

Impacts of Climate Change on the Construction Industry

Dandan Liao,

Department of Environmental Design, 390 East Sports Club Road, Xianda College of Economics & Humanities Shanghai International Studies University, Shanghai, China.

Abstract: Through the analysis of the causes of global climate change, the building sector is found to be closely related to climate change. Based on the challenges and opportunities in this sector, some related policies have been published, making different effects in different regions. Taiwan is chosen to be the example to briefly describe the relationship between its architecture and the climate change, including the summary of a series of policies.

Keywords: Climate Change; Building Sector; Challenges; Opportunities; Taiwan

1. Introduction

The global climate has been affected by solar activity, earth orbit changes, volcanic activity and other natural factors, but since the industrial revolution, artificial activities have produced large amounts of carbon dioxide which is also called greenhouse gases (GHG). Greenhouse gas concentrations in the atmosphere continue to increase, resulting in an increase in the temperature of the earth, called the greenhouse effect. Climate change has become a major challenge for mankind now, especially in the construction industry.

As a pillar industry of the national economy and social development with high energy consumption, high emission and low energy efficiency, the construction industry has important emission reduction potential. This article briefly outlines the measures the construction industry has taken under the influence of climate.

2. Challenges

Cities and urban areas are estimated to use 75% of the world's energy and produce up to 80% of its GHG emissions.^[1] Buildings have a significant impact on the environment; accounting for one-sixth of the world's fresh water consumption, one-quarter of its wood harvest and two-fifths of its material and energy flow.^[2] IPCC's Third Assessment Report (IPCC AR3) indicates that the seven key areas of world GHG emissions are energy applications, architecture, transportation, industry, agriculture, forestry, and waste disposal, where the building sector is one of the main sources of GHG.^[3]

IPCC's Fifth Assessment Report (IPCC AR5) indicates that GHG emissions from the buildings sector have more than doubled since 1970, accounting for 19 % of global GHG emissions in 2010, including indirect emissions from electricity generation. The share rises to 25 % if AFOLU emissions are excluded from the total. The buildings sector also accounted for 32 % of total global final energy use.^[4]

3. Opportunities

3.1 Potential in GHG reduction from the building sector

IPCC's Sixth Assessment Report (IPCC AR6) indicates that limiting the global scope to 1.5 °C will require a future of "fast travel" in land, energy, industry, buildings, transportation, and cities.^[5] Compared with energy supply, transport, industry, agriculture, forestry and waste, the building sector has the most potential of GHG migration in economic mitigation potentials by sector in 2030 estimated from bottom-up studies in IPCC's Forth Assessment Report (IPCC AR4).^[6]

3.2 Technical measures for reducing GHG emissions

Measures to reduce GHG emissions from buildings are divided into three categories:

- 1) To reduce energy consumption and tangible energy for buildings;
- 2) To convert energy into low-carbon fuels, including higher share of renewable energy;
- 3) To control non-GHG (CO_2) emissions.

The findings of the European Union's study of 80 projects to reduce GHG emissions show that energy efficiency lighting technology is one of the most promising measures in almost all national buildings for cost-effectiveness and potential energy-efficiency. Other measures in terms of energy efficiency potential include: solar hot water installations, energy-efficient household appliances and energy management systems. The study also shows that occupants' behavior, culture and consumption choices, and the use of technologies are the main determinants of building energy use and play a fundamental role in determining GHG emissions.

Also, net zero energy/emission, or even negative energy buildings are dynamically growing. World Business Council for Sustainable Development (WBCSD) points out: "Our target is all buildings, everywhere the EEB project will map out the transition to a 2050 world in which buildings use zero net energy. They must also be aesthetically pleasing and meet other sustainability criteria, especially for air quality, water use and economic viability."

4. Related stakeholders

1) Government

The government is the protector of the social public interest. It is conducive to achieve energy conservation, protect the environment and improve people's livelihood when promoting green building in the society. Financial and regulatory support for energy-efficient retrofits of existing buildings, and accelerated construction of low and zero-energy buildings in some nations. Take Germany as an example, additional funding of around US\$2.5 billion in 2020 and 2021 for a building renovation programme targeting energy efficiency improvements.

2) Investors and developers

Investors and developers are the main body of the new building's investments. They are to achieve the maximum profit for business goals, and the most concerned about is the return of the project's investment. At the same time, they are subject to national policies and regulations which will directly affect the tendency of the development. The choice of consumers will guide the developers in the project's strategic choices. However, during the process of promoting green buildings, the developers' sense change will drive the whole direction of the construction market.

