Challenges on the Way Towards a Becoming a Low Carbon City – The example of Wuxi, China and Düsseldorf region

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(1) Overview

Increasing urbanisation and climate change belong to the greatest challenges of the 21st century. About 40 to 78% of global greenhouse gas emissions are estimated to originate in urban areas (UN Habitat 2010). Therefore, low carbon city strategies and concepts implicate large greenhouse gas (GHG) mitigation potentials. The Low Carbon Future Cities (LCFC) project, funded by the German Stiftung Mercator, develops integrated low carbon strategies for two pilot regions - the Chinese city of Wuxi and the region of Düsseldorf in Germany - based on in-depth scientific research The strategies do not solely focus on GHG mitigation but also take into consideration the current status and projected trends of resource use as energy consumption and resource demand are closely interlinked.

The presented paper summarises the most important outcomes of the Wuxi case study and is structured as follows: (1) Key sectors for GHG mitigation are identified in a cross-sectoral GHG inventory. (2) Based on the assessment of the status quo, the project team develops a business-as-usual scenario (Current Policy Scenario/CPS) until 2050, which takes into account existing policies and strategies of the municipal government of Wuxi. (3) A business-as-usual projection of resource demand in two of the previously identified key sectors – energy production and buildings – is conducted, offering excellent insights on future material flows and resource intensity. (4) The outcomes of the outlined status quo and trends assessment are fed into a low carbon scenario (LCS). The scenario is based on the assumption that incumbent technologies in the identified key sectors will be replaced with best available technologies (BAT) as soon as they are ready for commercialisation. (5) The low carbon scenario also integrates an analysis of resource use and intensity. Both the mitigation and resource low carbon scenarios allow for deriving key technologies for a local low carbon development of Wuxi. These key technologies will be important cornerstones of the low carbon strategy for Wuxi, which is currently being developed. (6) In order to take into account the possibility for action of the city government, the paper frames the previously described quantitative analysis with a brief assessment of the corresponding institutional settings which either drive or inhibit a low carbon development. (7) Finally, the conclusions will outline a framework for a possible low carbon strategy for Wuxi. – In a parallel process, challenges of the Duesseldorf+ region (including cities of Duesseldorf, Neuss and Ratingen, districts of Mettmann and Rhein-Kreis Neuss) have been analysed and will as well shortly be outlined in the presentation of the results.

(2) Methods

The paper implies a holistic research approach, which is in accordance to the multi-dimensional challenges coming along with the development of urban low carbon strategies. Thus it applies a combination of different scientific methods. The GHG inventory is mainly based on data from the Wuxi Statistical Yearbook (WMBS 2001-2010) and uses the inventory methodology outlined in the 2006 IPCC guidelines on GHG inventories (IPCC, 2006) in a simplified and adapted manner. The inventory focuses on CO_2 emissions. Other GHG have also been considered, depending on available data, but only to a lesser extent.

The CPS and LCS show the development of energy demand and energy-related CO_2 emissions in Wuxi until 2050 based on different assumptions. Both scenarios are based on a modelling approach, which can be described as a model framework, consisting of one core model and five sub-models. The core model named Wuxi CESS Model (CESS= City Energy System Simulation) is an energy system simulation model and linked to five sectoral sub-models (industry, buildings, household appliances, service sector, transport and the power & heat sub-model). They provide activity data, market shares and mean efficiencies of technologies to the CESS model.

The projection of future resource use and demand under business-as-usual conditions and a low carbon pathway is based on two main methodological tools: Material Input per unit of Service (MIPS) and Economy-Wide Material Flow Analysis (EW-MFA). The first one- MIPS – focuses on the input side of life cycle inventory to a studied product or process and accounts for economically non-valued resource extraction. The latter method EW-MFA covers all material flows for the studied region. The analysis accounts for all natural resource inputs (direct or indirect, economically used or unused, domestic or foreign) that are activated by human activities in Wuxi, including through trade.

The analysis of institutional settings for a low carbon development is based on a qualitative research design, which combines desk research with expert interviews. Desk research included various municipal, provincial and national policy documents. Interviews with local government officials in the key sectors were conducted to obtain insights into actor constellation as well as opportunities and barriers for the transition towards a low carbon path.

