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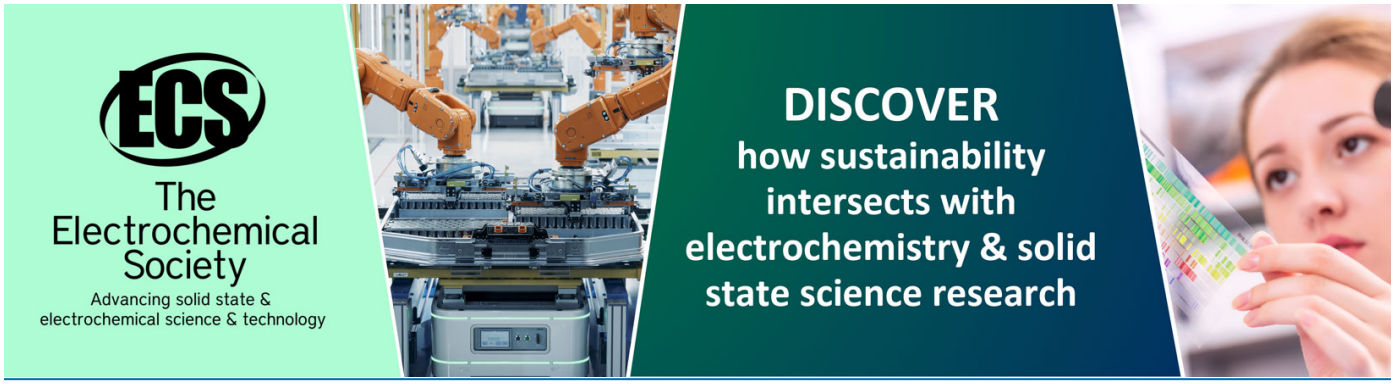

Study on optimization of low carbon renewal system for residential area

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Abstract. Global climate change has been an impending cosmopolitan issue. As the basic part of the city, urban residential area is the basic space for the use of sustainable ideas to promote the construction of low carbon city. Along with urban expansion, social polarization and significant change of social space in China, the decline tendency of central city become significantly faster. Faced with the double test between climate change and residential area recession, traditional renewal methods no longer meet the needs of urban sustainable development. The urban renewal modes need a major transformation, and Low carbon renewal is an effective way not only to slow down the decline of residential areas but also promote sustainable development of the city. To put forward an analysis and optimization methods for low carbon renewal, we proposed a low carbon renewal system from six aspects: layout planning, road and traffic, architecture planning and design, environment engineering, municipal engineering and construction management. Moreover, we used Analytic Network Process (ANP) to analyse the internal feedback of the system. At last, the optimization process of residential low carbon renewal was proposed.

1. Introduction

In the 21st century, the trends of global climate change increasingly evident [1]. Climate change has become an issue of common interest 2013 in Warsaw, Poland, the United Nations Climate Change Conference by the global natural and social scientists [2]. The conference released its fifth climate change assessment report which pointed out that since the 1950s, more than half of global warming is caused by human activities [3,4]. Figure 1 is a nearly 150-year change in average global temperature. We can see the trend of global climate warming, and this trend is more and more obvious [5,6].

Researches have shown that industry, construction, and transportation are the three main energy consumers in urban development [7]. For the scientific development of low carbon urban development and low carbon urban construction planning decisions, the government of some developed countries has tried a lot to explore and promote the development of low carbon urban settlements and has concluded many successful experiences. In the United States, low carbon settlements has become one of the most important development strategy of the state government; in Japan, to cope with the adverse effects of climate change brought to the country, adopted a series of measures and actions; in our country, in order to promote the development of low carbon living areas more effectively, "China's agenda 21" has stressed that the promotion of sustainable low carbon settlements is an important goal of urban development and made it clear of that "near-zero carbon emission zone" to be a demonstration project [8,9]. Faced with the double test between climate change and residential area

recession, traditional renewal methods no longer meet the needs of urban sustainable development. The urban renewal modes need a major transformation, and Low carbon renewal is an effective way not only to slow down the decline of residential areas but also promote sustainable development of the city [10,11]. To put forward an analysis and optimization methods for low carbon renewal, we proposed a low carbon renewal system from six aspects and used Analytic Network Process (ANP) to analyze the internal feedback of the system and proposed the optimization process of residential low carbon renewal.

