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يتشرف القائمين على المؤتمر الدولي الخامس للاتحاد العربي للتنمية المستدامة و البيئة

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مستقبل منظومة الطاقة و المياه و الغذاء وتغير المناخ بالمنطقة العربية

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The importance of energy efficiency for sustainable urbanism
(The Chinese experience)

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ونحن بهذه المناسبة نشكركم على اهتمامكم بالقضايا البيئية التي تخص منطقتنا العربية متمنين ان نصل بمشاركتكم الفعالة الى حلول تطبيقية للمساهمة في إيجاد حلول لتلك المشاكل

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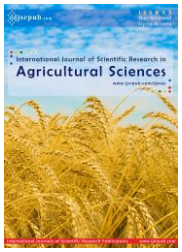

The Importance of Energy Efficiency for Sustainable Urbanism (The Chinese Experience)

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Abstract. The major urbanization activities are taking place in the developing world. Consequently, sensitivity to environmental issues related to energy, efficiency and sustainability become a vital issue when addressing urbanization. Although many countries of the developed world have given considerable attention to this issue, most developing countries have paid little or none attention. Urban energy consumption plays an ever-increasing role, as more than half of the world´s because the most of states are facing the challenge of meeting energy demand sustainably. Buildings energy consumption is a large ultimate driving force of a nation's energy use. Realizing a sustainable energy future will require behavioral change on the consumption side. In this context, examining the role of neighborhoods is important since neighborhoods are the building blocks of urban area's growth and the neighborhoods we build now will have a long-lasting effect on households' lifestyles of energy consumption. The paper studies the Impact of urbanization on urban energy in order to identify the factors having the most impact in planning for energy efficiency and its Multiple Benefits. In addition, energy consumption moderation in urban planning according to the main dimensions of sustainability and main levels where energy consumption moderation / decrease issues in cities should be tackled. This paper is addressing the relationship between energy efficiency and sustainable urbanisms throw the role of Sustainable urban form for energy efficiency. The article presents The Chinese experience: the Landsea housing project in Nanjing as a case study In order to reach a comprehensive assessment for the Sustainable urbanism of a residential area, which is a complicated built unit, should include economic, social and environmental aspects. Environmental aspects are energy, water, waste, etc., as discussed above. It is obvious that all these aspects are related and thus the assessment must be integrated. The aim was to improve the framework for sustainable urbanism, from energy efficiency to integrated sustainability.

Keywords: Urbanization, Urban energy, Energy consumption, Energy efficiency, Energy moderation, urban form, sustainable urbanism, China

1. INTRODUCTION

The balance between energy supply and demand is more fragile than ever because of the dwindling reserves of fossil fuels and increasing demand from developing countries style car culture. This imbalance is projected to have dire economic consequences when conventional oil production eventually peaks, as it must for this nonrenewable resource [1]. The Inter Against a backdrop of concerns about climate change, peak oil, and energy security issues, reducing energy intensity is often advocated as a way to at least partially mitigate these impacts. Energy intensity tends to correlate highly with income and higher income countries have lower energy intensity than poorer countries. In addition to in-come, other factors like urbanization and industrialization may affect energy intensity. The impact that urbanization has on energy intensity is difficult to predict because urbanization increases economic activity through a higher concentration of consumption and production but urbanization also leads to economies of scale and provides the opportunity for increases in energy efficiency [2].

Reducing the intensity of energy use in developed and developing countries is considered an important element in the world's ability to grow sustainably. Likewise, reducing energy intensity is considered a practical solution too many of today's common challenges including global energy shortages; mitigating against further changes in the climate; and health affects of local air and water pollution. Understanding the factors that influence fluctuations in energy intensity are of first - order importance for academics and policy makers not least given the rise of rapidly growing and energy hungry economies such as China and India [3].

Currently, the proportion of both building and transportation energy consumption in social site energy consumption is as much as about 33%. Following the experiences from developed countries, the proportion would stably increase with the

development of economy and the adjustments of industrial structure. For example, the proportions in OECD countries and EU member countries have reached about 2/3, among it the proportion concerning only urban building and transportation is more than 1/2 [4] Controlling energy consumption related to the daily activities of people in cities. Is integral to mitigating the threats posed by hydrocarbon scarcity and climate change to cities' development in the coming decades. Dual goal is achieving high quality of life in urban areas in ways that also minimize energy demand and carbon emissions.

2. URBANIZATION AND ENERGY CONSUMPTION

2.1. Impact of Urbanization on Urban Energy

Urbanization is associated with large-scale movements of the labor force from the countryside into urban areas the result of which is to increase population density in the urban areas. This increase in population density puts stress on the local environment [5]. For example, estimates that cities account for 75% of the world's consumption of natural resources yet cities cover only 2% of the world's surface [3].

Urbanization has a clarified impact on urban structures and energy demand in developing and developed countries. We focus particularly on energy-related mechanisms and processes associated with urbanization and on the policy implications of these as they relate to developing and developed countries. Since 2007, for the first time in human history, more than half of the world's population has lived in cities. The urbanization process is a key phenomenon of economic development, and leads to a significant concentration of human resources, economic activities, and resource consumption in cities. Although covering only about two percent of the earth's surface, cities are responsible for about 75 percent of the world's consumption of resources. This trend will intensify over the next decades as a consequence of high urbanization rates in Africa and, even more importantly, in Asia.

In order to estimate the impact of urbanization on energy demand, we have to identify the different processes and mechanisms of urbanization that substantially affect urban structures and human behavior. Taking a closer look at city-related production, mobility and transport, infrastructure and urban density, as well as private households, we find that various mechanisms of urbanization within these sectors lead to a substantial increase in urban energy demand and to a change in the fuel mix. The relevance of these mechanisms differs considerably between developed and developing countries as well as within the group of developing countries.

