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Original Research Paper

Simulation of Carbon Emission Scenario for New Town Based on Spatial Quantitative Analysis: A Case Study of Xishan Low Carbon Demonstration Region, China

Luyun Liu*†, Bohong Zheng and Jian Zheng*****
*School of Civil Engineering, Central South University, Changsha 410004, China
**School of Architecture and Art, Central South University, Changsha 410004, China
***School of Architecture, South China University of Technology, Guangzhou 510006, China
†Corresponding author: Luyun Liu

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ABSTRACT

New towns are the main source of CO_2 emissions. Stabilizing emissions of new towns have become an important issue due to rapid urbanization. In view of this, a System Dynamics model called the New Town CO_2 Emissions Model was developed to predict and assess the CO_2 emissions of spatial planning schemes. Based on the Xishan low carbon demonstration region, we proposed three schemes, which correspond to different land use dynamic variation simulation patterns for the targets of maximum economic benefit, minimum emissions and lower ecological impacts. In addition, we analysed the sensitivity of carbon emissions by changing the parameters of the model. The seven sets of parameters used, represent the seven different planning scenarios. Finally, we simulated the CO_2 dynamics data using the above model to compare the three schemes in terms of environmental impact, economic benefits and land use efficiency. The model can be used to predict and assess new town CO_2 emissions for all of China and may be applied to other developing countries.

INTRODUCTION

Cities are the main sources of CO_2 emissions. More than 80% of overall energy consumption and greenhouse gas (GHG) emissions take place in new town areas (Sunikka 2006). Therefore, stabilizing the emissions of new towns has become an important issue due to rapid urbanization. Cities are complex, self-organized dynamic systems with multiple dependent variables that all affect one another. The interactive effects of each variable should be considered systematically in the urban system model, considering related variables i.e., economic development, population growth, dweller trip mode and structure, dynamic land change and the corresponding changes of traffic currents. Therefore, to predict a new town's CO_2 emission trend, the complexity of each system and their interactions must be considered.

A number of studies were conducted for spatial quantitative analysis and the associated carbon emissions at the city level. The classical energy modelling and carbon emissions predicting methods can be categorized as follows: the index factor decomposition method (Kaya Yoichi 1989), the scenario analysis approach (IEA), the system dynamic model (Akimoto et al. 2008,Vera & Langlois 2007, Liu et al. 2009, Cai et al. 2009a, Feng 2013), the comprehensive scenario analysis and system dynamic analysis method (Wee-Kean Fong 2006,2007,2009, Qing Zhu 2011, Zheng & Liu 2013, Feng 2012), the energy and environmental prediction (EEP) model (Lu 2010, Phdungsilp 2010, Lin 2010) and the integrated modelling approach (Mirasgedis 2007, Turton 2008, Bohringer & Rutherford 2009). The classical energy models and carbon emission prediction methods, when applied to the previous studies by the present authors, seem difficult to apply to urban planning. Basically, there are three major problems: first, in China, the energy department statistics are mainly composed at the national level or provincial level; thus, energy statistics from cities is completely absent. The application of quantitative models mainly includes the regional scale. A low-carbon index is very difficult to fulfil in meso-scale spatial planning in wide range views. Second, the traditional energy models applied to the previous studies usually take the urban built-up area or already formed town spaces as research objects. To be more precise, low-carbon policy hysteresis was very serious when the model was used to re-audit or re-assess the carbon emission trends. The model could not match the reality of countries with rapid urbanization; thus, the related research achievements cannot completely refer to the new town spatial planning. Third, there is almost no prediction model for carbon emissions from the spatial view of a new town. The settings of systematic emission factors in energy quantita-

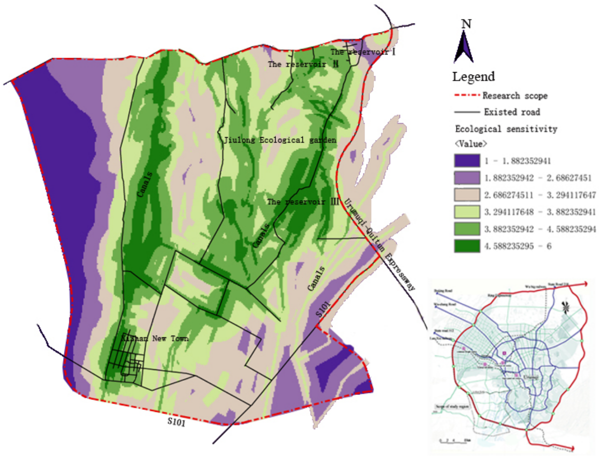

Fig. 1: Location and ecological conditions of Xishan demonstration region.

tive models are limited to separate scopes of economy, environment and energy consumption, for which the technique parameters are difficult to reflect the properties of the town space, making the model difficult to apply to town and country planning.