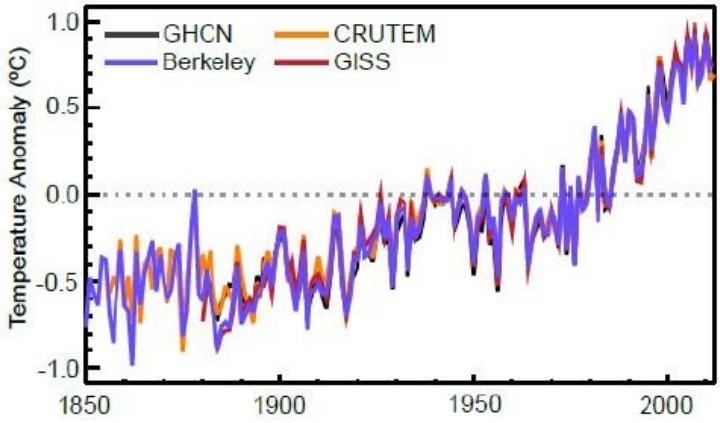

Figure 1. The average global temperature change.

2. The analysis of residential area low carbon renewal element

2.1. Residential low carbon planning

- Low carbon living area location

Low carbon residential should follow the principle of comfortable, convenience and employment; consider the full impact of micro-climate of the settlements energy consumption and carbon emissions; avoid staying too far from the main functional areas; prevent the formation of "sleeping city" or "lying city" phenomenon; reduce transportation energy waste, air pollution and traffic emissions.

- Planning and layout of low carbon land

Focus on land-use functions and mixed diversity, promotion the living area features with mixed land use patterns; make full use of underground space with the construction of three-dimensional space to encourage residential development; promote low carbon development through conservation land and increase the connectivity between underground garages and achieve resource sharing.

- Low carbon master plan layout

To build moderately compact living area space and rational distribution the population, construction, transportation, environment and facilities with the formation of ecological low carbon living area groups and provide technical guidance for the transformation of consumption patterns to form a low carbon and low carbon life.

2.2. Residential low carbon architecture design

- Residential low carbon architecture design

Take overall consideration of the surrounding environment settlements, road network construction, public buildings and residential layouts groups combined, the intrinsic link green space systems and space environment for building land moderately densely arranged to constitute a perfect, compact and relatively independent organic. In accordance with the geographical area where the climatic conditions, combined with the building's energy efficiency and ventilation requirements, using optimum orientation to ensure there is enough sunshine in winter and summer to avoid excessive sunshine.

- The main design of low carbon buildings

The building design should be carried out according to the surrounding environment, site conditions and building layout, consider the factors such as sunlight, natural lighting and natural ventilation inside and outside the site to determine the appropriate building shape. On the selection of building materials, local materials should be adapted and make full utilization of local resources, building materials, construction and the supply of building materials should be nearby.

- Low carbon energy equipment system

Take full use of intelligent building technology, setting building ventilation, air conditioning, lighting and other equipment automatic control system; using the implementation of intelligent building log and a sub-room temperature control; household metering charging system should be provided with embodiments household energy consumption metering.

2.3. Residential low carbon road traffic

- Low carbon road network system

The roads in the residential areas shall be divided into three types: sidewalks, non-motor vehicle lanes and motor vehicle lanes. Independent and consistent dedicated bicycle lanes shall be set up to form functional mixed, suitable, safe, and convenient walking spaces, and main roads should be avoided from introducing and transiting traffic.

- Low carbon transportation system.

The establishment of land use and population structure of the layout to match the efficient and convenient, peaceful and comfortable, convenient transfer of settlements external transport system; internal road traffic settlements should give priority to pedestrian and bicycle traffic principles; establish and improve the people-oriented slow traffic system.

2.4. Residential low carbon environment project

- Residential low carbon water environment planning

Residential low carbon water environment planning includes water-saving planning and residential low carbon water system planning. Water-saving planning should reflect comprehensive water-saving from the planning, design, construction and construction of residential quarters to operational management. Residential low carbon water system planning should achieve intensive use of natural water systems and residential living area of water resources.

- Green landscape design

Residential green layout should be rational arrangement of green spaces, green space to meet the requirements of the relevant indicators and to increase the green area settlements. Plant configuration should adhere to the principle of local conditions to achieve plant communities to live in harmony and beautiful area, and play a shade, reducing energy consumption effect. Green landscape maintenance management mainly refers to the use of low carbon management and reduce carbon emissions.