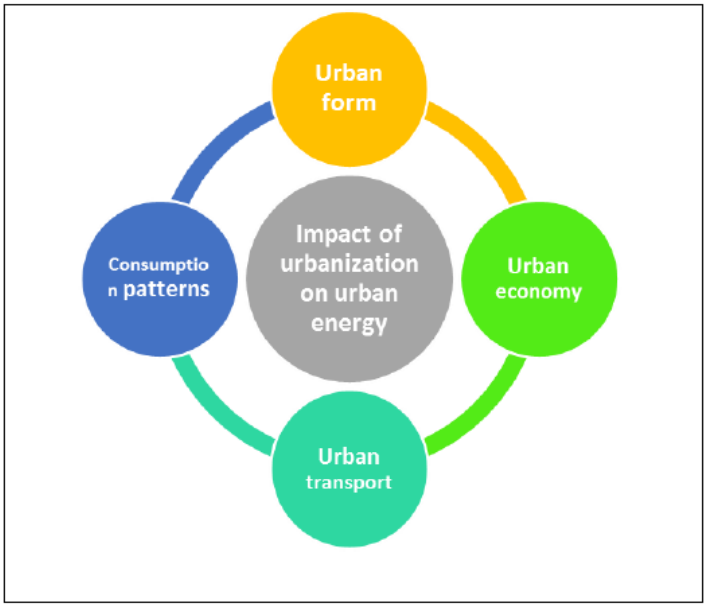

Fig. 1: Impact of urbanization on urban energy – researcher

In view of the fact that the urban population will double within the next 40 years in most Asian and African developing countries, cities and especially newly emerging megacities will play a key role in the development and distribution of global energy demand. Given an urbanization elasticity of energy per $ of GDP of about 0.47, which implies that a one percent increase of the urbanization rate leads to a 0.47 percent increase in energy consumption, energy demand as a consequence of increasing urbanization is expected to rise by about 10.5 percent in Africa and 11.1 percent in Asia within the next 40 years. Hence,

urban energy planning and urbanization management will become future challenges of paramount importance in order to create the right framework conditions for a sustainable energy future.

Urbanization can affect urban energy use by several channels as the following: [6]

(a) Urban form:

Urban form, which refers to the spatial configuration of urban land use within a metropolitan area, has profound influences on energy consumption of a city [7]

Among commentators, there is a range of views as to what would best achieve a significant reduction in transport energy use in a largely 'automotive' city such as Melbourne: some favor more compact, higher-density urban forms, while others favor, and indeed defend, more dispersed patterns of development.

The view among many urban planning theorists is that there is, at least in theory, a strong relationship between urban form and transport energy consumption. Based on a study of 32 cities around the world [8]. The goal of the urban form ideas was that buildings and city streets would gain greater solar and fresh air access (refer Figure 2) through breaking up city blocks with lanes and courtyards. This has the potential benefit of creating buildings that could effectively use natural. Lighting/heating/cooling and ventilation and therefore a passively comfortable environment [9].

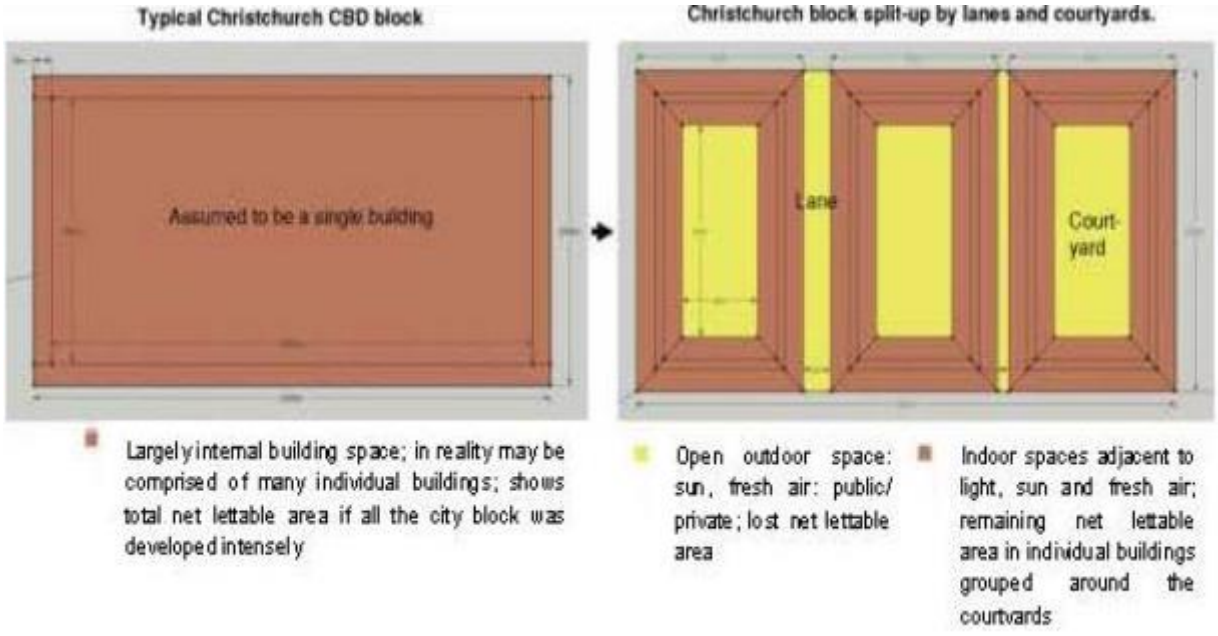

Fig. 2: Plan View of City Block with the CCP Urban Form Changes Implemented [9]

(b) Urban economy:

Urbanization is associated with a concentration of economic activity in cities and metropolitan areas, which leads to economies of scale in production. Production shifts from less energy intensive agriculture to more energy intensive manufacturing. Urbanization brings about fuel switching as decentralized rural energy sources like traditional wood burning are switched for centralized energy sources. Increase production in urban areas canals lead to an increase in the informal economy, which may be further source of increased energy use [10].

(c) Urban transport:

Urbanization affects urban transport by increasing the amount of motorized traffic into and out of urban areas, this increase in traffic increases the demand for energy. Transporting raw materials into the urban area production centers and then transporting the finished goods to other destinations increases the demand for energy. Urbanization also separates the con-summers of food from the producers of food and energy use increases as food products are transported into urban areas. Provided there is adequate mass transit infrastructure, mass transit may offer some relief from commuter chaos and reduce the demand for energy (transportation fuel) compared to how much energy would be consumed if every commuter travelled in his own car. Australian researchers Newman and Kenworthy have argued that there is a strong inverse relationship between the population density prevailing at a given location within a city and the amount of transport energy that is consumed. In other words, the lower the population density, the greater the amount of energy that is likely to be consumed by the population for the purposes of travel. One example they cite is that of Perth, which, like a great many cities throughout Australasia, Britain and North America, experienced the well-known phenomenon of

'suburbanization' in the post-Second World War period. This strong inverse relationship between density and transport energy consumption is supported by the work of Mobridge [11].

(d) Infrastructure:

Increased urbanization increases the demand for infrastructure. Growing cities, for example, increased the demand for energy intensive products and materials as Infrastructure is built. On the other hand, recently developed green building codes like LEEDS certification will help to reduce the energy intensity of buildings [3].

(e) Consumption patterns

Urbanization can impact energy demand through its impact on private consumption patterns. Urbanization is accompanied by economic development and as urban dwellers become Wealthier their consumption patterns change to include more energy intensive products. Obvious examples include refrigerators, air conditioning and automobiles.