In view of the above, the present authors developed a new town CO_2 emissions model based on system dynamics simulation software to predict a new town's carbon emissions and its future spatio-temporal dynamic tendency under different planning policies and purpose orientations. The carbon emissions become a constraint index for intermediate or long-term planning of the town's sustainable development. More importantly, this theoretical model can be an initial reference for estimating and predicting the carbon emissions in a new city.

STUDY AREA AND METHODS

Overview of the study area: The Xishan low-carbon demonstration region (Xishan-DR) of Urumqi is located to the west of the Urumqi-Kuitun expressway, north of the national road 216 and provincial road 101, south of Xishan road and closely connected to downtown, which belongs to the former Xinjiang production and construction corps 12 division. The region covers an area of approximately 148 km^2, approximately one-sixth of the developed area of Urumqi. Xishan-DR was chosen as the case study region due to its good ecological resources, environment and abundant ecological diversity. Because it is located on the middle of the diluvial plain of the Urumqi River and the Toutun River, the mountain inclined plain, downstream of the Xingfu-canal and the Young-canal water resource protected area, happens to have the number one and two reservoirs and 104 regiment number 3 reservoirs in this district (Fig. 1). Recently, with the promotion of western development strategies, the speeding up of industrialization and modernization is facing increasingly intensified resource and environmental limitations. The development of regional economic systems and ecological environment systems is an evil coupling tendency.

Concept of system dynamics: System dynamics is a branch of system science and management science that has been widely used in many fields such as social economics, ecology, environmental management and policy, sustainable development and environment, traffic and energy. Applying this field in urban planning was initiated by Forrester (1969) of the MIT Sloan School of Management, who established the MIT System Dynamics Group. Among his recent works, the two most well-known are the Urban Dynamic Model by J.W. Forrester and the World3 Model by Meadows et al. (2004). Moreover, the research for estimating and predicting city level energy consumption and CO_2 emission trends mainly includes the FML Dynamics Model developed by Wee-Kean Fong (2009) with particular focus on Malaysia, the Energy Backcasting Model developed by Gomi et al. (2010 and 2011) using a quantitative estimation tool called EXSS (Extended Snapshot) to organize a system of various LCS activities and estimate their detailed implementation toward a given target year, and the Beijing-STELLA Model developed by Feng et al. (2013) using the STELLA® platform to simulate the energy consumption and CO_2 emission trends for Beijing in the period of 2005-2030.

New town CO_2 emissions model: The purpose of this study is to develop a simulation model based on system dynamics-the New Town CO_2 Emissions Model, that can be used to predict and assess a new town's carbon emission level and can further discuss the relationship of economic development, land expansion, land use, environmental effects and carbon emissions with different spatial planning schemes and provide a virtual management platform for predicting energy requirements and CO_2 emissions for the new town in long-term development. The model refers to the Xishan low-carbon demonstration region in Urumqi that covers an area of approximately 148 km^2 from 2012 to 2030, corresponding with the master planning target year. In light of the research purpose and available data, the model basically consists of five sub-models, namely buildings (residential and public buildings), commercial and service, industrial, transportation and carbon sequestration sub-models, as a result of flows from the green space. The stock-flow diagram for the spatial quantitative carbon emission model is shown in Fig. 2.

The building sub-model: For the building sub-model, the CO_2 emissions, mainly stem from the civil buildings, including residential buildings, large scale public buildings, me-

