

THE ROLE OF STRUCTURE NOVELTY OF SUSTAINABLE URBAN FORM IN ENERGETIC CITIES (CASE STUDIES OF MASDAR AND BUSHEHR CITIES)

Ahmadreza Tourani

Department of Architecture, Faculty of Engineering, Islamic Azad University, U.A.E Branch
mr.tourani@yahoo.com

Amirhossein Jamshidi

Department of Architecture, Faculty of Engineering, Islamic Azad University, U.A.E Branch
jamshidiamirhossein@yahoo.com

ABSTRACT

Bushehr and Masdar are two of the most famous cities in warm and humid climate which are situated in the same macro climate of Persian Gulf region. This research tries to discuss one of the most important themes which threatens the sustainability and comfortability of tomorrow's life. Analyzing Bushehr and Masdar as energetic cities was an effective way of finding the cities problems and the result led to the presentation of a more comprehensive pattern for planning an energetic city in warm and humid climate. For this purpose main questiones were found worthy of investigation: What characteristics should be presented in designing an energetic city?, What are the aims of changing a city into an energetic city?, In this paper we provide a model which responds to the sustainability of Bushehr and Masdar. This model uses five levels of activities, with each level responding to at least two significant characteristics of an energetic city with regard to the compact urban form. Ultimately the presented model was confirmed by the Delphi s Experts Panel and the model was used to clarify the superiority of the analyzed energetic cities.

Keywords: *Sustainable design, Urban form, Energetic city, Delphi's Panel*

1.INTRODUCTION

In the second half of 20 century the environmental problems played an important role in international researches, since our life was threatened by phenomena such as deforestation, ozone depletion, global warming, pollution, acidic rains, nuclear waste, etc. Consequently we as human-being were obliged to take into consideration these new global environmental challenges for achieving a higher level of urban sustainable development. However there are still many cities all around world that are developing irregularly and are considered of natural resources and also avoid using recyclable energies. To further understand the issue of uncontrolled development of urban sustainability we must first review the effects of Industrial Revolution on designing cities.[1]

After Industrial Revolution, the growth in the urbanization meant to the formation of mega cities. This process occurred so quickly that we can guess some day the earth will change into an urban world, so researchers have determined their definitions and presented a very helpful model in designing future cities and constrain uncontrolled development. Some of the presented models are as follows:

Hulmes model (1988), Hossein, (1988) in Manchester, Hockerton model (1992) ,Vahid, (1992) in Nottinghamshire, HTA model (1993) in Greenwich Millenium.[2]

But all these models are about small cities and sometimes they don't cover climatically issues and this challenge has induced scholars, planners, local and international NGOs, civil societies, and governments to propose supposedly new frameworks for the redesigning and restructuring of urban places to achieve sustainability.[3]

The following theories have been addressed on different spatial levels, by the some group of experts: **1-** The regional and metropolitan levels, such as the Bio-Region approach (Jabareen 2006), **2-** The city level(e.g., Girardet 1999) Nijkamp and perrels 1994, Gibbs, Longhurst, and Braithwaite 1998, ROSELAND 1997; Engwicht 1992; OECD 1995; Jenks, Burton, and Williams, **3-** (1996); The community level (e.g. , Nozick 1992 Paulson 1997 Corbett and corbett 2000 Rudin and Falk 1999 Van der Ryn and Calthorpe 1991) and **4-** The building level (e.g. Roelofs 1999, Edwards and Turrent 2000, Boonstra 2000, Woolley Kimmins and Harrison 1997).

This study in line with the previous approaches presented by different scholars seeks to shed light on the matter from a new perspective to present a comprehensive model which can be applied to the future Mega cities with consideration on climatically issues.

A critical review of these approaches demonstrates a lack of agreement about the most desirable urban form in the context of sustainability.