The impact that urbanization has on energy intensity is difficult to predict because urbanization increases economic activity through a higher concentration of consumption and production but urbanization also leads to economies of scale and provides the opportunity for increases in energy efficiency.

2.2. Energy Consumption in Cities

Energy consumption is the largest contributor to carbon dioxide (CO2) emissions, the leading cause of climate change. It is important to understand which sectors consume the most energy to take appropriate remedial actions for emissions reduction. It is helpful to view cities as organic systems that have their own metabolism [12].

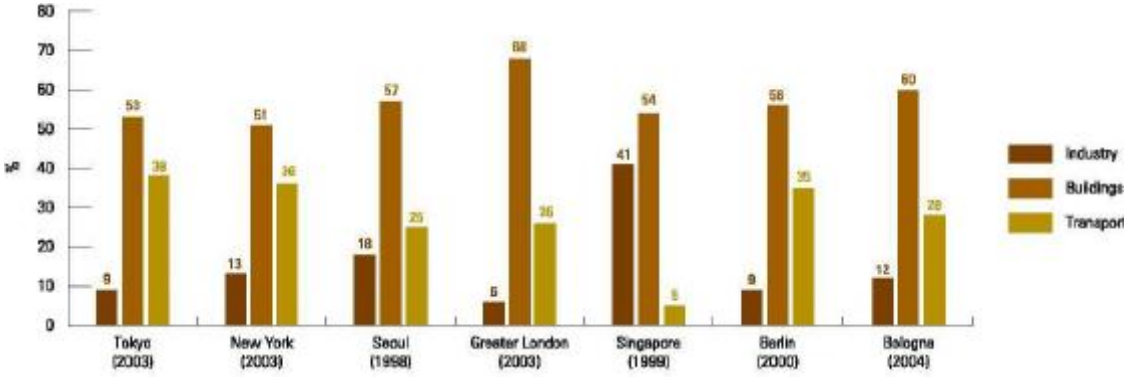

Fig. 3: Energy consumption in selected cities in high income countries [13]

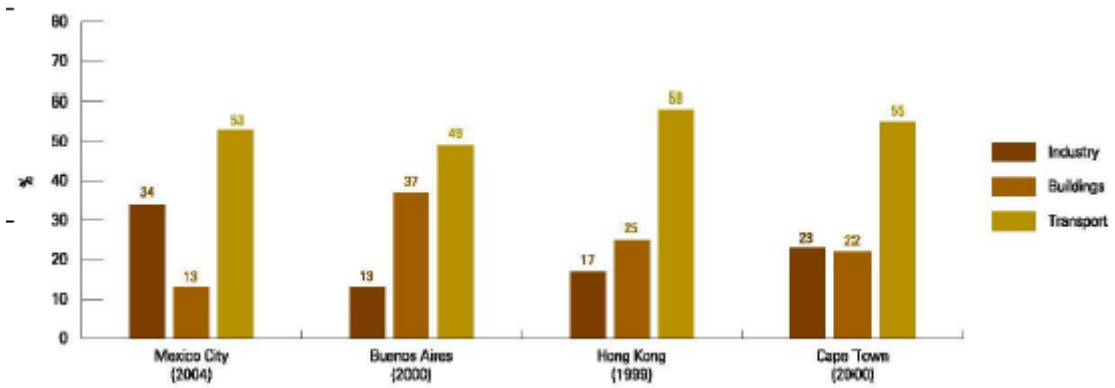

Fig. 4: Energy consumption in selected cities in middle income countries [13]

The metabolism of a city involves physical inputs – energy, water and materials – that are consumed and transformed, by means of technological and biological systems, into wastes and goods, or the city's outputs. Like any thermodynamic system, urban energy consumption can either be efficient or inefficient.

An environmentally successful and energy efficient – or sustainable – city should ideally combine economic growth with social equity and minimum waste production (including greenhouse gas emissions). To meet minimum waste standards, cities must fulfil two prerequisites: minimization of fossil fuel use and material. To meet minimum waste standards, cities must fulfil two prerequisites: minimization of fossil fuel use and material inputs; and maximization of recycling and reuse of energy, water and materials. The need for sustainable, or harmonious, urban development further requires cities to function with a circular, rather than a linear, metabolism. But first understanding how cities came

to develop high-impact, linear metabolism systems is essential for knowing how to find effective means to make the shift to sustainable, circular metabolic systems [13].

The contribution of cities to global warming derives from combustion processes – from the production of energy. However, energy also plays a vital role in sustaining the metabolism of cities. Agriculture, which sustains both rural and urban populations, for instance, also contributes to greenhouse gas emissions. Land use change (for urban development or for cultivation), and agriculture combined account for more than 30 per cent of global greenhouse gas emissions.

3. UNDERSTANDING ENERGY EFFICIENCY

3.1. Energy Efficiency Concept

In a nutshell the concept of energy efficiency may be defined as using less energy to satisfy our current needs. In other words, it means having a more efficient way of using energy, which enables us to keep the same comfort while consuming less energy. According to this concept, a sustainable energy strategy should be organized around three elements, which are by order of importance:

(1) Reduce energy demand as much as possible,

(2) Use renewable sources of energy,

(3) Use fossil energy as efficiently as possible and only if sustainable sources are inadequate

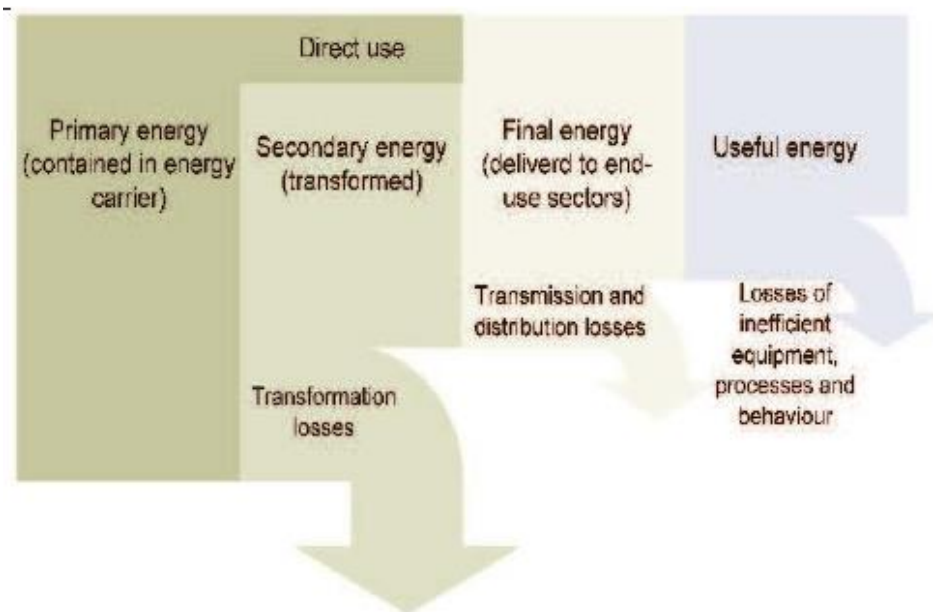

Fig. 5: Energy flow - basis for understanding energy efficiency [16]