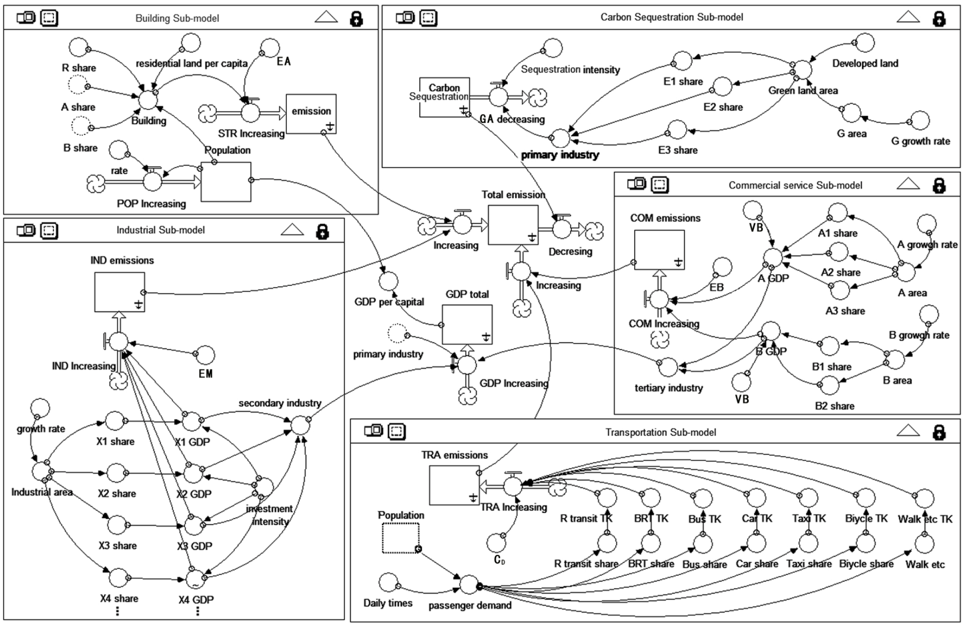

Fig. 2: The overview of the stock-flow diagram for the new town CO_2emissions model.

dium-sized public buildings and office buildings. For residential buildings, the energy consumption, caused by cooking, air conditioners, heating and household appliances, increased continuously with the population growth. It was assumed that the energy consumption was mainly affected by four major factors: population, residential land per capital, land use intensity and energy consumption per unit area of floor. For the other civil buildings, the energy consumption was mainly affected by three factors: the ratio of auxiliary land, land use intensity and energy consumption per unit of floor area.

In this study, the population depends on the growth rate, which is a result of both, the naturally increasing rate and continued migration rate. The index of residential land per capita is related to climatic zoning. The study scope is located in zone VII. Based on "Construction land urban land classification and planning standards" (GB50137-2011, in China), the index can value between 28-38 m^2 per capita in II, VI, and VII climatic zones. For the intensity parameter of each land use, we can take the value between the upper and lower range of "The technical regulations of Urumqi urban planning management" and "China's low-carbon eco-city development strategy-China's green building development strategy research." Moreover, the energy consumption per unit of floor area is composed of heating energy consumption and everything other than heating energy; the latter refers to cold region building energy consumption per area, while the former can be considered as 35% cogeneration district heating, 35% central heating boiler and 30% decentralized heating. The average consumption can be transferred to standard coal, using 14 kg × 0.35 + 24 × 0.35 + 22 × 0.3=20 kg-ce(m^2.a). The basic equation for CO_2 emissions by building sector is as follows:

$$F_{Str} = F_{Str1} + F_{Str2} = \sum (EA_1 + EA_2) \times A_i \times FAR_i \times K \quad ...(1)$$

Where F_{str1} is everything other than the heating energy consumption; F_{str2} is the heating energy consumption; *EA* is the energy consumption per unit of floor area; *A* is the land area, *i* is the area of the land-use type, i.e., R1, R2, B1, B2, B3, A1, A2, A3 and A4; *FAR* is the floor area ratio; and *K* is the conversion coefficient.

Industrial and commercial service sub-models: Carbon emission calculations of industrial and commercial service sectors are very similar; they were estimated based on two main factors, the GDP values of the industrial and commercial sectors and the energy consumption per unit of GDP (energy intensity). The former depends on the land areas of land-use dynamic simulation map by planning, and the latter is related to the input-output ratio of land. Energy intensity can refer to the historical statistic data and existing conditions analysis, economic development, scientific and technological progress, and technique innovation. The model of the industrial sector can be expressed as eq. 2, and the model of the commercial service sector can be expressed as eq. 3.

$$F_{Ind} = M_i \times VM_i \times EM_i \times K \quad ...(2)$$

Where *M* is the land area of the industrial land, *i* is the area

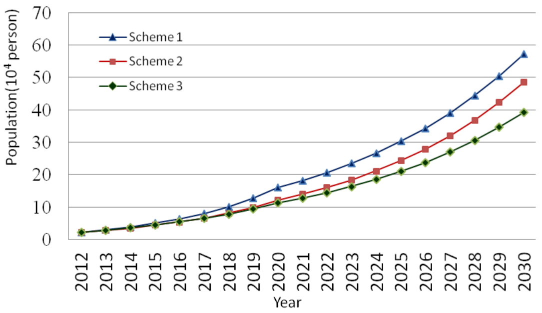

Fig. 3: Population growth tendency chart from 2012 to 2030.

of the land-use type, i.e., M1, M2 and M3; *VM* is the GDP value per unit of land area; *EM* is the energy consumption per unit of GDP; and *K* is the conversion coefficient.

$$F_{Com} = B_i \times VB_i \times EB_i \times K \qquad ...(3)$$

Where *B* is the land area of commercial service land, *i* is the area of the land-use type, i.e., A1, A2, B1, B2…; *VB* is the GDP value per unit of land area; *EB* is the energy consumption per unit of GDP; and *K* is the conversion coefficient.

