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Analysis on the Development of Low-Carbon Marine Economy

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Abstract From the perspective of low-carbon economy, the paper analyzes the factors that influencing the development of low carbon economy. It is showed that the damage of marine ecological environment results in the low ability of oceans in absorbing green gas; environmental pollution leads to lowering capacity of ocean to deal with the wastes; development of related marine industries brings deterioration of marine environment; changes of climate threat the healthy development of marine economy. The paper points out the development routines of marine low carbon economy: accelerating the innovation of energy techniques, exploring marine renewable green energies; planning scientifically and strengthening the protection and repairment of marine environment; developing marine recycle economy, upgrading resources using efficiency; adjusting marine industrial structures and exploring greatly the marine low carbon industries; guiding industries to chase chances and accelerating the development of low-carbon marine economy.

Key words Marine, Low-carbon economy, Emission of green house gas, Sustainable development, China

The 21st century is the marine century and the contribution made by marine economy to economic society has become more and more obvious. In terms of human climate environment, oceans take the responsibility of absorbing greenhouse gas CO₂, at the same time, ocean contains rich reproducible green energies, which are the major resources for improving energy structure and developing marine low-carbon economy. In recent years, marine economy in China grows rapidly. The statistics show that in 2009, the marine GDP was 3 196.4 billion yuan, 8.6% more than that in the previous year. The marine GDP takes 9.53% of the total GDP, 15.5% of the total GDP in coastal areas^[1]. Probing into the low-carbon model for the sustainable development of marine economy is a crucial subject faced by marine economy. The influencing factors that affect the development of low-carbon marine economy are analyzed, as well as the developmental approaches for the development of low-carbon marine economy to provide references for the low-carbon marine economy.

1 Analysis on the factors that affect the development of low-carbon marine economy

1.1 The damage of marine ecological environment results in the low ability of oceans in absorbing green gas The oceans have the ecological functions of adjusting human ecological environment. One of the main functions is adjusting climate. In terms of adjusting climate, oceans have the same functions as forests in absorbing CO₂ and emitting O₂. The ocean like a gigantic reservoir of CO₂ can prevent more CO₂ from discharging to the air. The materials show that in the past two centuries, the oceans have absorbed about 525 billion t greenhouse gases, 1/3 of the total gases discharged by human

at the same stage. Last year, the oceans have absorbed 2.3 billion t CO₂, 1/4 of the total gases were released by human. The number was equivalent to the petrol consumed by America in 6 years. The recent researches conducted by marine experts show that the ability of oceans in absorbing greenhouse gas is decreasing. If the oceans could not absorb greenhouse gas any more, the earth would become hot sharply and the cycle period of the oceans themselves would be affected gravely. The damage of marine ecological system is accountable to the downward ability of marine in absorbing CO₂. For example, the continuous increase of the CO₂ emission leads to the increase of the acid of seawater. The acid of seawater is changing the chemical environment of the whole ocean, and the absorption rate of seawater is decreased. Pollution of the sea and man-made sabotage damage the living environment of marine creature. The diversity of ocean creature (such as marine alga) is shrunk, and the marine alga plays a decisive role in the photosynthesis of marine carbon sequestration.

1.2 Environmental pollution leads to lowering capacity of ocean to deal with the wastes Oceans have certain capability in dealing with the wastes. The waste water and waste gases emitted by human production and daily life go to oceans by the way of overland runoff, direct emission and atmospheric sedimentation and some other ways. Oceans transform wastes in the end through resolving, degradation, absorption to harmless materials. For example, in the eutrophication areas of the immediate offshore area, the zooplankton and cultured shellfish absorb a large amount of N and P and some other nutritive materials, which choke back the probability of red tide disaster and reduce the damage of red tide to the ecological environment system of oceans; grassland, coral reef and mangrove have the functions of reducing the damage on seacoast, dyke and equipments caused by storm and some other marine natural disasters. But in recent years, the major ecological problems,