Therefore, measures to use energy as efficiently as possible should then be the priority of any sustainable energy strategy. The basis for understanding this concept is energy flow, from primary energy contained in energy carriers to the useful energy consumed through various activities of the society (Figure 5). Energy efficiency also gives cities the ability to supply energy to a greater number of people. Worldwide, 1.3 billion people lack access to electricity, and 14% of those are in urban areas. This is a particular challenge in rapidly growing cities with informal settlements or slums, whose residents often have access to energy sources that are costly, unreliable, or heavily polluting. Greater energy efficiency can make energy supply available to more people, and make energy more affordable for low-income households [14].

Energy efficiency is a huge task that requires cooperating of multiple disciplines, including building envelope, industrial sector and transportation. But how to implement sustainable energy through designing and development is what we should pay attention to. In order to minimize the GHG emission and achieve value for money, development will often be a combination of demand reduction, efficient supply and renewable energy. How these design strategies operate depend on the overall scale, from little single house to a wide range of urban planning scale [15].

3.2. Multiple Benefits of Energy Efficiency

Urban energy efficiency is one of the many responsibilities of municipal policy-makers. It cannot be considered in isolation – its economic, social and

environmental implications are interwoven. While roles and patterns of decision-making vary, often choices are made about the neighborhood, without awareness of the impacts of these decisions.

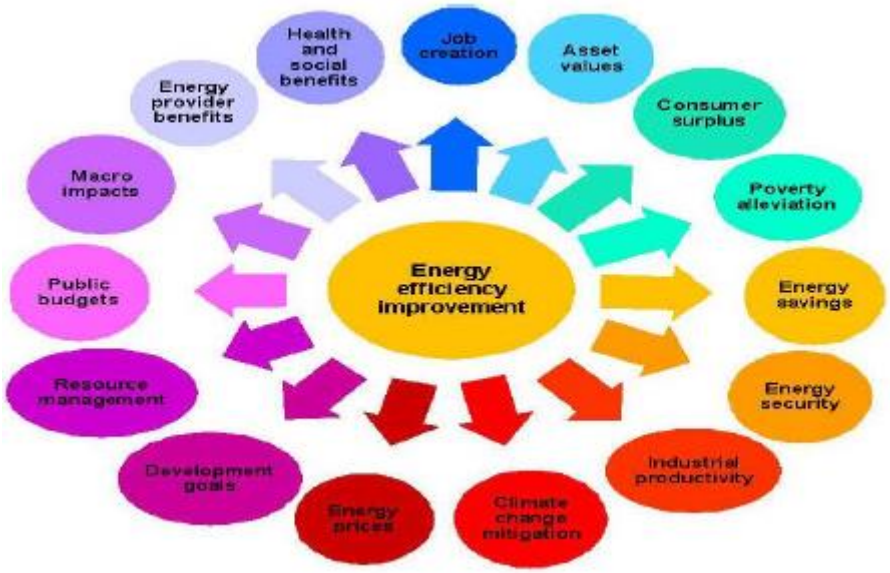

Fig. 6: Multiple benefits of energy efficiency [18]

Orientation, built form, mix of uses, public transport access, parking, cycling provision, the viability of district heating and cooling, public and shared open spaces, refuse/recycling facilities, accessibility and adaptability – these and many other matters may influence the sustainability of the occupants' lifestyles and energy intensity [17]. A study by The International Energy Agency (IEA) in France in 2012 modelled the macroeconomic effects of investing revenue from carbon taxes in the installation of energy efficiency measures in fuel-poor households. The report enumerates many of the most prominent benefits of energy efficiency and, although the list is not exhaustive, it provides a rich menu of the variety of the benefits that may be of interest to policy-makers [18].

3.3. Energy consumption moderation in urban planning

Moderating and decreasing energy consumption of the cities in relation to sustainability issues has three major meanings, according to the three main dimensions of sustainability:

(1) From an economic viewpoint, it means: a) minimizing the energy bill of the urban citizens for a given standard of living; b) minimizing the energy bill of state, as regard energy imports.

(2) From an environment viewpoint, it means: a) improving the living conditions in cities (air quality, noise, congestion); b) minimizing the GHG emissions for a given standard of living of the population.

(3) From a social point of view, it means: a) favoring appropriate conditions for life styles and aspirations (standard of living) which minimize energy needs for a given income : b) reducing inequalities as regard living standards.

There are two main levels where energy consumption moderation / decrease issues in cities should be tackled: [17]

(4) The first level is that of the urban citizen, both in his current living conditions (the dwelling) and in his urban mobility: minimizing his energy bill and improving his living conditions while increasing his living standard. It is both a matter of technology and of behavior and life-style.

(5) The second level is that of the city as a whole: providing a spatial and functional organization of the city likely to minimize the needs for energy services, and providing these energy services minimizing the requirement to imported energy and minimizing the environmental impact, both at local and global levels.

3.3.1. Energy Consumption Moderation / Decrease in Buildings

Energy consumption in buildings and construction can be moderate by three means:

(a) The architectural and technical characteristics of the building itself: insulation, passive solar, exposition to the wind, etc.

(b) The technical performance of the appliances inside the buildings, in particular in relation to heat and cooling demand.

(c) The supply of solar energy through dedicated panels on the building.

In addition, Behaviors and life-styles are likely to affect strongly the energy consumption of the

buildings. Two aspects are particularly sensitive from this point of view: first, perception of comfort .Second, in-door management of the energy requirement [19].

3.3.2. Energy Consumption Moderation / Decrease in Urban Transport

Moderating / decreasing energy consumption in urban transport has two main dimensions:

(a) The technical performance of the vehicles used for urban transport

(b) The use of energy with fewer impacts on energy imports and on environment.

For Behaviors and life-styles, there are three major aspects in this regard: [17]

(c) For those who purchase a car, the characteristics of the car purchased (size, power, energy,)

(d) For those who own a car, the decision to use it or not according to the travel type and purpose, and how (load factor, driving attitude…)

(e) For all, the use of soft modes (walking, bicycle) according to travel distance.