Transportation sub-model: Carbon emissions in the transportation sector are primarily affected by daily transport demand, traffic modes and traffic structures, traffic turnover and CO_2 emissions per unit of distance. The daily transport demand is the product of the population and the average daily travel per person. According to the resident travel survey data of Urumqi in 2012, the average daily travel is 2.4 times/day, and the value increased to 2.6-2.8 times/day in 2013 based on the prediction. Moreover, the population density is reflected by the effect of traffic modes and traffic structures on the urban land layout and land use intensity. For different city scales and population densities, the corresponding traffic mode needs to run. Moreover, traffic turnover is related to the residents' travel distance; the longer the distance, the larger the traffic turnover. The CO_2 emission standards of every vehicle are adapted from the regulation of sustainable human settlements. The model of the transportation sector can be expressed as follows:

$$F_{Tra} = \sum\left[(V_{total} \times V_i) \times D_i \times C_{Di}\right]_{Rail,BRT,Bus,Car,Taxi,Motor...} \qquad ...(4)$$

Where V_{total} is the total daily transport demand; *V* is the share of the total daily transport demand; *D* is the daily travel distance; C_D is the carbon emissions per unit of distance travelled; and *i* is the vehicles, i.e., rail, BRT, bus, car, taxi, motor, etc.

Carbon sequestration sub-model: Carbon sequestration represents the flows from the atmosphere to the biosphere. There are many methods we can use for carbon sequestration according to the availability of data and specific measurement accuracy requirements. In the master planning stage, we use the methodology used in estimating carbon sequestration related to the green land space. The factors are divided into two main parts: the area of the carbon stock land, including, water, arable land, garden land, woodland, grassland, public parks, protective greenbelts and other green space, and carbon sequestration per unit of green land. The model of carbon sequestration can be expressed as follows:

$$F_{Ga} = \sum(G_{total} \times S_i) \times \Phi_i \qquad ...(5)$$

Where G_{total} is the total area of green land; *S* is the share of area to total green land area; *i* represents water, arable land, garden land, woodland, grassland, public parks, protective greenbelts and other green space; Φ_i is the coefficient of carbon sequestration per unit of green land.

SPATIAL PLANNING SCHEMES AND SCENARIO SETTINGS

Based on the three qualitative planning targets, high economic benefits, low carbon emission and minimizing environmental impact, this study proposed land use dynamic variation simulation process of three different spatial planning schemes from the two dimensions of time and space (Fig. 4.). The comparative description of the development characteristics of the three schemes can be seen in Table 1. Specifically, the population capacity, economic growth and economic structure should be decided by a monographic study of master planning as an important aspect. Under different policy guidance, the population prediction trends from 2012 to 2030 by the three schemes is shown in Fig. 3, while the economic structure tendency diagram is shown in Fig. 5.

In the new town CO_2 emissions model, we can make efforts from seven different aspects to reduce emissions: guid-

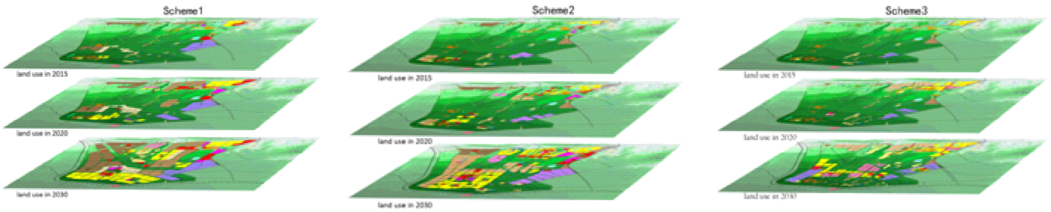

Fig. 4: Land use dynamic variation simulation map from 2012 to 2030.

Table 1: Comparison of the three schemes by qualitative descriptions.