3) Equipment or material businessman

During the construction project life cycle, building materials, energy consumption occupies a large proportion. Hence, the equipment and materials suppliers play an important role due to the energy-saving technologies of products used. While the state's implementation of economic incentives and environmental policies will promote the development of low-carbon equipment and materials.

4) Designers

Green building promotes the principle of local conditions, so it is necessary to introduce the local green building evaluation standards, putting forward detailed requirements for the design department. Designers have the responsibility to recognize the objective requirements of the promotion of green buildings and the world situation, putting the green concept throughout the design.

5) Others

Many other stakeholders are related to green buildings, such as construction workers, property company, consumers, etc. They play a very important role in the construction cost, operating cost and options of the building, etc.

5. Taiwan

5.1 Brief introduction of Taiwan

Taiwan is located on the southeast coast of China, located in the Western Pacific between Japan and the Philippines. The total area is about 36,188 square kilometers. More than 60% of the island was listed as mountain. Located in one of the world's most geologically and climate-sensitive regions, the problems caused by Taiwan's climate is exceptionally prominent. The "921" earthquake that took place in 1999 caused Taiwan to take a response to the climate changes.

5.2 Challenges and opportunities

Taiwan's urban development is still growing. According to the statistics from Taiwan DGBAS (Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan, R.O.C.) in 2014, new constructions, additional constructions and altered constructions increased annually from 19,000 to 34,000 between 2008 and 2014. Construction area has grown 199.2–397.2 million/m² each year.^[7] Statistics published by the International Energy Agency (IEA) have also indicated that Taiwan emitted 255 million tons CO₂ in 2005, which is 22nd highest in the world.^[8] At the end of 2008 Taiwan's total GHG emission levels accounted for 1% of all emissions globally. Moreover, CO₂ emissions per person in Taiwan were also found to be 18th highest in the world.^[9]

In addition to threats from the severe climates, Taiwan also faces the challenge in mitigation of climate change. Since Taiwan is not a signatory of the United Nations Framework Convention on Climate Change (UNFCCC), it cannot participate in the Kyoto mechanisms^[10] (Lin et al., 2006; United Nations Framework Convention on Climate Change, 2008) established by the UNFCCC, which would have forced companies to incur greater costs in reducing GHG emissions. Taiwan's industries will lose international competitiveness as well as the incentives to move toward a green industrial structure and low-carbon society. Even though, as a member of the global village fulfilling the responsibility of mitigating climate change as well as attaining sustainable development, Taiwan would still respond actively and push forward different mitigation policies.

5.3 Policies and effects

To meet the challenge of carbon reduction, the Taiwan government promoted green building in 1995, green building materials in 2004, and intelligent green building in 2010.^[11] Taiwan government's policy of intelligent green building has some features, establishing clear and operable evaluation index system in the first stage. Secondly, public buildings are obligated to be assessed in the evaluation system, also, private buildings are encouraged with incentives to apply assessment. Finally, evaluation mechanisms are mutually linked to help promote industrial development.

1) Starting from green building material to Green Building Label and then Intelligent Building Label for a friendly environment, the government makes efforts to promote the green policies. In addition, they try to use green building and intelligent building to build eco-community and wisdom green city.

2) Carrying out the aim of carbon reduction and environmental sustainability by conducting different design methods. The Green Building Evaluation and Labeling System has capitalized on passive design to make the most of available resources. On the other hand, Intelligent Building Evaluation and Labeling system has seen to the integration of ICT to maximize the efficiency of carbon reduction and living quality.^[12]

3) Ensuring policies create maximum synergy; for example, connect the Green Building Material Label and the Indoor Environmental Quality Index to invent green building material. This will promote industry interests and opportunities. Alternately, integrating Green Building Label and Evaluation Index of Intelligent Building Label will enlarge benefits of carbon reduction by applying ICT to green buildings.

4) At the moment, Taiwan has not established consummate policy and mechanism to react with carbon emission costs from the economic activities, and has not framed green circular economy and its developing environment for carbon reduction. Consequently, the main means stays in promoting incentives and compulsory policies.^[13]

6. Conclusion

Based on the analysis of policies of building sector which are devoted to the climate change, the importance and potential of the building sector is obvious. Different regions implement different relevant policies, bringing different benefits and effectiveness. From the case of Taiwan, it is necessary and urgent to make more efforts to promote the implementation of policies due to the serious climate problems.

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