Development of biomass power plant technologies in Malaysia: niche development and the formation of innovative capabilities

The objective of this thesis is to contribute to advance further the emerging research agenda on the transfer and diffusion of low-carbon technologies in developing countries by adopting a study of the development of biomass power plant technologies in Malaysia. The main research question addresses the main factors influencing the transfer and diffusion of biomass power plant technologies in Malaysia. This question is explored in the four papers comprising the thesis, which are based on analyses of qualitative data, mainly in the form of interviews, documents and observations collected during successive periods of fieldwork in Malaysia.

The thesis conceptualises the diffusion of biomass technologies in Malaysia as a niche development process and finds that the development of a palm oil biomass waste-to-energy niche in Malaysia has only made limited progress despite a period of twenty years of niche formation. The thesis identifies the reluctance to implement an efficient energy policy as the main limiting factor for niche development in this case. Although a number of donor programs have advocated the introduction of a stronger enabling framework for niche development, they have generally had only a limited impact on policy development. This was mainly attributed to the strong opposing interests of key actors in maintaining the existing situation, particularly the national electricity utility company in Malaysia, which deliberately obstructed niche development over an extended period because it was against their economic interests. When the government decided to improve incentive structures through a reduction in fossil fuel subsidies and by introducing a feed-in tariff system, the niche development momentum had already been lost because investors had limited confidence in project investments. Since many planned plants were never put into operation and those that were constructed generally showed only poor performance, the lack of investor confidence was due mainly to the largely negative results from experimentation activities in the niche. Moreover, a number of alternative biomass waste utilisation options gained increasing interest in the Malaysian palm oil industry, which were considered more commercially attractive compared to energy generation. On top of this, the increasing interest in these alternative usages of palm oil biomass waste led to a significant rise in biomass resource prices, which meant that it became difficult to negotiate long-term biomass fuel contracts. These factors turned out to be detrimental for niche development.

The transfer of technology is understood in this thesis as the exchange of knowledge through international inter-firm linkages, which contribute to enhancing the technological capability of the recipient firms, thus enabling them to engage in innovation. The thesis considers whether the use of different learning mechanisms could explain differences in the accumulation of technological capabilities in the biomass boiler and power plant supplier industry in Malaysia. It is found that not only is differences in the levels of technological capability achieved by individual firms influenced by the specific combination of learning mechanisms the firms employ, but also by the differences in the relative levels of resources dedicated to exploiting these learning mechanisms. Firms relying on a combination of learning from foreign technology partners and internal learning by planned experimentation make most progress in terms of technological capability. Firms using a combination of learning by imitating national competitor firms and internal trial and error also made advances in technological capability although to a comparably lesser extent. The thesis also finds that CDM projects implemented in Malaysia played a limited role in stimulating the introduction of new technology and knowledge to Malaysian biomass boiler and power plant equipment suppliers. Their involvement in CDM projects did not add anything above and beyond what was already encompassed in the existing relationships between the firms in question.