including ecological environment pollution, ecological habitat loss and the decrease of biological diversity, are serious. In 2009, the China bulletin of marine environment quality showed that in China 147 000 km² of the sea has not achieve the standard of clean sea, 7.3% more than last year. The major contaminations in seawater are still inorganic nitrogen, reactive phosphate and petroleum-contained materials. In Chinese immediate offshore area, the deterioration of healthy status of ecological system has not been effectively relieved. According to the statistics, 73.7% of the pollutant-emission outlets emitted pollution over the stipulated volume, and part of the sea area near the pollutant-emission area has been gravely polluted^[2]. The amount of wastes taken by rivers and lakes to the seas has also increased. The pollution of oceans is characterized by multiple sources, strong durative, wide rang of scatter, so it is hard to control. The harmful materials, which will lead to the pollution of oceans, damage of biological resources; harm the quality of seawater; increase the emission of greenhouse gases and have had effects on the environment and climate.

1.3 Development of related marine industries brings deterioration of marine environment The related marine industries emit certain carbon to different degree. The marine related industries, such as marine chemical industries, marine salt, marine fishery, marine shipping industry, marine transportation, marine oil and gas industry, offshore sand mining, marine projects and construction, will boost the emission of carbon. For example, the fossil fuels used in marine fishery; the energy consumption in the processes of processing and circulating sea products; the wastes discharged into the sea by sea food breeding industry; the consumption of various packing goods, such as market and packing bags in supermarkets; the process and usage of various wastes from the marine related industries will directly lead to the emission of greenhouse gases. In the process of developing marine related industries, the consumption on marine resources, industrial pollution emission and living sewage all damage the sea area ecological system, as well as the carbon emission. For example, the excessive fishing in the process of developing marine fishery tails off the marine resources; makes the vacancy of oceanic creature chain and decreases the biological diversity. In terms of marine related projects, in the process of constructing sea crossings, coastal roads, sea reclamation, the sea reclamation occupies beach wetland and disturbs and damages the ecological system of wetland; the construction of beach sand mining, stone drawing, road base, bridges and hydraulic structures may lead to the decrease of the wind-protecting and sand fixing functions of coastal shelter forest; the erosion on coast may be aggravated and the diversity of biology may be damaged; sea reclamation may increase the sand and mud contents in the neighboring sea area; destroy the quality of seawater and harm the marine ecological system. In the process of constructing ports and docks, the improper discharge of sands and mud and the emission of oil-containing waste water will lead to the deterioration of the quality of seawater and the pollution of dangerous chemical products will damage the marine biological resources to differ-

ent degree^[3]. The pollutant will lead to the deterioration of marine ecological environment and the weak capability to fix carbon and increase the emission of greenhouse gases.

1.4 Climate change threats the healthy development of marine economy The negative effects caused by climate change covering all over the human living environment; the inhospitable environment leads to the frequent appearance of natural disasters and the drop of the capability of natural ecological system to resist extreme weather. The references show that the global climate warming leads to the melting of icebergs in south and north poles, the raise of sea level, the change of climate model, the sink of small islands, ocean acidification and coral bleaching and a series of results. The damage of marine ecological system results in the reduction of marine diversity. Global warming has caused certain effects on the biological circles in some areas; the raise of the temperature of sea has led to the permanent change of marine biological circle. Some fishes will disappear and even extinguish. The emission of greenhouse gas not only has bad effects on the related marine industries such as marine fishery, marine tourism, but also to the whole social economy. *Economics of Climate Change in Southeast Asia* issued by Asia Development Bank recently points out that if the global warming problems can not be solved, the southeast countries will be affected greatly. If the whole world does not adopt prompt measures, in 2100, the losses of southeast countries caused by climate change will account for 6.7% of the total local GDP, and the losses will be two times more than that of the average losses of the whole nation. By 2100, the grain production in southeast countries will decrease 50% comparing with that in 1990. The report points out that climate change will gravely affect the yield of rice and threaten the national food security, as well as lead to the raise of sea level and force millions of residents in the coastal area to move away from their homeland^[4]. Southeast area has become one of the serious areas affected by climate change in the world, and the climate change will seriously threaten the economy of southeast area. Climate change caused by the emission of greenhouse gas will further threaten the whole human living environment.