The remainder of this article consist of six sections. The second section discusses the specific sustainable compact and energetic city criteria that appear in the literature. The third section focuses on the methodology of the study and its parts. The study applies thematic analysis, which is an appropriate methodology when analyzing a larger body of interdisciplinary texts. In addition, it presents the operational aspects of urban form to examine it more accurately. The forth section identifies and describes the design concepts of sustainable energetic city based on sampling population and data analysis. The fifth section offers a conceptual framework for assessing the sustainable energetic city, the final section draws some conclusions and suggests several models for planning the energetic city based on Delphie's Expert Panel comments.

So the aims of energetic city in this paper is to make city as a model of highest quality of life with the lowest environmental footprint. Therefore, this article seeks to answer the following questions: what are the distinctive urban forms proposed by the model? What is an energetic city? In addition, the article aims to offer a conceptual framework for assessing the sustainability of urban forms.

A further aim of an energetic city in this research is to implicate forms, processes and flows to make a model of environmental excellence and it includes task of changing the blue print of sustainable development into the wide action of the city to make it understandable and more practical according to the site scale to illustrate environmentally planning alternative to our present life theme.

But to clarify the gap we have to answer the main question: **what characteristic should be present in designing an energetic city?** So regarding the energy conservation or what is nowadays called energy crisis, the most important factor which threat the sustainability and comfortability of our tomorrow's life is lack of sustainable energetic cities criteria that change a city into an ecological one based on consideration of form, processes and passive or active flows.

Concerning the aforementioned explanations it can be understood that in an energetic city low energy consumption is integrated with the level of optimum efficiency.

Meanwhile despite the above mentioned point some statistics and technical researches show the existence of many towns with a low level of energy consumption which are not energetic because some

important factors have been neglected for some time including a passive or active reaction towards technology as modern movement.

Living in an information era with the daily development of technology is going to influence human life, but some planners want to fulfill the gap, related to the lack of technology and the futurity needs by the passive reaction like primer post modernism fans.[3]

Therefore it is clear that the low consumption of fossil energy and using of renewable energies instead, can be contributed to technology and the general attitude of techno centrism. So from this aspect energetic cities are not cities with a lack of techno centrism flows and processes contrary to most theorists, we believed that only passive reaction based on anthropocentrism general attitude would lead to the same dead end which guided who those believed in Bushehr old fabric zone as an energetic city. In addition other factors like futurity and responding to the future needs of humans are equally important.

Energetic cities are cities which have become successful in answering some aspects of digital urbanism age such as techno centrism, telecommunication, futurity, environmentally consideration and simultaneously has considered the anthropocentrism general attitude of human life by passive and active responds.

To gain these characteristics, the new model of a city should be designed in a flexible way. After all, based on what presented, the definition for an energetic city is:

A city which is designed according to general principles of techno centrism and anthropocentrism that by using its environmental potential can achieve a low level of energy consumption and take advantage of renewable energy to meet the needs - energy or technology - of future generation.

What should be done to obtain the criteria of an energetic city?

Despite its importance, this pivotal question is rarely considered by government officials, energy company executives and most people and at the sometime changing the situation is probably the most important difficult part which we face as planners.

As it was mentioned, sustainability is a process and a flow but energetic or eco city should be known as the product, so to have an energetic city we have to utilize the process and catch the flow, which we would call energization process in this research paper.

In terms of the previously mentioned text any attempt to get closer to energization process is categorized under one of these four aspects:

- Physical aspects
 - Behavioral aspect
 - Environmental aspect
 - Perceptual aspect
- } Socio/Cultural Containment
} Economical aspect

Figure 1: Energization Process Chart Categorized under Five Aspects [Source: Authors]

Place

Sustainability										
Physical aspect				Behavioral aspect	Environmental aspect			Perceptual aspect		
Accessibility	Connectivity	Permeability	Planning engineering & architecture			Renewable energy	Recycling		Socio/Cultural Containment	Economic aspect
	Public open space		Architecture	Material	Structure		Energy Generation & Management	Waste Management		
						Zero-Carbon emission				

2. THEORETICAL FRAME WORK (L-R)

The literature is enriched with studies on the different aspects of sustainability, urban forms and general concepts of energetic cities and any research study seeking to this body of knowledge must consider what Literature has to offer on the subject material.