Qualitative factors	Scheme 1	Scheme 2	Scheme 3
Purpose of the master planning orientation	High economic benefits: tending to the priority of economic development	Low carbon emission: economic and environmental factors are equally important	Low ecological impact: minimize environmental impact
Population capacity (POP)	571,900 people Policy: promoting rural labor transfers to the town	485,700 people Policy: reasonably guiding rural labor transfer to the town	391,800 people Policy: strictly controlling the city population increases
GDP growth	High speed growth	Medium speed growth	Low speed growth
Industrial planning	Manufacturing and modern warehousing logistics industry	Equipment manufacturing, electronic information industry, cultural creative industry	Countryside agriculture, travel and leisure, high-end real estate
Industrial structure	The second industry leads the economic development	Balance development of the second and third industries, in which the second industry is supposed to play the major role	Balanced development of the second and third industries, while the primary industry plays the major role
Green land space	Promoting green land transfers to urban construction land	Properly controlling construction	Strictly protecting the green space

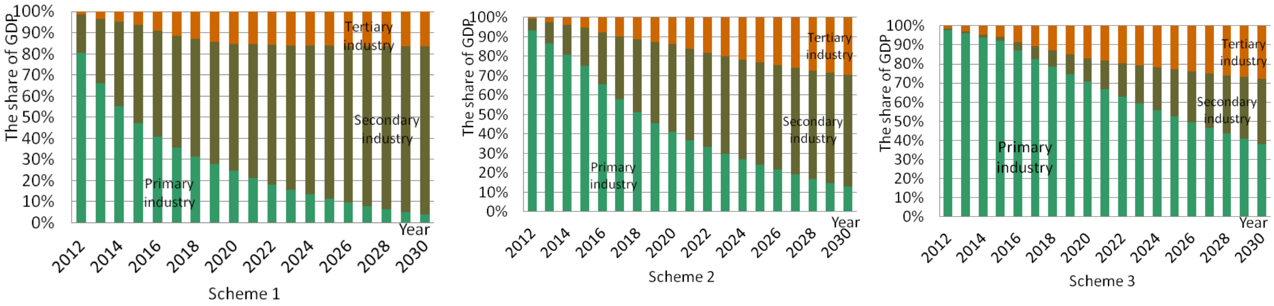

Fig. 5: Economic structure development tendency of the three schemes from 2012 to 2030.

ing the employment transfer to the town, intensive use of land, controlling the land intensity, building energy efficiency, improving investment intensity, controlling energy intensity and optimizing traffic structures. Each aspect also contains many sub-factors, such as controlling the land intensity by controlling the higher of FAR and building density and fulfilling building energy efficiency by increasing the ratio of energy efficient buildings and decreasing building energy intensity. The details of the scenario settings are presented in Table 2.

RESULTS AND DISCUSSION

Comparison and Analysis for the Basic Scenario

Total emissions and carbon intensity: Under the basic scenario, the total emissions and carbon intensity of three different spatial schemes are shown in Fig. 6 in terms of tendency with time change. From the results, the total carbon emissions of the three schemes are linearly increasing, and they are 115.11 Mt-CO_2, 39.14 Mt-CO_2 and 10.14 Mt-CO_2 by the end year of the master plan. Specifically, considering the tendency of carbon intensity, scheme 1 will escalate straight up for the near term (2015) and then gradually increase stepwise. For scheme 2, it increases slowly before the medium term (2020) and then keeps stable after that, which means that the carbon intensity also does not change after 2020. For scheme 3, it rises smoothly in the whole planning period. However, for the absolute value of the carbon intensity, they are 11.63 t-$CO_2/10^4$ CNY, 5.73 t-$CO_2/10^4$ CNY and 2.84 t-$CO_2/10^4$ CNY for the three schemes by the end of the master plan (2030). From this point of view, scheme 1 has a relatively higher index for both total emissions and carbon intensity, while scheme 3 has a relatively lower index. Moreover, scheme 2 has a more stable carbon intensity compared to scheme 3; although it has larger total emissions, it is more suitable for the low-carbon economy policy.

GDP values and the efficiency of land use: Three basic scenarios represent the economic structure of the different industrial levels. To be more precise, scheme 1 is the extensive economy led by industries. Scheme 2 adopts a parallel development of secondary and tertiary industries and gradually transfers to more advanced economic structure. Last,

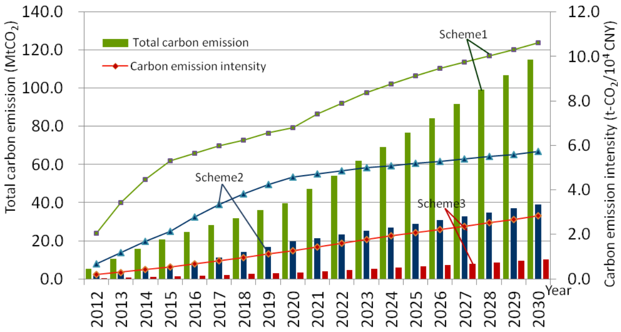

Fig. 6: Comparison the total carbon emission and carbon emission intensity of the three projects with time difference.

