Neighborhood	40
4.1	The gender of respondents	43
4.2	The age of respondents	44
4.3	The level of income respondents	47
4.4	Number of respondents according to Land ownerships	47
4.5	Type of House	50
4.6	Number of rooms	52
4.7	Comparison between last prices of Electricity, Gas and Water bills	55
4.8	The appliances which producing Green Energy in neighborhood's Building	56
4.9	The appliances which using for producing Green Energy in the Building	57
4.10	The appliances which using for producing Green Energy in the Building	58
4.11	The appliances which using for producing Green Energy in the Building	59
4.12	The reasons of respondents' opinion	60
4.13	Existing bus stop in the Neighborhood	61

4.14	Existing bus stop in the Neighborhood	62
4.15	Times of using public transportation in a day	62
4.16	Number of respondents whom using bicycle	63
4.17	The ways to encourage using bicycle	64

LIST OF APPENDICES

Appendices	TITLE	PAGE
A	Questionnaires	78
B	SPSS Data Analysis	88

CHAPTER 1

INTRODUCTION

1.1 Introduction

Since the early 1990s, sustainable development, both nationally and globally, has laid a new agenda gradually. In protecting the environment, introducing the widespread advantages of sustainable construction (Sustainable Building) is important in building a sustainable neighborhood. This can result in reducing energy bills and enhancing the welfare and health of neighborhoods. The infrastructure construction in the neighborhood will bring more benefits if built with sustainable features, which are environmentally sound. This research is done to consider the possibility of improving the existing neighborhood through rehabilitation of the neighborhood. This rehabilitation is done using some methods established in sustainable neighborhood and green neighborhood to create a low-carbon neighborhood (Liu, 2005).

Given this urbanization context and current global environmental threats, concepts of sustainability will in the long term succeed or fail in cities. To succeed, it has been needed to provide life-cycle-based data aimed at improving the

environmental performance of new neighborhood developments and rehabilitation especially in existing neighborhood (Cole, 1999).

The design of sustainable neighborhood is a key issue that addresses most of the global environmental problems that existing neighborhood has created. Currently, there is enormous pressure on the natural environment resulting from neighborhoods. The world cities are directly or indirectly responsible for 80% of global energy consumption, generating more than 70% of the total waste and more than 60% of greenhouse gas (GHG) emissions for the planet. These data show the high contribution that cities through existing neighborhood and new neighborhood make to the global warming phenomenon, which is increasing due to urban growth that is occurring worldwide (Hachem et al, 2012).

Developing countries, particularly in Iran, are experiencing an expansive urban growth. This urban growth causes excessive pressure on the existing infrastructure, which affects buildings, public transportation, green spaces, road networks, water quality, waste collection and public health. New settlements continue to be created informally at the urban peripherals. In addition, cities occupy expansive areas and because of that they are the cause of significant loss of agricultural land and green areas. This will also results in increased level of consumerism and larger travelling distances in people's daily lives (Su et al, 2012).

Understanding the metabolism of neighborhood settlements and the characteristics of their material and energy flows is essential to understanding the many subtle interrelated factors present in existing neighborhoods. Based on this knowledge, the most pressing neighborhood environmental problems are related to increases in inputs and management of the residual outputs. It can be identified an strategy to improve neighborhood sustainability that can be rehabilitated (Gao & Zhang, 2011).

In the meantime, one of significant factors for rehabilitating of existing neighborhood is green building or sustainable building. Sustainable building is being

focused on several tools to be able to make decisions and evaluate how objectives of sustainable building can be implemented. People began to realize that the development tools of sustainable building, especially tools which are supposed to evaluate the environmental performance of buildings, are essential for good design (The European Commission Report, 1999) and are useful in promoting and regulating the development of sustainable building market. Until now, many kinds of sustainable building tools have been developed and applied in the market, while the numbers of new tools emerge every year. Some of the tools in the early stages, as Building Research Establishment Environmental Assessment Methodology (BREEAM) in the United Kingdom (Baldwin et al, 1998), American Leadership in Energy and Environmental Design (LEED) (Green Building Council of America, 2001) and utility green building (Natural Resources Canada, 2001), can help to rehabilitate existing neighborhood, decrease consumption energy and reduce pollutants.

However, many of these changes, being insufficient to meet the specific neighborhood conditions, have been criticized in many ways. So there are still several areas which need new assessment systems, tools, and methods. The rapid growth and success in this area is generally due to the development of new tools or custom tools created for each existing neighborhood (Liu, 2005).