2.5. Residential low carbon municipal project

- Low carbon water supply project

Water supply project should meet the general requirements of water conservation to reflect a virtuous cycle of sustainable use of resources and ecological environment and realize the rational allocation and efficient use of water resources.

- Low carbon drainage project

Low carbon drainage project should mainly be analysed from the perspective of rain and sewage diversion, low-impact development technology, and rainwater utilization systems. Through rain and sewage diversion to improve environmental quality and management level, and to improve the living environment and quality of life.

- Low carbon energy system

Energy systems should make full use of renewable and clean energy. Encourage the use of new energy sources, combined with elements of local weather conditions and resource distribution, reasonable construction of solar, geothermal, biomass and other new energy system.

2.6. Residential low carbon construction management

- Preparation and implementation of low carbon planning

The preparation and implementation of the plan encourage the active participation of society, residences and residents, widely solicit the opinions of experts, and residents. The planning and preparation shall implement the system of quality assurance responsibility.

- Residential energy-saving management

Establish a sound residential low carbon operation management system, including water-saving management, material-saving management, energy-saving emission reduction management, afforestation management, waste management, intelligent management and low carbon behavior management, etc.

- Residential greening management

Set up a complete vegetation planting process and later-stage greening management system. To strengthen residents' environmental awareness, conduct low carbon guides on residents' lives, consumption, and work methods, and transform residents' daily behaviors. To reduce residential carbon emissions and encourage residents to participate in low carbon construction and management.

3. Optimization analysis of residential low carbon renewal system

3.1. Division of subsystems

According to the above analysis, the low carbon renewal systems correspond to six subsystems, which including low carbon layout, low carbon construction, low carbon transportation, low carbon environment, low carbon and low carbon management and the low carbon elements of each subsystems are shown in table 1.

Table 1. Low carbon elements in residential areas.

system	subsystem	low carbon elements
Low carbon settlement	Low carbon overall layout	Site selection of low carbon house(pre-selection survey, native landscape retention); overall layout(development density, layout of rural public buildings); land layout(land use balance, land-saving measures)
	Low carbon building design	Architecture layout(building orientation, building interval); form and structure(energy saving design, selection of building materials); energy and equipment.(use of passive energy saving technology, energy level, indoor temperature set, use of intelligent technologies)
	Low carbon road traffic	Road network system(use of low-carbon materials, density of road network, road classification and grading, selection of waterproof materials); traffic system(energy utilization in traffic system, convenience of travel)
	Low carbon ecological environment	Water environment(water-saving equipment utilization, water circulation use); greening system(green belt layout, plant disposition, greening management level, roof greening and vertical greening)
	Low carbon municipal engineering	Energy system(energy-saving management level, selection of low-carbon energy, effectiveness of power use); water supply system(use of circulating water, dual water supply)
	Low carbon construction management	Residential planning management, residential energy-saving management, residential greening management

3.2. Structure analysis

Following the basic concept of "controlling carbon sources and expanding carbon sinks", residential low carbon systems could be divided into two sub-systems: C sub-system mainly from the point of view of the carbon source and E sub-system mainly from the point of view of carbon sink. E and C sub-system include a plurality of subsystems and each subsystem has a lower number of factors: C sub-system includes a lower mainly from the "living area carbon control"; E sub-system is evaluated mainly from the "sinks settlements extended".

Through the analysis of the correlation between low carbon factors, the low carbon factors affect each other while the low carbon factors contained in the C and E sub-systems have little influence, so we use Analytic Network Process (ANP) to analyse the structure of each system [11]. Network Analytical Method is a practical decision-making method applicable to non-independent feedback systems based on Analytic Hierarchy Process (AHP) in 1996 by American operational researcher TL Saaty. AHP/ANP are the most powerful synthesis methodologies for combining judgment and data to effectively rank options and predict outcomes. The Analytic Hierarchical Process (AHP) and the Analytic Network Process (ANP) make it possible to include intangibles in decision making. The Super Decisions is decision support software that implements the AHP and ANP. ANP considers the interrelationships between the element groups and the elements inside the element group, which could be an improved AHP. Due to the intricate relationship between low carbon factors in residential low carbon renewal systems, this paper applies network analysis (ANP) to build a low carbon network hierarchy and uses Super Decisions (SD) software to build the ANP structure model of C sub-system and E sub-system, as shown in figures 2 and 3.