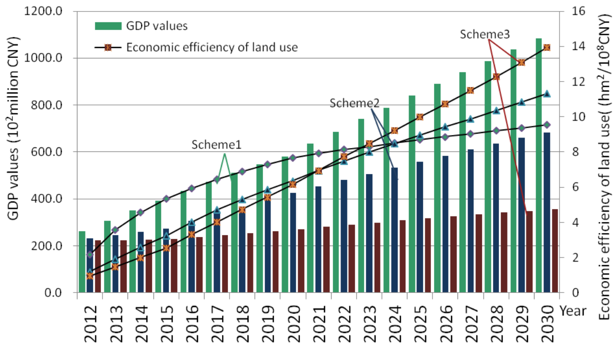

Fig. 7: GDP values and economic efficiency of land use tendency diagram of the three schemes from 2012-2030.

scheme 3 is mainly based on the primary industry. As the results in Fig. 7 shows, the GDP values and the economic efficiency of land use are simulated. It is clear that the total GDP values of the three schemes, all constantly kept increasing development. To be more exact, the slope of scheme 1 is relatively higher, while the slope of scheme 2 is almost zero, which means, the economic development is very slow. In the view of the economic efficiency of land use, which is the per unit GDP output need of non-building land into construction land areas, scheme 3 has an obvious straight up trend during the whole period. Scheme 1 has a higher initial point compared to the others before the near term (2015) and is still slightly higher than scheme 2 until 2020, which means low economic efficiency of land use. However, after 2020, scheme 1 has obvious advantages in terms of land efficiency, while scheme 2 is still rising.

Carbon emissions of sub-models: Fig. 8 shows the CO_2 simulation results for the sub-model of three different spatial schemes by the end of the master plans. The emissions of scheme 1 and scheme 2 are mainly from the industrial sector. In addition, for scheme 3, the commercial service and industrial sectors sub-model and the building sector's emissions also account for a certain proportion, while the traffic sector has the smallest contribution. Comparing the carbon emissions and carbon sequestration, the amount of carbon sequestration from green space only achieves one-thousandth of the carbon emissions, which means that the carbon sequestration is not enough to absorb the emissions from the carbon sources such as the building, commerce, industries and transportation sectors. Therefore, to develop a low-carbon town, we cannot only depend on the increasing green space to balance the flows from the biosphere to the atmosphere. To solve the problem, we can increase the ecological green space in a larger regional scale to balance the regional carbon flux and, to fulfill the goal of stabilizing carbon, we can control the emission sources.

Comparison Analysis of CO_2 Emissions for Policy Scenario

Among the above three spatial schemes, scheme 2 has obvious advantages with regard to carbon intensity, so we selected it as the basic scenario for the low-carbon policy scenario analysis (Fig. 9). In terms of total carbon emissions, scenario 1 and scenario 2 have the smallest effect on carbon emissions and the lowest sensitivity. Scenarios 3, 4 and 7 have relatively lower emission effects, while scenario 6 has the biggest influence on carbon emissions.

Specifically, by the end of the master plan, when the annual population growth rate decreases by 1% in scenario 1, the carbon emissions would decrease 0.47 Mt-CO_2 and the emission intensity would decrease 0.11 t-CO_2/10^4 CNY. When the average residential land per capita decreases by 10 m^2 in scenario 2, the carbon emissions only decrease 0.1 Mt-CO_2 and the emission intensity decreases 0.07 t-CO_2/10^4 CNY. For scenario 3, by controlling the two planning indexes, FAR and the building density, properly-reducing 0.5 % of residence's FAR and 5% of its building density and 1% of public facilities and public service land's FAR and 5% of its building density, the carbon emissions decrease by 1.53 Mt-CO_2 and the emission intensity decreases first and then rises again gradually. For scenario 4, by controlling the ratio of energy efficient buildings, which means that the ratio of energy efficient buildings in newly built buildings is over 50% and reducing energy consumption intensity of sources other than heating and the heating energy consumption intensity by 30% and 50%, respectively, the carbon emissions decreased by 0.52 Mt-CO_2 and the carbon intensity decreased by 0.08 t-CO_2/10^4 CNY. In scenario 5, when the investment intensity of commercial service, industry and primary industry increased by 10%, 15% and 5%, respectively, although the carbon emissions increased by 8.55 Mt-CO_2, the carbon intensity decreased to 0.47 t-CO_2/10^4 CNY.