Low carbon neighborhood has not been found a comprehensive definition that is the same between all of the countries, i.e. developing countries and developed countries. The low carbon neighborhood can result in development for different countries with different financial and social limitations. In addition, this development can ensure a solution for all needs belonging to all groups within the society and also keep the concentration of greenhouse gas (GHGs) and specially Carbon dioxide (CO_2) at global limits which will prevent climate change. (Skea and Nishioka, 2008).

Despite the fact that all countries know about the dangers of global climate change, their counteractive actions are not of adequate speed. According to reports

from scientists, the world is being faced by detrimental outcomes of this neglection (Liu, 2005).

In other hand, the developing countries are looking for measures to reduce greenhouse gas (GHG) concentrations in long term by levels lower than 450 ppm, Policies adopted for climate change reduction not only help to control greenhouse gas (GHG) emissions, they also can improve and keep national energy and cause mitigation of local air pollution. (Shrestha & Shakya, 2012).

On the global level, transportation is one of significant factors that makes and helps to global warming. The transport segment expended 28% of the aggregate vitality in 2005, ensuing in real outflows of greenhouse gases, for example, Carbon Dioxide (CO_2), methane, and Nitrogen Oxide (NOx). As well as transport traveller causes to increase environmental problems, such as: air pollution, CO2 emissions, water, noise pollution and so on. In addition the importance of transport for neighborhood (Jensen, 1999).

Unfortunately, the growth of energy use in urban public transport is less than in private transport. From this part, it means not that the emission and energy, which come from urban public transport, is not significant subject. The current was changed nature of community and people's lifestyle. Also today most of the people are dependent on car travel (Anable, 2005).

In the other hand, the neighborhood green spaces have been demonstrated to significantly diminish ambient air temperature and relieve hotness islands made by urbanization. However, one of the ecological profits of neighborhood green spaces is cooling. Evaluated emanation decrease of neighborhood green spaces in Kerman city of Iran illustrated that neighborhood green spaces play a real part in decreasing GHG emission and ambient air temperature (Da Graça Carvalho et al ,2011)

In cities, planted communities can provide a wide range of ecological services including the conservation of biological diversity, air and soil pollutant removal, carbon sequestration, oxygen renewal, ground water recharge, soil protection, and urban cooling effects through the increase in evapotranspiration and wind course regulation. It is utilized in home gardens, neighbourhood's parks such as, screening and shading impacts inside urban parks, institutional grounds. Also, non-assembled up a complex of buildings, street, trees played a role in shaping landscapes by playing significant environmental and social roles and by adding magnificence to the encompassing of human life (Fossum, 2005).

1.2 Problem Statement

One of the great problems in countries such as Iran is their dry weather and also poor vegetation. Iran is one of countries which are largely poor in the environment. This weakness includes the environment, plants, drinking water resources, etc. So the use of resources should be in the same manner that is consistent with the principles of sustainable development. Iran is a developing country which has environmental problems; of course, it has particularly rich renewable resources that can help to increase renewable energy and improving environment in the neighborhood (A. Boghziyan and I. Nasreabadi, 2006).

The concept and idea of low carbon neighborhoods is presently obtaining momentum in the neighborhoods improvement and neighborhoods rehabilitation. Neighborhoods are understanding that global weather change and environmental change are the consequence of urbanization, population increase and economic development. The most important enhancement of energy consumption and Carbon Dioxide (CO_2) emissions happens in urban communities and urban area. (Skea and Nishioka, 2008).

This chapter provides an overview of the development of sustainable construction and green building tools. These tools are part of the neighborhood that are able to have great effects in the rehabilitation and improvement of neighborhood as part of city in Iran. Construction term "stable" can be also named as "environmental" or "green" building. There are many different concepts of sustainable or green buildings to suit a wide range of sustainability issues in construction of infrastructures in the neighborhood. Regarding sustainable development, the “definitions range from broad concepts that incorporate all aspects of sustainability to narrow definitions that focus on one specific sustainable design feature such as recycled content materials or energy efficiency and renewable energy” (U.S. Green Building Council, 2001).

Stable operation is often cited definition of "meeting the needs of present generations without compromising the ability of future generations to meet their own needs" in 1987. This definition is proposed by the World Commission on Environment and Development. An important component of "Sustainable Construction" of the operation is stability (Sneddon et al, 2006).

One of the actions that deeply related to the principle of sustainable development is low carbon neighborhood. Sustainable development will ensure that all requirements belonging to environment, consumption energy, Carbon Dioxide (CO_2) emission and health society within the neighborhood can be solved. (Skea and Nishioka, 2008).