Many researchers (Wines, 1996 ,Oliver, 1997 Egenter, 2004 Holden, 2004 Barton, 2006 Sabastani, 2007 Owens, 2008) by conducting studies and presenting theories have paved the way for better understanding of sustainability aspect.

In some cases by putting these theories side by side different aspect of the problem towards sustainability and urban form of an energetic city can be better identified and the researcher can find more comprehensive answers to fill the gaps from each direction.

Table1: Chronologically literature Related to Sustainable and Energetic City[Source: Authors]

Year	Thinker	Text	Conceptual, philosophical and aesthetic framework
1996	James Wines	New wave economic architectural: Building art in the age of ecology	Under James Wines direction, site has been identified internationally with innovative concept for building and public spaces and currently he has focused on creative works in the area of green architecture, the fusion of building with the site and surround, advocacy of a new role for all building and in the global environmental protection movement. The overview of Wines book is around changing the relationship between building and natural environment.[4] A compendium of Wines purpose, works on dealing with such issue as environmental technology, energy conservation and fusion of building with the site and surround in terms of sustainability.

1997	Paul Oliver	The encyclopedia of vernacular Architecture of the world	In 1997 Oliver et.al published an encyclopedia in which they described theories and principles underpinning traditional architecture. Technically the research has tended to focus on concept and theories specifically (cultural and social) context, but foundationally theories describe vernacular architecture, vernacular materials and technology based on utilizing the potential of the site.[5]
2004	Nold Egenter	Vernacular architecture	In the 2004 Nold. Egenter pointed to some principal tenets on the interpretation of anthropological definition of architecture and its functions to provide a symbolic model to harmonize the built form with environment.
2004	Erling Holden	Ecological footprints and sustainable urban form.	This article review also strongly supports the idea of sustainable urban form in city while the characteristics are as follows: <ul style="list-style-type: none"> • Dense and concentrated housing design. • Relatively high degree of density. • Shortest possible distance to the town center. • Modern size of the location.[6] In terms of this criteria the present research will be justifiable on the table 3.

Table1: Chronologically literature Related to Sustainable and Energetic City[Source: Authors]

Year	Thinker	Text	Conceptual, philosophical and aesthetic framework
2006	Hugh Barton	Health map for the local city	
2007	Naser Sabatsani	Energetic City	To date, little evidence has been found on the energetic city but the first systematic study on the Bushehr urban zone as an energetic city was researched by Sabestani , Naser (2007). In the above mentioned research three factors have been identified as being potentially important in energetic city.

			<ul style="list-style-type: none"> • low energy consumption • Futurity • Environmentally friendly[1] <p>In terms of the aforementioned text tenets, firstly Bushehr and Masdar city will be under analysis and secondary based on new pattern the deficiency will be covered to obtain the energetic city criteria.</p>
2008	Susan Owens	Land limit and sustainability: A conceptual framework and some dilemma for the planning system.	<p>In recent review, researchers have investigated a variety of approaches to achieve sustainability which emphasis the usage of post materials and amenity criteria on the environment without resource depletion and renew the usage of the water, mineral and energy resource.</p> <p>In addition research focused on quoted principal, protecting what is the most valuable in the cultural environment[8]</p> <p>According to the latest scientific research it is needless to say which of these approaches will be usable for pointing out the challenges of Masdar and Bushehr as sustainable cities.</p>

1-2- Methodology

To fulfill objectives of the study data was collected based on a field investigation from our chosen samples namely Masdar and Bushehr and a qualitative method was utilized, and in order to ensure the reliability and validity of the research method an Expert Panel consisting of 15 researchers was consulted:

- In the first step a lecture on the samples was presented which included basic and climatically information beside charted data or energy calculation and evaluation of environmental, social and economic pivots.
- In the second step a seven minute movie on the selected cities was shown which gave full account of the above mentioned points.
- In the final step the expert panel gave their comments and evaluated the prominent criteria of achieving an energetic city in a warm and humid macro climate based upon a 32 item licrt, scale questioner.