4. SUSTAINABLE URBANISM AND ENERGY EFFICIENCY

4.1. What is Sustainable Urbanism?

Sustainable Urbanism, as a defined term, is application of sustainability and resilient principles to the design, planning, and administration/operation of cities. There are a range of organizations promoting and researching sustainable urbanism practices including governmental agencies, non-governmental organizations, professional associations, and professional enterprises around the world. Related to sustainable urbanism is the Eco city movement which specifically is looking to make cities based on ecological principles, and the Resilient Cities movement addresses depleting resources by creating distributed local resources to replace global supply chain in case of major disruption. Green urbanism is another common term for sustainable urbanism. Sustainable development is a general term for both making both urban and economic growth more sustainable, but is not specifically a mode of urbanism [20].

Sustainable urbanism aims to close the loop by eliminating environmental impact of urban development by providing all resources locally. It looks at the full life cycle of the products to make sure that everything is made sustainably, and sustainable urbanism brings things like energy and food production into the city. This means that literally everything that the town or city needs is right there making it truly self-sufficient and sustainable. Figure 7 clarifies the key principles of sustainable urbanism which include: [21]

(a) Elegant and Coherent Places, by using good design and good building materials.

(b) Mixed Use, such as retail, residential, leisure, business, and community.

(c) Mixed Type, in order to support movement within the neighborhood and thus encourage community stability.

(d) Mixed Tenure, each new settlement must have a variety of income groups and occupations.

(e) Good Transport Layout, the street pattern, public transport connections, and overall transport layout must be carefully designed to promote walking and cycling and to reduce car dependency

(f) Walkable Neighborhoods, community, that is well interconnected and avoids cul-de-sacs and so encourages a range of deferent routes.

(g) High Net Densities, high enough to support the viability of mixed-use areas, convenient public transport, and walkability.

(h) Well defined Open Space, easily accessible to as many people as possible.

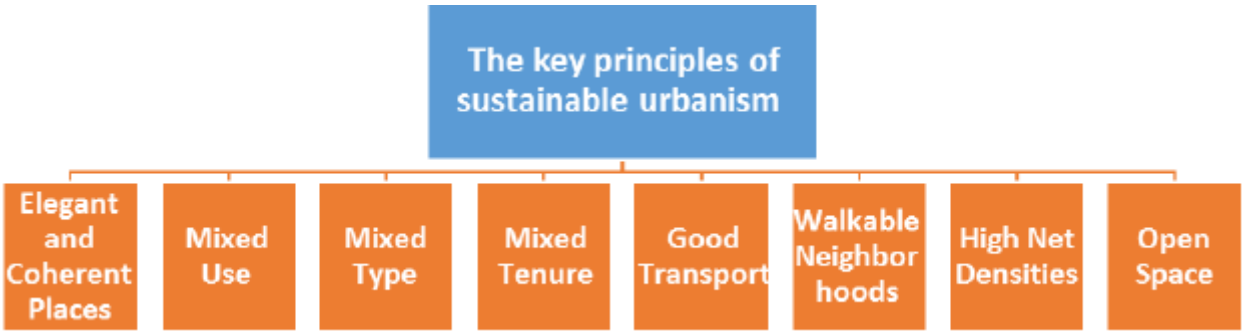

Fig. 7: The key principles of sustainable urbanism - researcher

4.2. The Role of Energy Efficiency in Sustainable Urbanism?

Energy efficiency is the first step toward achieving sustainability in urban areas and organizations. Energy efficiency helps control rising energy costs, it is the fuel for sustainable urbanism. It touches upon nearly every aspect of municipal services: lighting, transport, buildings, power and heat, water, and solid waste. Through energy efficiency evaluation, planning and financing process, we can help cities manage their energy use for the long term reduce environmental footprints, and increase the value and competitiveness of buildings. So how do you identify the most effective solutions? [22]

Energy efficiency and renewable energy are said to be the "twin pillars" of a sustainable energy policy. Both strategies must be develop concurrently in order to stabilize and reduce carbon dioxide emissions. Efficient energy use is essential to slowing the energy demand growth so that rising clean energy supplies can make deep cuts in fossil fuel use. If energy use grows too rapidly, renewable energy development will chase a receding target. Likewise, unless clean energy supplies come online rapidly, slowing demand growth will only begin to reduce total carbon emissions; a reduction in the carbon content of energy sources is also needed. A sustainable energy economy thus requires major commitments to both efficiency and renewable [23]. Energy efficiency and renewable energy technologies improve this generation of sustainable cities, joining forces to minimize home energy requirements and provide direct energy production, with the ultimate goal of generating as much energy as is consumed. Today's zero energy homes utilize high-efficiency appliances, building materials and heating and cooling systems, as well as onsite energy production such as solar pho photovoltaic systems and solar thermal, to reduce energy consumption by 30–90% compared to standard homes.

The roles of energy efficiency include the following items [24].

(1) Reduced energy bills.EE creates home energy savings; with more efficient resources. RE sources such as photovoltaic, generate onsite power, lowering the need for electricity from the grid. Combined, these measures significantly cut energy costs.

(2) Magnified resource impact. Renewable energy resources, unlike energy efficiency measures, are some years away from being cost-effective in residential buildings on their own. By lowering a home's overall energy demand, efficiency creates advantage for the use of renewable energy production, thus magnifying its potential to serve a high proportion of energy demand.

(3) Electric grid benefits. EE and RE provide complementary benefits on electric utility load curves. While EE reduces demand across many hours of the day, solar generates energy during peak hours, providing maximum benefits to the electricity grid.

(4) Capturing lost opportunities. New homes are a key driver of growth in electric demand. ZEH can keep growth to a minimum. Designing ZEH with new homes provides maximum cost-effective and financial advantages.

(5) Economic stimulus. ZEH increase investment in energy efficiency and solar technology. These extra thousands of dollars per home stimulate sectors of the economy involved in the construction, sale, and installation of these technologies.

(6) Reduced carbon emissions. Energy savings from the use of more efficient appliances, lighting, and heating and cooling systems together with the generation of onsite power reduces electricity demand, decreasing carbon emissions at power plants.