(3) Results

The analysis shows that Wuxi already has initiated important steps on its way towards becoming a low carbon city but still has a long way to go. The emission inventory indicates that the main source for Wuxi's emissions is the combustion of raw coal, which is needed to fulfil the high demand for energy. Electricity and heat production represent more than half of the current CO_2 emissions. However, being a city strongly dominated by energy-intensive industries, Wuxi's iron and steel industry as well as the chemical industry are the manufacturing industries most relevant in terms of greenhouse gas emissions. Wuxi's total CO_2 emissions add up to about a quarter of the corresponding CO_2 emissions for the German industrialized state of North Rhine-Westphalia or the total CO_2 emissions of Chile. Since not all sectors could be included in the emissions inventory due to a lack of data, the actual emissions are expected to be even higher. Key sectors for GHG mitigation are major industry branches, such as the iron and steel industry and the chemical industry, power generation, buildings and road transport.

In the CPS, final energy demand is expected to grow by 86% (for 2050 compared to the 2009 level). Within the scenario timeframe, structural change will occur, thus non-energy intensive industries ad the service sector are expected to grow stronger than others. As a consequence, CO_2 intensity is likely to significantly decline until 2050. However, mainly due to ongoing economic growth, increasing electricity demand and the continuous predominance of coal, Wuxi's absolute greenhouse gas emissions will almost double by 2050 compared to today's level (2009: ca. 78,000 kt/a). The resource use analysis focuses on the power sector and buildings. For electricity production, annual material flows and water consumption for coal extraction and use dominate the picture. In parallel to the increasing energy demand, the related material flows will significantly increase in the future. For the building sector, the construction of new buildings as well as the demolishing of old buildings will lead to an increase in material demand.

In the low carbon scenario, the boost of absolute CO_2 emissions and energy demand can be alleviated. The demand for electricity in the LCS in 2050 is 22% below the level of the CPS. Power generation is becoming increasingly efficient and potentials for renewable energy production are gradually tapped. CO_2 intensity can be reduced by about 94% by 2050 compared to the CPS. However, despite this substantial reduction, direct and indirect CO_2 emissions of the selected key sectors hardly fall below the current emission level. The same applies to per capita emissions (2009: 12.1 t/capita; 2050: 11.4 t/capita). These outcomes suggest that local potentials for technology-driven mitigation measures are not sufficient to enter the pathway towards a low carbon development. Instead, they need to be complemented with effective behavioural measures.

With regard to the institutional dimension of Wuxi's low carbon policy, the project team concludes that a broad range of regulatory instruments, e.g. closing down energy inefficient capacities or stopping the construction of coal-fired power plants, and fiscal instruments, such as subsidies and preferential tax schemes, have already been adopted. Furthermore, the city government has established administrative units, which coordinate policy processes for the transition to specific low carbon actions in the key sectors. However, their effectiveness is impeded by institutional complexity and overlapping responsibilities. Therefore, the institutional setting is yet to be optimised. –

In Duesseldorf+ region, the analysis of socio-economic indicators and the institutional setting for a low carbon development strategy revealed that a lack of inter-municipal collaboration constitutes a major barrier towards an ambitious regional climate policy approach. Therefore, the focus and objective of the word was shifted towards facilitating regional collaboration on the field of greenhouse gas mitigation.

(4) Conclusions

It can be concluded that the challenges of fostering a low carbon development in Wuxi are enormous due to the city's high share of energy- and resource-intensive industries. The city government has clearly articulated its determination to shift the local economic structure towards a more service-oriented economy with a high share of the commercial and service sector. However, this is a long way to go. In the meantime, energy-intensive industrial processes in key industries, such as the power sector as well as the steel and iron industry and the chemical industry, need to be made more efficient. At the same time, the city government has to alleviate the ecological footprint of rising living standards, which are projected to lead to increasing energy demand by private households and a significant increase in traffic volume. The city government has already adopted a broad array of regulatory and fiscal measures to foster these targets. However, efficient and effective administrative structures to achieve and monitor these targets are still needed. Furthermore, a stronger emphasis needs to be put on the development of learning processes and advisory schemes, e.g. for privat residents on how to reduce their energy consumption, in order to decouple economic growth and increasing living standards from energy demand and resource consumption.

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