2 Developmental paths of low-carbon marine economy

2.1 Pushing forward the innovation of energy technology and developing renewable marine green energy The essence of low-carbon economy is the problem of energy efficiency and clean energy, and the core is innovation of energy technology and system. The innovation reform of low-carbon economy starts from the non-fossil energy of renewable green energy. The renewable green energy in ocean create major innovation platform for the energy reform. The formal economic model with high carbon emission is caused by unreasonable energy structure. At present, fossil energy is the main energy in the world. In Chinese current energy structure, coal takes 70%, petrol and natural gas account for 23%. Except for hydroelectric power, the renewable energy in China only occupies 1.5% of the total energy. China still relies on coal mainly; the energy

structure depends on fossil energy and the fossil energy accounts for over 90% of the whole energy structure. It can be seen that the existing high carbon economic energy structure is hard to inhibit ecological deterioration and global warming. In order to realize the transformation to low-carbon economy, the over dependence on fossil fuel should be gotten rid of. Oceans contain abundant renewable green energy, including tide, ocean current, wind energy on the sea, seawater temperature difference and seawater salt difference, therefore, the development and use of renewable green energy should be regarded as the key to developing low-carbon economy. In addition, the innovation of various energy-saving technologies can be adopted to improve the efficiency of energy use. The advancement of energy technology and the technology innovation are of great significance to reduce the emission of greenhouse gas.

2.2 Planning scientifically and strengthening the protection and restoration of marine ecological environment

The rapid development of economy engenders great pressure to marine ecological environment. The urbanization and rapid expansion industries near the ports, pollutions from industry and daily life, excessive exploitation and demand lead to the increasingly serious marine ecological environment. The emission of greenhouse gas results in climate deterioration. Therefore, reducing marine pollution and man-made damage are the root for protecting marine ecological environment and containing climate change. From this significance, any item or project should fully consider the potential influence on marine ecology, and then plan the items and projects scientifically to prevent their damage on marine ecological environment.

Developing marine economy must adopt the scientific sustainable development way. The growth of marine economy can not simply rely on the target of GDP. In the process of promoting scientific development of marine economy, the protection on marine resources and ecological environment should be greatly intensified. The marine related industries should be scientifically planned and developed. For example, the catch quota of fishery resource; scientifically adjusting the industrial structure of inshore fishery; giving consideration to industrial economic interests and marine ecological protection; limiting the waste gas emitted by fishery boats; intensifying the supervision on waste gas discharge. The coastal reclamation projects should be scientifically demonstrated and planned, and the projects, which affect marine ecological environment, damage ecological balance, do not agree with the developmental law of sea should be strictly limited. The input strength on the projects that are conducive to marine ecological balance and reducing greenhouse gas emission should be intensified. For example, the evaluation, protection, development and application of algae resources which has great importance on marine ecology. It is of vital importance in balancing marine ecological and reducing greenhouse gas emission.

2.3 Developing marine recycling economy and improving the use efficiency of resources Recycling economy is the new economic development model put forward on the basis of the profound retrospection about the traditional developmental

model of "pollution goes prior to handling". The essence of recycling economy is the recycling and effective use of resources. The idea of recycling economy is to make full use of the resources; change the wastes to into valuable things and turn harmful things into harmless things. Developing recycling economy can improve the efficiency of resources (including energy), as well as reduce the emission of wastes (including CO₂ and some other greenhouse gases). The target of developing recycling economy is in synonymous with developing low-carbon economy.

Developing marine recycling economy is to combine environmental protection and environment management; follow the 3R principles of reduction, reuse and recycle of recycling economy; adopt the law of ecology to guide the marine social economic activities and form the recycling economy model of "natural resources (come from sea and land) → products → wastes (resources) → products" in the process of developing marine economy. There are many successful exploration and practice on many fields of marine economy, such as seawater recycling use, ocean chemical industry, ocean fishery, seawater desalination and the development and use of marine energy. Seawater desalination is the newly emerged industry that agrees with the idea of recycling economy. The comprehensive application on waste water handling, comprehensive use of strong brine and chemical industries has realized the low energy consumption, low pollution and low-carbon discharge. In these areas, the recycling economy of marine economy has realized the reduction, reuse and recycle of marine resources; displayed the efficiency of marine resources and effectively reduced the emission of greenhouse gas. Developing marine recycling economy can improve the efficiency and interest of marine economy and the use of resource in land; realize the clean production of marine industry and sustainable use of resources; reduce the emission of greenhouse gas, so it is an efficient path for developing marine low-carbon economy.