All of the values of neighborhood depend on the factors which are the environmental values of neighborhood. These values are parks, street trees, squares, open space and other greenery in neighborhood that are biotic and vital wealth necessary for a healthful and livable neighborhood. These factors have the environmental benefits that are important to improve environment: improves air quality and decrease dust in air, landscape, provides vital habitat and corridors for birds and wildlife, and reduces erosion through wind, help groundwater recharge and

purification. Trees and other plants always absorb carbon dioxide and they result in reduction in neighborhood warming and global warming. It is important to know that the phenomenon of global warming has been confirmed in reality and it is not theory (Cerón-Palma et al., 2013).

1.3 Research Questions

This research will be conducted in order to find the appropriate answer to the following questions;

1) What are the existing neighborhood conditions and design neighborhood in relation to rehabilitation of existing neighborhood?
2) What kind of measure needed to rehabilitate the energy efficiency of the existing buildings?
3) What is the best way to implement neighborhood rehabilitation program to achieve low carbon neighborhood?

1.4 Objectives of Study

This case study aims to enhance low carbon neighborhood through rehabilitation of buildings and its surrounding area.

1) To make inventory of components of the existing neighborhood and obtain people's opinion, which are being lived in the existing neighborhood about low carbon neighborhood concept.
2) To suggest improvement of the energy efficiency and reduce carbon of the existing neighborhood.
3) To suggest a policy mechanism for the implementation of neighborhood rehabilitation program.

1.5 Scope of Study

This research provides literature review of ideas, concepts and theories on methods used for implementing low-carbon neighborhood, sustainable building or green building, and open space in existing neighborhoods. The city of discussion in this research is Kerman, Iran. Different measures introduced in Sustainable neighborhoods will be discussed and analyzed through questionnaires to find the most important problems in the neighborhood. Through this knowledge, the best ways to rehabilitate the existing neighborhood toward a low-carbon neighborhood can be found. The scope of the study is focused on following aspects:

i. To review literatures on concept and application low carbon neighborhood and existing neighborhood in relation to neighborhood rehabilitation.
ii. Conducting of a case study to find the problems in an specific existing neighborhood, i.e. Emam-Jome Neighborhood in Kerman Region.
iii. Examining the view of residents on their acceptance abilities and constructs for the application of low carbon neighborhood and their suggestion on measures to neighborhood rehabilitation.
iv. To suggest policies for the application of existing neighborhood rehabilitation.

1.6. Case Study

The present study has been carried out in the city of Kerman, Iran. Kerman city is the centre of Kerman state, which is located in the south east of Iran. At the 2011 census, its population was 621,374 with 171,389 households, making it the 12th most populous city of Iran. The Emam-Jome neighbourhood has been selected for this research. The main reason to choose Kerman city of Iran is that this area have good situation due to the fact that Iran is geographically located on the Sun Belt, where the average number of hours of sunlight in a year is up to 2,800 hours. Also in Kerman province, the average of time is up to 3200 hours, which means that there are sunlight in 13 hours from 24 hours in some days. The Emam-Jome neighbourhood has poor environmental properties and it is more than 20 years old. More details about this case study and neighbourhood will be discussed in chapter 3. Figure 1.1 shows location of Kerman City of Iran and Figure 1.2 shows Emam Jome Neighborhood (Atapour and Aftabi, 2002).