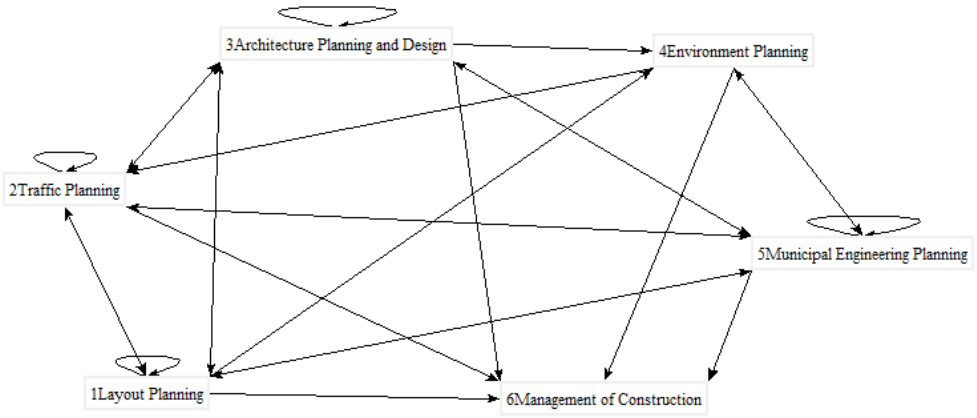

Figure 2. C sub-system ANP structure model.

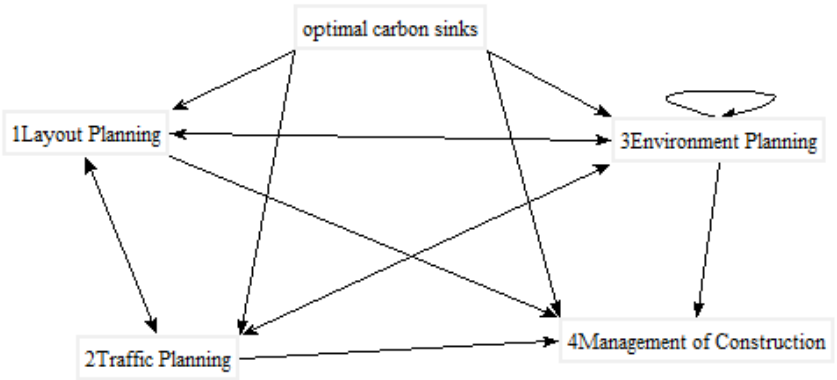

Figure 3. E sub-system ANP structure model.

3.3. The processes of system optimization

This paper presents the optimization processes of low carbon renewal system, including the following five processes: analysis of low carbon settlements system, exploration of low carbon potential, low carbon detection and diagnosis, low carbon analysis and optimization and low carbon feedback. Low carbon analysis and potential optimization belong to the pre-analysis, the results can be used as basis for diagnosis and optimization; feedback belong to optimize post-maintenance and the data of this stage can be used in the next stage. The foundation thus constitutes an optimized circulation system.

- Analysis of low carbon settlements system. Based on low carbon renewal system above, we could design an indicator system to evaluate the low carbon degree of indicators which associated with these elements.
- Exploration of low carbon potential. According to the results of low carbon settlements system analysis, the actual score of the low carbon factor could be obtained. Through the relative scores generated from the comparative analysis, the perspectives of low carbon potential (non-low carbon symptoms) with low carbon potential were explored to achieve targeted low carbon optimization.
- Low carbon detection and diagnosis. To find the low carbon factors associated with non-low carbon symptoms and analyse the characteristics of low carbon factors. Low carbon diagnosis can begin after the symptoms associated with a non-low carbon symptom detected.
- Low carbon analysis and optimization. Low carbon optimization could be developed according to the results of low carbon detection and diagnosis.
- Low carbon feedback. To obtain the effect of low carbon renewal after the appropriate optimization measures and to do comparative analysis.

4. Conclusion

In this paper, we put forward the analysis and optimization methods for low carbon renewal and proposed low carbon renewal technologies from six aspects. Moreover, we built an optimization analysis of residential low carbon renewal system from the perspective of “carbon source control” and “carbon sinks expansion” and used ANP combined with SD software to analyse the internal feedback of the system. At last, the optimization process of residential low carbon renewal was proposed. The aim of this study is to further explain the renewal system of low carbon residential area.

Acknowledgments

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