4.3. Sustanable Urban Form and Energy Efficiency

In his study on relationship between urban form and energy efficiency, Yang Jiang pose the question: Does Energy Follow Urban Form. Hence energy Efficiency? He took an empirical approach to examining the relationship between the neighborhood and household travel energy use in Jinan, China, using 9 neighborhoods representing four different urban form typologies commonly found in Chinese cities: [25] "Traditional", "grid", "enclave", and "superblock." Data on neighborhood forms and households are obtained from visual survey, GIS digitalization and a household survey. Household transport energy uses (and greenhouse gas emissions) are derived from self-reported household weekly travel diaries. Descriptive analysis, multivariate regression analysis, and advanced two-step instrumental models are employed [26]. Results show that, all else equal, households living in the "superblock" neighborhoods consume more transportation energy than those living in the other neighborhood types, as they tend to own more cars and travel longer distance. The proximity to transit corridors and greater distance from the city center also apparently increase household transport energy use, although both impacts are somewhat minor, partially due to offsetting effects on car ownership. A number of effects of household socioeconomics, demographics and attitudes on transport energy use and car ownership are also identified.

Urban form refers to the arrangement of the larger functional units of a city, reflecting both the historical development of the city and its more recent planning history; it is defined by the spatial patterning of industrial, commercial and residential land uses and also by different levels of residential density [27]. Jabareen (2006) provided a thematic typology of literature from the sustainable development and environmental planning fields and suggested that urban sustainable development has traditionally been addressed at four spatial levels: 1) the regional and metropolitan level; 2) the city level; 3) the community level; and 4) the building level. He suggested the possibility of comparing the performance of typical sustainable forms on the basis of design concept criteria associated with urban sustainability [28].

Table 1: Sustainable urban form' matrix: assessing the sustainability of urban form [28]

		Urban form			
		Nontraditional development	Compact city	Urban containment	Eco city
Design concepts (criteria)	Density	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Diversity	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Mixed land use	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Compactness	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Sustainable transportation	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Passive solar design	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Greening – ecological	1. Low 2. Moderate 3. High	1. Low 2. Moderate	1. Low 2. Moderate 3. High	1. Low 2. Moderate
	Total score	15 points	17 points	12 points	16 points

Jabareen also suggested: "the ideal sustainable form" is that which has a high density and adequate diversity, is compact with mixed land uses, and its design is based on sustainable transportation, greening, and passive solar energy [29]. Also, Compact urban form can cut on-road gasoline emissions, the largest segment (62%) of transportation CO_2 in the U.S. The transportation sector is the largest emitter (33%) of CO_2, outpacing the residential, industrial, and commercial sectors. (Electricity generation, when totaled for all sectors, accounts for 41% of CO_2 emissions.) Records of automobile usage (Figure 8) show an inverse relationship between population density and per capita daily vehicle-kilometers traveled [30].

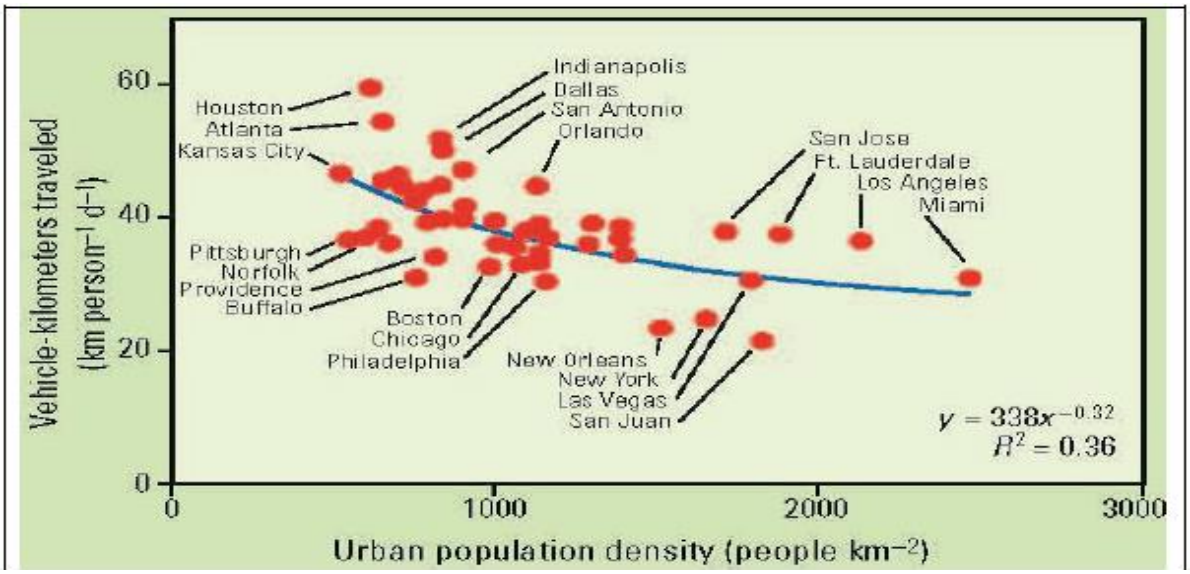

Fig. 8: relationship between population density and vehicle-kilometers traveled [30]

5. THE CHINESE EXPERIENCE: THE LANDSEA HOUSING PROJECT IN NANJING

5.1. General Description

With the boom in real estate in China, the idea of Green Building has inevitably been commercialized and introduced in mass housing projects, including the Landsea's Project in Nanjing. 'Landsea' is the developer's English transliteration of its Chinese name. The housing project is located in the new district of Nanjing, West Riverbank New Town, which lies to the southwest of the old town. A metro line launched in 2005 connects this new district with the main city and one of the stations is about 500 m from the Landsea Housing site [31]. The developer obtained a 70-year lease on the land from the local government, with some restrictions on maximum total floor area, setbacks along roads, maximum building height, building footprint.

Fig. 9: Site plan of the Landsea Housing Project [31]

Total land area: 13.04 ha for residential and 2 ha for commercial, which consist of three phases on three neighboring blocks. Total land area: 13.04 ha for residential and two ha for commercial, which consist of three phases on three neighboring blocks.

The Landsea Project is a typical gated residential project in China. To achieve high land efficiency, namely in terms of FAR, the project consists of 11 eighteen-storey high-rise apartment buildings and about 20 six-storey medium-rise apartment buildings (Figure 10). The Landsea Project is a typical provider paradigm [32] for mass housing development, and residents have little influence on the final product, namely apartments. The developer constructs the apartments according to mass production principles −centralised, standardized and industrialised − and then sells them to residents at the market price.

5.2. Technical Analysis

The primary energy for heating and cooling in this project is produced by the heat pump from surface earth, while heating and cooling are provided by the water running in tubes embedded in the concrete ceiling slab. Technically, heat pump technology is especially suitable for the hot-summer/cold-winter climate, because the system not only gets heat from the earth in winter but also returns heat to the earth in summer, so that the thermal balance of surface earth is easier to acquire. The main thermal transfer mechanism in buildings is thermal radiation, which is more effective than convection and conductivity, and thus the water inside the tube can be low-temperature for heating and high-temperature for cooling, i.e. more energy-efficient. Independent mechanical fresh air ventilation is also part of the system [31].