What follows is a further clarification of the research method:

1- At first related literature was reviewed on the concepts of sustainable development, compact cities, urban form and energetic city ending up

2- The emerged sustainability trends in the location were analyzed through assessing a number of zero energetic cities patterns which lead to exploring the impact of these trends on the planning energetic city.

3- A comprehensive model was recreated based on the collected data from analyzing zero energy case studies in the different climate on four cities (Vaxjo city/ Bedzed City/ Dongton City/ Yazd City).

4- Many criteria were identified to recognize special and fabric distinctive urban form in warm and humid climate to compose an energetic city.

5- The most important characteristics of an energetic city were conceptualized and incorporated into our model based on Expert Panel comments to reach a higher level of accuracy.

2-2- Sampling

The selected cities both shared a similar climatical situation. Bushehr is located on the upper coastline of Persian Gulf. Its Latitude, longitude and altitude are respectively 28.58 50.49, and 9 meter. Masdar on the other hand is constructed in 17 km east-south of the city of Abu Dubai. Its latitude, longitude and altitude are respectively 54.61, 24.42, and 10 meters.

Bushehr and Masdar as models of energetic city:

Table2A: Bushehr and Masdar City General Information[Source: Authors]

Case study	Name	Place	Date of formation	Designer	Developer	Area	Population	Function	Main concept	Certificate
1- Case study Iran	Bushehr Old Urban zone	South Region of Iran	Nader shah afshar period 10 century	Local planners & civilians	Residents	Hectare 350	persons 20000	Multi tenure & multi-function	Organic City [Climatically Compatible fabric]	No certificate
2- Case study Abu Dubai	Masdar City	17 km East-South of Abu Dubai	2010	Norman foster Chris Boss LAVA group	Emirate Government	Hectare 700	Persons 40000	Monumental mixed use city &	Sustainable City [Zero Energy Zero waste]	R.I.B.A Sustainability & Climatically system

3-2- Data Collection

The data analysis made on the basis of investigation on cities designed according to sustainable concept in different climate zones reveal similar pattern toward sustainability and development. Although the collected data on these cities to some extent differ from the climatic zone of this research, the underpinning principles for designing an energetic city could be taken from the following chart:

Table 2b: Case Studies and Documentary Analysis of Their Characteristics[Source: Authors]

	similar case study	Designer	Date of formation / Design	Main Concept		
				Sustainability		
				Social Amenity	Financial Effectiveness	Reduced environmental Impact
1- Case study Frame work	Bedzed sustainable city In uk London	programize city Arup group	1999	Urban Density Community Critical mass Private Open space Individual choice for carbon-free lifestyle	low energy running bills planning gain to add development value addresses fuel poverty	zero fossil fuel 100% renewable energy use zero heating homes
	Vaxjo sustainable city In Sweden	programize city Based on participatory design model	1996	Promoting living and working social activity Reduced need for car	affordable / key worker accommodation improved public transport viability	passive solar heating wind-powered ventilation systems improved site ecological value
3- Case study Frame work	Dongton sustainable city In Shanghai china	programize city Arup group	2005	sunlight and daylight amenity	planning gain to add development value	Light pollution control Roof Garden Zero waste

4- Case study Frame work	Yazd sustainable city In Iran	Organic City Local planners owners & civilians	1514	Accessibility Mixed Tenure	100% renewable energy use Local material	recycling facilities zero fossil fuel zero heating homes
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3. DISCUSSION