2.4 Adjusting marine industrial structure and developing marine low-carbon industry Developing marine low-carbon economy means transforming the growth pattern of traditional marine economy. In Chinese existing economic structure, the heavy and chemical industry, which take raw materials and energy industries as the center, are the main body. The industries are characterized by high consumption, high energy consumption and high carbon emission. But some industries in marine economy have the feature of low-carbon emission. The ocean service industry in marine industries belongs to the low-carbon industries, for example, marine tourism, marine cultural industry, marine creative industry and marine related finance and insurance industries, are the focal point of future marine industry to transfer to low-carbon economy^[5]. The marine new energy and renewable green energy of marine economy are of great significance to the whole human energy structure, and they can provide important resources for realizing low-carbon economy.

The scientific plan should be made when developing the related industries of marine economy. The structure of marine

industry should be adjusted from the perspective of low-carbon economy and the marine service industry should be greatly developed, for instance, offshore tourism industry, marine cultural industry, marine creative industry (including software centre), modern marine logistics, modern marine telecommunications and marine related finance and insurance. The modern marine service industry should be guided according to ecological and low-carbon standard. For example, combining offshore tourism, island sightseeing, natural environment with the production of agriculture, forestry and fishery, fishing village culture and life to provide sightseeing and leisure environment for tourists, as well as enhance people' experiences on sea, islands, fishing village. It owns the education, economy, tourism, medicine, culture and environmental protection functions. The construction of offshore tourism industry can reference the demands of ecology, and it can change the products in the area into harmless, safe and nutritional food. Offshore tourism leisure industry is characterized by the diversity of marine creature and the elegancy of marine ecological environment, so it is an important model for developing low-carbon marine economy.

2.5 Directing the enterprises to seize the opportunities and accelerating the development of low-carbon economy

Enterprises take the leading role in developing low-carbon economy. For one thing, the enterprise should take social responsibility; fulfill the obligation of reducing emission; enhance the efficiency of energy use in production, transportation and selling; reduce the emission of greenhouse gases. For another thing, the enterprises have many opportunities in developing low-carbon economy. in the future developmental process of coastal cities, the government should lead the enterprises to know the changes of the domestic and international policies on emission reduction; to make use of polices provided by Chinese government and international organizations on discharge fee, trading of emission right, emission trade, clean development mechanism(CDM) and the opportunities supplied by joint implementation mechanism(such as advance technology and capital support); so as to improve the efficiency of energy use and dampen the emission of carbon. The international emission reduction market also provide many opportunities to enterpri-

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cases of circular agriculture by many forms. Through communication and education, economy consciousness of the carders and farmers within agriculture system should be strengthened, in order to improve the consciousness and initiative of developing circular agriculture, and to create a healthy social atmosphere of developing circular agriculture.

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ses, for example, since 2010, the United Nations CDM Executive Board has had new change to CDM market. The gas emission reduction projects of big industry and chemical industry have faced more and more severe supervision. The former Chinese projects, which use wind power, small hydropower and have low industrial efficiency, have faced more and more severe supervision^[6]. It can be seen that there are many opportunities in international and domestic emission reduction market. Thus, the projects including the construction of offshore forests, forests in deserted island and forests established by cooperating with oversea organizations, and some other projects that are conducive to improving the quality of environment and enhancing the capability of oceans in absorbing carbon should be reevaluated and known. In terms of fund collection of enterprises, the banks will treat the low-carbon enterprises and high-carbon enterprises discriminately. The low-carbon enterprises are easy to get the support from the banks, but the credit volume of high carbon enterprises will be limited. The policies are of great significance for the enterprises to grasp the opportunity to develop low-carbon economy.

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