The building envelope has been improved greatly compared with normal buildings. The exterior wall and windows have a lower thermal transfer coefficient and the adjustable exterior sun screens also greatly help reduce excess solar heat gains in summer.

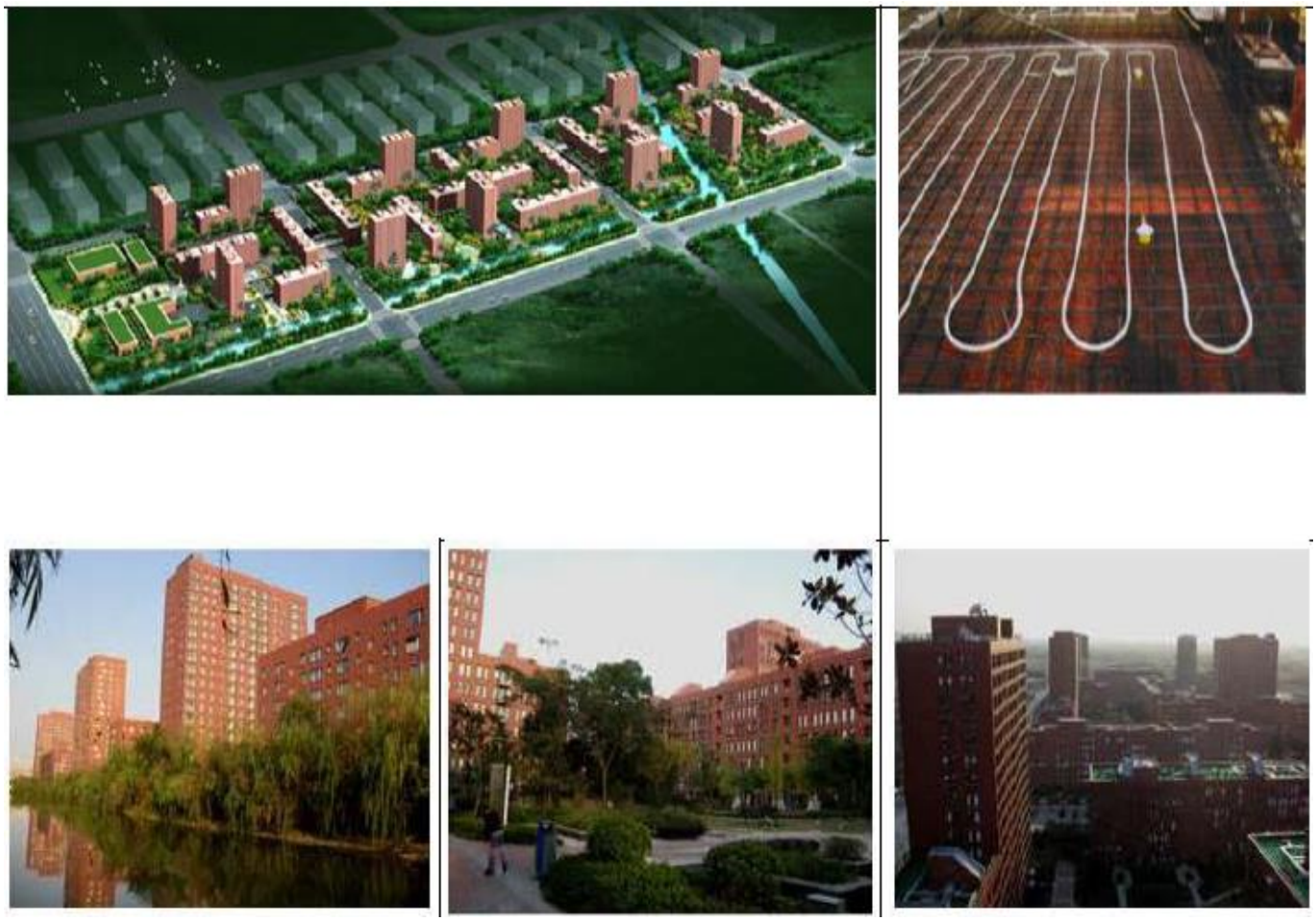

Fig. 10: photos of Landsea Housing [32]

5.3. Assessment of the Landsea Housing Project

As a real estate project, Landsea Housing directly responds to China's specific conditions, such as high density, improving standard of living, local climate, etc. The interior thermal comfort has been improved greatly compared with other normal apartments in Nanjing; though it is merely the same or even lower than that in developed countries. However, when the indoor comfort is being discussed in a developing country, the standard of living is considerably different and this must be taken into account. Good building envelope is the key factor in energy-efficiency. In hot-summer/cold-winter regions, it consists of good wall insulation, good windows, and exterior sun shading. From a Life Cycle Perspective, the additional investment on envelope could be paid back within a reasonable time. In the specific case of the Landsea Project, the residents get a high level of thermal comfort at a low additional cost. However, enormous energy is needed for buildings with a bad envelope if high indoor thermal comfort is to be achieved [33].

Since the Landsea Housing Project is a market-orientated project, measurable indicators and performance-based evaluation are essential to marketing success, as has been shown by its good sales. The technology implemented in the project is normal technology rather than fascinating high-tech equipment, which is sometimes very deceptive.

Generally, Landsea Housing is a commercial project and it is also market-orientated. In terms of Cost-Benefit Analysis of the building cost itself, Landsea is an affordable practice, improving thermal comfort greatly with a limited cost and it could be recognised as Green Building practice in this regard.

6. FROM ENERGY EFFICIENCY TO INTEGRATED SUSTAINABLE URBANISM

Sustainable urbanism assessment of a residential area, which is a complicated built unit, should include economic, social and environmental aspects. Environmental aspects are energy, water, waste, etc., as discussed above. It is obvious that all these aspects are related and thus the assessment must be integrated [31].