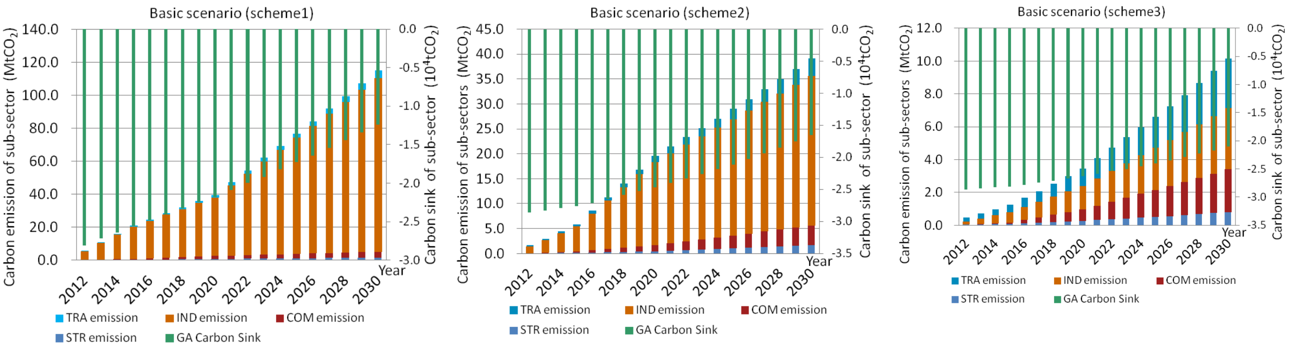

Fig. 8: Carbon emissions of sub-models.

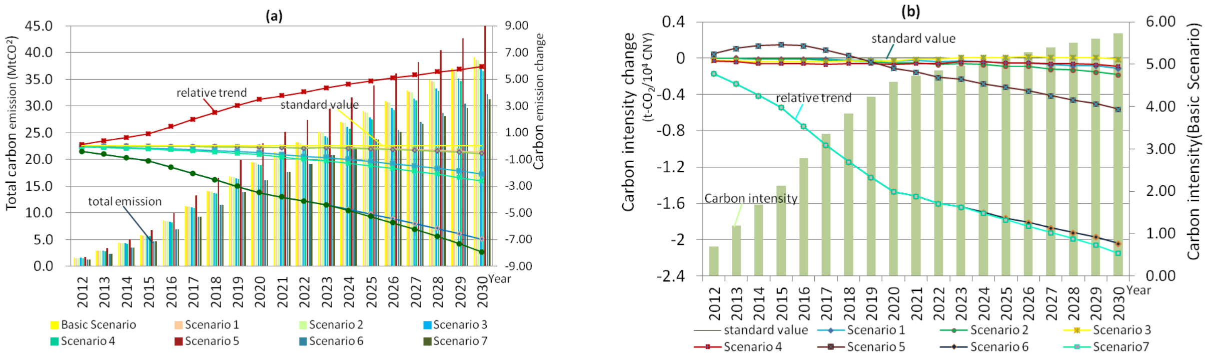

Fig. 9: Total emissions (a) and carbon intensity (b) variation for policy scenario.

In addition, for scenario 6, when the carbon intensity of the commercial service and primary industry were reduced by 10% and 5%, respectively, and the energy consumption intensity of equipment manufacturing (X_1), the electronic information industry (X_2), the cultural creative industry (X_3), and the modern warehousing logistics industry (X_4) were reduced to 0.5 t-ce/10^4 CNY•a, 5.0 t-ce/10^4 CNY•a, 0.5 t-ce/10^4 CNY•a and 2.0 t-ce/10^4 CNY•a, respectively, both carbon emissions and carbon intensity very obviously decreased, reaching 12.91 Mt-CO_2 and 1.48 t-CO_2/10^4 CNY. Finally, scheme 2 has a population of 473,200 people, which is suitable for choosing the traffic pattern led by BRT. In this case, scenario 7 optimized the current traffic structure (when the population reaches 150,000, under the basic scenario, the share of BRT travel will increase by 10%, the share of car and taxi travel will decrease by 4% and 6%, respectively; when population reaches 300,000, the share of bus travel will decrease by 5% again, while the share of BRT travel increases by 5%), the carbon emissions and carbon intensity decrease to 0.95 Mt-CO_2 and 0.11 t-CO_2/10^4 CNY, respectively.

