TOWARD A NEW CLIMATE REGIME ESTABLISHMENT (3) CASE STUDY IN CHINA

Fengjun Duan, The Canon Institute for Global Studies, +81-3-6213-0550, fengjun.duan@canon-igs.org
Chenglong Zhang, State Grid Energy Research Institute, +86-10-6341-1900 , zhang-cl06@mails.thu.edu.cn
Aling Zhang, Tsinghua University, Institute of Energy, Environment and Economy, +86-10-6277-1024, zhangal@tsinghua.edu.cn

Overview

In order to benefit the establishment of a new international agreement against global warming under the Durban Platform, a post-2012 climate regime has been examined based on new evidences from climate science and global energy system optimization[1), 2)]. An economically rational and technologically feasible long-term global energy vision was proposed together with a regionally equitable CO_2 emission allocation plan. The analysis also indicated that a technology oriented international cooperation mechanism is essential for achieving the global vision.

China became the largest CO_2 emitter ten years after the adoption of the Kyoto Protocol under which the biggest emerging economy doesn't have legal obligation to reduce CO_2 emissions. However, with the predicted rapid economic growth, China's energy demands will increase substantially during the following decades, thereby the decarbonisation of Chinese energy system will play the most essential role on combating global warming. Therefore, this paper carries out a feasibility study in China to evaluate the practical reality of the climate regime.

Methods

An economy-energy hybrid model was utilized for long-term numerical projections. The economy module of the model is modified based on a common macro-economic model, the State Information Center General Equilibrium (SICGE) model [3)]. Energy production function, emission computing function and carbon tax function were included for evaluating the effects of energy system and the emission constraints [4), 5)]. The energy module of the model is an inter-temporal energy system optimization model (IESOM) developed in Tsinghua University [6)]. The two modules are linked through linkage variables such as the energy service demand, energy efficiency, and energy investment in order to obtain a converged solution. Three scenario analyses were executed. Those are business as usual scenario (BAU), energy conservation scenario (REF), and emission reduction scenario (Z650) in accordance with the global analysis. The general assumptions such GDP and population in BAU was set to be the same with the global model, and the global analysis provided CO_2 emissions in REF and Z650. In order to evaluate the effects of technology deployment, two approaches that with and without energy efficiency catch up scheme were applied for Z650.

Results

The key results from numerical experiments till 2050 are as the following.

In BAU scenario, the total energy consumption will increase to more than 4GTOE with coal occupying almost half of them in 2050. Oil and gas cover approximate 35%, while clean energy obtains a share of 15%. Thereby, the CO_2 emission in 2050 will be more than 14 billion tons. These results are similar with the global model analysis.

In REF scenario, the total energy consumption in 2050 will be approximate 10% less than that of BAU to follow the emission pathway defined by global analysis. Coal will still be the most important energy, but its share will lower to 30%. Oil and gas will be similar with BAU, and clean energy will supply more than one third of the total energy. Influenced by the less energy consumption and cleaner energy mixture, the CO_2 emission in 2050 will be approximate 11 billion tons. Measures in energy sector will influence the national economy slightly. Compared with BAU, GDP in 2030 and 2050 will be 3.3% and 4.5% lower, respectively.

In the case of Z650 without technology catch up scheme, significant changes in energy sector are necessary to meet the global constraint, in which the emission in 2050 should be limited to approximate 4 billion tons. First of all, the total energy consumption needs to be reduced by 15% in 2030 and more than 30% in 2050 respectively compared with BAU. At the meanwhile, clean energy should occupy nearly 60% of the total energy. These conversions of the energy sector will cause huge damage to the national economy. Compared with BAU, GDP loses in 2030 and 2050 will be more than 10% and more than 20% respectively. The largest influence occurs in industry and transportation. Services sector gets less damage, and agriculture will be the only sector that obtains positive influence. The projection with energy efficiency catch up scheme indicates that the technology deployment could mitigate approximate half of these economic influences.

Conclusions

Chinese Government pledged a relative target of reducing CO_2 intensity per GDP by 40 to 45% in 2020 compared with 2005 levels under the Copenhagen Accord. It is clear that the target can be achieved through energy conservation according to the constraint targets in the National 12^{th} five year plan in which the energy consumption per GDP and CO_2 intensity per GDP are requested to be reduced by 16% and 17% respectively in 2015 compared with the 2010 levels. On the other hand, a newly proposed climate regime against global warming requests a CO_2 reduction rate of 18% in 2050 compared with the 2005 levels in China. Numerical projections were executed to assess the economic performances of the two scenarios.

In the case of promoting energy conservation, the economic impacts till 2050 will be slightly compared with the non-action scenario. The results are in accordance with the current national policy.

In the case of CO_2 deep reduction, large economic losses would occur if the measures were carried out though domestic efforts only. These results limit the motivation of national mitigation actions. On the other hand, the large economic impacts caused by deep reduction could be substantially mitigated through rapid catch up of energy efficiency with industrialized countries by international technology transfer and deployment. This analysis suggests the practical reality of the climate regime is depended on effective international cooperation mechanism.

References

1） Duan, F., Ujita, H., and Yuhara, T., Toward a New Climate Regime Establishment (1) Mitigation of Global Warming by Optimum Energy Mixture, 12^{th} IAEE European Energy Conference, September 9-12, 2012, Venice, Italy, 2012.

2） Ujita, H., Duan, F., and Shindoh, T., Toward a New Climate Regime Establishment (2)Energy Issue after Fukushima Daiichi Accient, 12^{th} IAEE European Energy Conference, September 9-12, 2012, Venice, Italy, 2012.

3） Zhang, A. and Li, J., Chinese Integrated Energy-Economy-Environment Assessment Model (in Chinese), J Tsinghua Univ. (Sci&Tech), No.9, Vol. 47, 2007, 33-37.

4） Zhang, C., Li, J., Zhang, A., and Bi, C., SICGE Extensions and Their Linkage with IESOM (in Chinese), J Tsinghua Univ. (Sci&Tech), No.2, Vol. 51, 2011, 234-240.

5） Zhang C., Zhang, A., Bi, C., Shan, B., and Zhu, F., Mid-&Long-term Energy and Carbon Emission Scenarios Analysis Based on IESOM Model (in Chinese), Energy of China, No. 12, Vol. 33, 2011, 9-13.

6） Bi, C., Analysis of NAMA in China Using IESOM, Master Thesis of Tsinghua University, 2010.