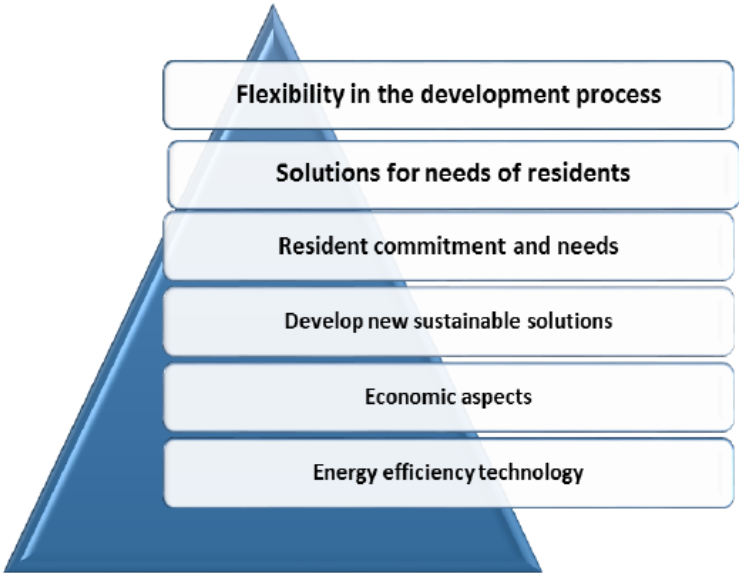

Fig. 11: The overall sustainability aspects for the development – researcher

The overall sustainability aspects for the development should include:

(1) Flexibility in the development process to change operating goals due to experiences and the assurance of new technology and knowledge.

(2) The solutions must be tailored to the needs of residents and promote social inclusion and environmental responsibility.

(3) Resident commitment and needs should be taken into account in order to influence the neighborhood design.

(4) The implementation should be used as leverage to develop new sustainable solutions for e.g. use of energy, natural resources, closing the loops for nutrients, reuse/recycling of waste and minimization of private transport needs.

(5) The solutions and measures used should not give increased costs that prevent the spread of experiences.

(6) The experience, know-how and technology generated in the development process should be disseminated in order to contribute to sustainable development elsewhere.

These operational objectives should be formulated in harmony with other national and local objectives. It is important to realize that there are no absolute goals for sustainability but specific goals for different sectors, e.g. energy, transport, waste, water and drainage, building materials, land use, etc., should be developed.

6.1. How Do Energy Efficiency Make Cities Sustainable

Growing urbanization can be a plus for the environment, because people who live in dense cities drive less, their living spaces use less energy, and they require fewer resources. However, there are also troubling trends, like increased traffic congestion, smog, and blight. Beijing's per-capita greenhouse gas emissions are higher than China's national average, and many U.S. cities are surrounded by suburbs with large carbon footprints. It will be important to pay attention to how we build cities, if we want metropolitan areas that make the planet a better place. [34] Hers som of ideas in order to make cities more livable and sustainable in their use of energy:

(1) Improve mass transit

Around the world, urban commuters spend hours each year stuck in traffic congestion, burning through gasoline just idling in road jams. Use of public transit is increasing in some places, but not at the pace most experts say is needed. Roadway occupancy levels could increase sixfold in some countries, according to the International Energy Agency (IEA).Would better mass transit systems get more commuters off the road.

(2) Make buildings more efficient

In the developed world, fully 40 percent of carbon dioxide emissions come from heating, cooling, and powering buildings. Many countries have embarked on major efforts to better insulate buildings and install more modern and efficient heating and ventilation equipment. Energy savings could reach 30 percent or more. Should cities invest in major weatherization and energy upgrade efforts?

(3) Preservation of historic and natural assets

Part of what makes each city unique is its architecture. Preserving buildings, and the history and culture they embody, is often difficult for cities as they face the pressure of growing population and changing economic demands. Natural assets, like waterways, parkland, and wetlands, also are a key factor in making cities livable. How important is it to integrate preservation into city planning?

(4) Boost clean energy

The electricity plants that power the world's cities are often out of sight and out of mind. However, some municipalities are taking steps to reduce their reliance on power transmitted from distant generating stations. Cities are integrating solar energy onto rooftops, capturing and recycling waste heat, and purchasing wind power. Switching from coal to natural gas also can cut carbon emissions and other pollutants.

(5) Upgrade power infrastructure

As New York City learned during Hurricane Sandy, aging energy delivery systems in many cities need to be upgraded to handle increased weather and flooding risks as well as growing population. Cities will need smarter and more resilient electricity and fuel delivery systems to provide basic human services, and for communities to grow and thrive into the next century.

7. CONCLUSION AND RECOMMENDATIONS

Energy efficiency is the first step toward achieving sustainability in buildings and organizations. Energy efficiency helps control rising energy costs, reduce environmental footprints, and increase the value and competitiveness of buildings.

The building industry is an important component in achieving environmental sustainability because it contributes more than one-third of total energy consumption and it has great potential to decrease environmental impact. However, due to the involvement of many stakeholders and participants compared with other industries, technical innovation in this area is rather slow.

China has great variation in terms of geography, climate, vernacular building and life style. Green Building is essential for China's sustainability strategy and it should have its own character based on the uniqueness of the country. The current legislative framework for green residential building development in China mainly focuses on energy-efficiency and neglects the issues of energy supply, pollution and resources. China is thus still on a lower level of Green Building development where the understanding of the concept is very limited and needs to be expanded in the physical and temporal domain.

Technically, the Landsea Project achieved a high level of energy-efficiency, but neglected other environmental issues. However, the Landsea Project used Green Building as a market lever, and focused on energy-efficiency to meet the market demand for high thermal comfort and to maximize profits. This ultimately hampered Green Residential Development. Furthermore, the distinct roles of different stakeholders were not clear and no platform for collaboration was built.

The answer to the question (When does energy efficiency lead to sustainability?)Is including three aspects:

(a) When it leads to reduced demand, emissions and costs.

(b) This can happen, but only in certain circumstances.

(c) To ensure it does happen requires an integrated and informed approach to the various systems issues.

It is vitally important for our cities and towns to function efficiently and to lower the use of scarce natural resources, to achieve a sustainable quality of life for citizens now and into the future. To this end, the EU has adopted a number of key policies and initiatives aimed at decoupling economic and social development from consumption of resources: [35]

1-Resource efficiency

Resource efficiency is also one of the themes of the Thematic Strategy on the Prevention and Recycling of Waste, which requires drawing up waste prevention programs. Cities offer an opportunity to manage our use of resources better, use them efficiently and cut down on waste and pollution. For example, studies have found that per capita consumption of resources such as energy tends to be lower in urban areas, because of efficiencies achievable in areas with higher population densities. However, there are considerable differences between cities in terms of performance, and there is room for improvement in all cities.

2-Energy efficiency

Green buildings that require less energy for lighting, heating and cooling through clever use of suitable materials and innovative airflow systems, are an important component of the effort to achieve efficient and sustainable cities.

3- Green mobility

Efficient urban transport is fundamental to citizens' quality of life and to economic development. Yet our current reliance on the internal combustion engine is a major source of air and noise pollution and negative impacts on health and the environment.

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