This study has identified five design categorized concepts and 32 subcategorized criteria which their related to sustainable urban forms to create an energetic city in warm and humid macro climate namely (energetic city model). The literature analysis shows that different combinations of these concepts produce a number of distinguished criteria. Eventually, the study has identified five models of sustainable development in an energetic city these models are compatible and not mutually exclusive and they are as follows:

1. **Compact city model-** the distinctive concepts of the compact city are high density and compactness. It proposed mixed land uses and walkability like the approaches of new urbanism.
2. **The ecological city model-** emphasizes urban greening, ecological and cultural diversity, passive process and flows. In addition the approaches of the ecological city model emphasize environmental and energy management, beside other key environmental sound policies.
3. **Physical development model** - emphasizes sustainability, transportation, diversity, connectivity, accessibility, permeability, planning, engineering and architecture. In addition physical model has much to do with style and design coding.
4. **Socio- cultural containment model-** emphasizes policies of considering the identity, history and social health of generations.
5. **Economical sustainable development model-** emphasizes policies of making the different social levels closer besides affordable housing towards a more cost effective lifestyle.

Table 3. The Criteria to Achieve an Energetic City in Warm and Humid Macro Climate[Source: Authors]

Place																																
Sustainability																																
Physical aspect						Behavioral aspect	Environmental aspect				Perceptual aspect																					
Accessibility	Connectivity		Permeability	Planning engineering & Architecture			Renewable Energy	Recycling		Socio/Cultural Containment	Economic aspect																					
	Public open space	Architecture		Material	Structure	Energy Generation & management		Water management	Water Generation & Management																							
Primary infrastructure P.R.T	Transportation	Radius Access	Public Squares	Green space	Neighborhood Center	High density ((Low Impact))	Site- surround	Orientation	Facade	Landscape	Supply Chain	Thermal conduction factor	Light absorption factor	Technology	Durability	Walkability	Mixed Use	Solar Energy	Wind Energy	zero-carbon emissio	Design Building	Waste	Energy Generation	Transportation	Gray Water	Leak Prevention	Identity	History	Social Health	Affordable Housing	Equalization of different social class habitat	Cost effective life style

4. CONCLUSION

According to the sustainable city chart (table3), this article concludes that different urban forms and general attitudes contribute in various ways to sustainability. Moreover, different planners and scholars may develop different combinations of design concepts to achieve sustainable development goals. They might come up with different criteria, with each one emphasizing different concepts. However, all of them should be in forms that environmentally contribute beneficially to the planet for the present and future generations. The ideal sustainable urban form according to the design concepts of sustainable development which has a high density and adequate diversity, compact with mixed land uses, is designed based on infrastructure in sustainability. Furthermore many factors concerning sustainability such as transportation, greening, passive process and flows are aims to achieve innovative trends in designing energetic cities. Ultimately by combining these trends and general attitudes on techno centrist and anthropocentrism, future need of(technology) will be met and what is more the gaps of multi aspect sustainability will be filled.

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Central Branch, Tehran-Iran

Professor Mofidi Majid, Iran University of
Science and Technology, Tehran- Iran

Professor Tahbaz Mansureh, . Shahid Beheshti
University, Tehran- Iran

Professor Memarzia Kazem, Azad Islamic
University, Shiraz- Iran

Professor Aliabadi Mohammad, Shiraz
University, Research Institute

Ph.D. candidate Mohammadi Mina, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Bahrani far Peyman, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Aghili Amin, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Ilka Shahab, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Ghazi Kosar, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Shoja Amir, research
council of I.A.U- Dubai U.A.E

Ph.D. candidate Mehri Soodabeh, research

council of I.A.U- Dubai U.A.E

Ph.D. candidate Nazarboland Mohammadali, research

council of Azad Islamic University, Yasuj- Iran

M.Sc. Nematollahi Hajar, research council of International Imam Khomeini

University, Qazvin, Iran

M.Sc. Riazikhah, , research council of Azad Islamic University,

Central branch

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