CONCLUSIONS

Based on systematic thinking of the methodology, this study developed a System Dynamics Simulation Model for new town CO_2 emissions. Using the model, the objectives of the study were to dynamically predict and assess the CO_2 emissions and to subsequently quantitatively evaluate the pros and cons of a new town's spatial planning from environmental, economic benefits and land use efficiency aspects. This study took the Xishan low carbon demonstration region as a case study. The purpose of this work was also to understand the driving forces and key factors of a new town's carbon emissions by setting different policy scenarios and planning scenarios based on the optimal scheme and to guide the direction of the future according to its priority in stabilizing CO_2 emissions. The study found that the population growth rate, economic growth rate and economic structure are the significant factors in minimizing CO_2 emissions. In addition, land index per capita, land use intensity, building energy efficiency and traffic improvement must be taken into consideration because they can reduce carbon emissions. Most of all, the investment intensity and the emission intensity are the key factors that should be included in a long-term emission reduction policy.

ACKNOWLEDGEMENTS

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Table 2: Details of the scenario settings.

Numbers	Policy	Variables	Units	Basic scenarios	Measures
Scenario 1	Guiding the reasonable employment transfers	Annual population growth rate	%	Scheme 2	Gradually reduce 1
Scenario 2	Intensive use of land	Residential land per capita	m^2 per capita	38	28
Scenario 3	Controlling land use intensity	FAR		R1 (≤0.8), R2 (≤2.2), A1 (≤5.0), A2 (≤4.5), A3 (≤1.2), A4 (≤1.0), A5 (≤2.5), B1 (≤5.0), B2 (≤5.0）	R2 (≤1.2), A1 (≤4.0), A2 (≤3.5), A5 (≤1.5), B1 (≤4.0), B2 (≤4.0)
		Building density	%	R1 (≤32), R2 (≤30), A1 (≤35), A2 (≤25), A3 (≤18), A4 (≤18), A5 (≤25), B1 (≤30), B2 (≤25)	R2 (≤25), B1 (≤25), B2 (≤20)
Scenario 4	Building energy efficiency	The ratio of energy saving buildings	%	Nil	50
		Everything other than the heating energy intensity	Kwh/m^2•a	Office buildings (55.45), large-scale public building (81.54), medium-sized public buildings (62.63), residential buildings (34.71)	Gradually reduce by 30% to the standard values
		Heating energy intensity	Kg-ce/m^2•a	All buildings (27.86)	Gradually reduce by 50% to the standard values
Scenario 5	Investment intensity	Commercial and service industry	104 CNY /hm^2 or 104 CNY per capita	Overall labor productivity: technology services (17), commercial and services (7). the employed people intensity is 320 people/hm2	Increase overall labor productivity 15%, reduce employed people intensity in commercial services sector to 200 people/hm2
		Industry		X1 (4050), X2 (5730), X3 (7), X4 (5)	Increase overall labor productivity 20%
		Primary industry		Overall labor productivity: high-efficiency agriculture (2). the employed people intensity is 110 people/hm^2	Increase overall labor productivity 10%
Scenario 6	Energy intensity and carbon sequestration intensity	Commercial and service industry	t-Ce/104 CNY	Technology services (0.96), commercial and services (2)	Gradually reduce by 20%
		Industry		X1 (1.0), X2 (7.41), X3 (0.82), X4 (2.97)	X1 (0.5), X2 (5.0), X3 (0.5), X4 (2.0)
		Primary industry	t-CO2/hm^2•a	Water (-0.248), arable land (0.42), garden (-2.1), woodland (-4.08), grassland (-2.81), public park (-1.66), developed land (6.77)	Gradually reduce by 10%
Scenario 7	Traffic optimization	Traffic dominant mode		The traffic structure would change dynamically with increasing population	Nil
		The traffic structure		When POP<150,000, rail: 0%, BRT: 0%, bus: 20%, car: 20%, taxi: 12.2%, bicycle: 2.8%, walking: 40%, other: 5%; when 150,000 ≤POP < 300,000, the traffic structure ratio is 0%: 15%: 15%: 14%: 8%: 3%: 40%: 5%; when 300,000≤POP<450,000, the traffic structure ratio is 0%: 25%: 5%: 14%: 8%: 3%: 40%: 5%; when POP≥450,000, the traffic structure ratio is 25%: 0%: 5%: 14%: 8%: 3%: 40%: 5%.	When 150,000≤POP<300,000, increase the share of BRT to total daily transport demand 10%, reduce the share of car and taxi 4% and 6%., respectively; when POP≥300,000 increase the share of BRT and bus 5% each, and reduce car and taxi 4% and 6%, respectively.

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