Figure 1.1: Kerman City of Iran

Source: *Google*

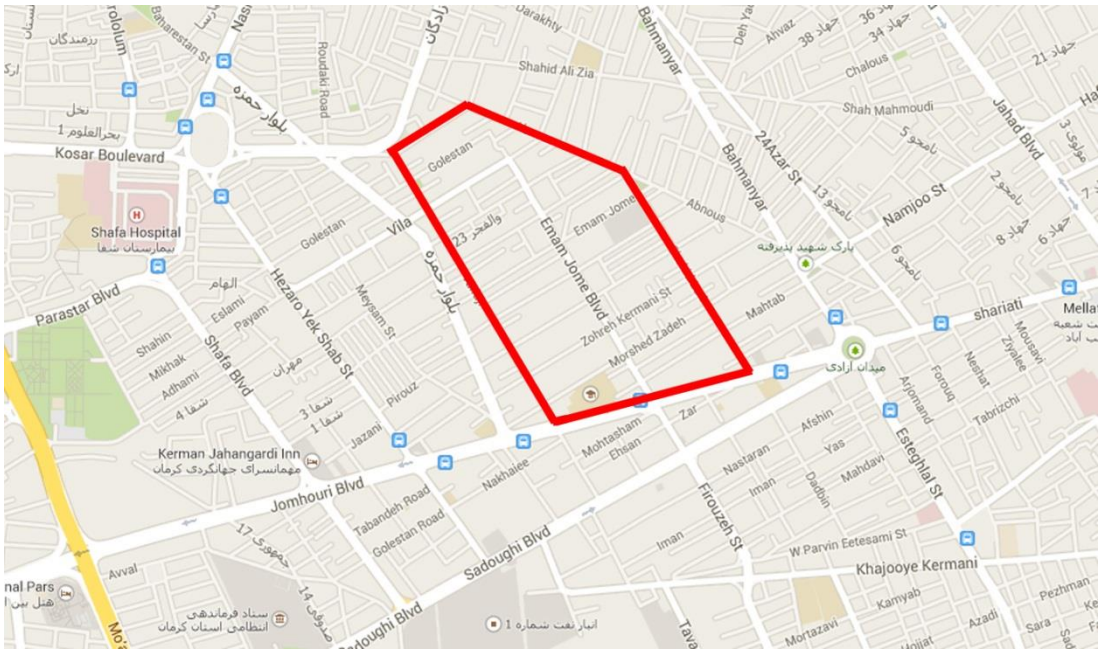

Figure 1.2: Shows Emam Jome Neighborhood

Source: *Google Map*

1.7. Significance of Study

"The building industry is increasingly scrutinized and required to develop approaches and practices that address immediate environmental concerns"(Cole, 1999). As a response, sustainable buildings are developed quickly and broadly. Sustainable buildings has many environmental, economic and social benefits and positive impacts that can be enjoyed by all building stakeholders, including owners, occupants, and the general public.

The U.S. Green Building Council states in a document called "Building Momentum", which was prepared for the U.S. Senate Committee on Environment and Public Works in 2002, that many of the benefits of employing Sustainable Building (SB) technologies and practices are quantifiable and well documented, including reduction of waste, decreased water use, energy saving, reduced operating

cost, and improved indoor air quality; while other benefits are less tangible and harder to demonstrate statistically, such as improvements in occupant health, employee morale, productivity, recruitment, retention, and improved public image for organizations that build green and sustainable. “While comprehensive scientific, studies are needed to verify results, preliminary studies and anecdotal evidence are confirming intuitive assumptions about the benefits” of Sustainable Building (SB) (U.S. Green Building Council, 2002).

“Green” or “Sustainable” buildings use key resources like energy, water, materials, and land more efficiently than buildings that are just built to code. With more natural light and better air quality, green buildings typically contribute to improved employee and student health, comfort, and productivity (Kats, 2003).

The creation of a low carbon society is based on some main elements such as renewable forms of energy solar, wind, hydro, geothermal, ocean waves, and biomass still account for a small percentage of the global energy mix, i.e. below 20%, even when counting biomass and large hydro, they are growing rapidly as governments mandate targets and benchmarks for their widespread introduction into the market and their falling costs make them increasingly competitive (Jamasb, 2007). Billions of Euros of public and private capital are being spent into research, development and market penetration, as businesses and homeowners seek to reduce their carbon footprint and become more energy efficient and independent.

Global investment in renewable energies topped $148 billion in 2007, a 60% from 2006 (Ruh, 2008). Global investments in renewable energies are expected to leap to $250 billion by 2020 and $460 billion by 2030 (Cooper, 1999). Renewable energies, those economic sectors that played a major role in CO2 emissions could play a fundamental one in a low carbon society. For example, the construction industry is the largest industrial employer in the EU and, in 2003, represented 10% of the GDP, and 7percent of the employment in the EU-15 (VillarinhoRosa & Haddad, 2013).

Buildings are the major contributor to human induced global warming. Worldwide as in the EU, buildings consume 35% of all the energy produced and are responsible for equal percentages of all CO2 emissions. Now, new technological breakthroughs make it possible, for the first time, to design and construct buildings that create all of their own energy from locally available renewable energy sources, allowing us to re-conceptualize the future of buildings as “power plants”.

These buildings will collect and generate energy locally from the sun, wind, garbage, agricultural and forestry waste, ocean waves and tides, hydro and geothermal enough energy to provide for their own power needs as well as surplus energy that can be shared (da Graça Carvalho et al., 2011).

As discussed in the previous sections, low-carbon neighborhoods can result to decrease pollution either in short or long term. If building green is cost effective, a broad shift to green construction offers a potentially promising way to help address a range of challenges facing Iran.

1.8. Chapter Summary

This chapter aims to identify some problems, and outline suggestions of the research question as well as objectives of the study. The Emam Jome neighborhood is case study that located in Kerman city of Iran. Also, this chapter described the scope and significance of the research. Moreover, this study would discuss the main factors that enhance low carbon neighborhood through the existing neighborhood rehabilitation in literature and research methodology. Furthermore, results will be

presented and discussed with recommendation about factors regarding the existing neighborhood rehabilitation in Kerman city of Iran.

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