

**Project Title:** 'Feasibility of Environmentally friendly natural ester free breathing 11kV 1MVA transformers'  
**Principle Investigator:** Dr Z Wang (University of Manchester)  
**Project duration:** 01/01/09 – 31/12/09  
**Grant Value:** £74,989

Transformers transfer electrical energy between two circuits and they are mainly used to change alternating current of one voltage to another voltage. They are essential for high voltage power transmission, which makes long distance transmission economically viable, and are also found in nearly all electronic devices. When high voltages pass through transformers they generate heat which can cause permanent damage to them so they are immersed in oil to keep them cool. This oil also acts as an insulator protecting the transformer from the formation of corona, discharges from corona represent a power loss and reduce efficiency.

Currently only mineral oils, a by-product of petroleum, are used for transformer oil. This project is investigating the potential of using natural esters, derived from vegetable oils, as a coolant and insulator for transformers in place of mineral oils. The two main drivers for using natural esters instead of mineral oils in power transformers are environmental concern and fire safety. Natural esters are derived from vegetable oils, one of the sustainable agricultural sources, so are highly biodegradable and therefore environmentally friendly. In the UK distribution transformers are usually free-breathing, which means an air space on top of the oil is vented to atmosphere through a breather pipe. Breathing is caused by expansion and contraction of the oil as temperature changes, moisture and oxygen can then dissolve directly into the oil from the air in this type of transformer. The combination of these can reduce the insulating properties of the oil, this is a problem for natural esters because their oxidation stabilities are not as good as mineral oil.

This project investigated the performance of a natural ester as both an insulator and coolant medium by testing it in a transformer under load at an operational site. Laboratory based accelerated ageing was also used in order to simulate the effects of the oil being used for a significant period of time as it would be in a distribution transformer.

This project was carried out in collaboration with Electricity North West (ENW) who provided additional funding and also accommodate the ester filled distribution transformer. The experience gained from this project will help ENW to become the first utility company to possess knowledge of how the commercially available environmentally friendly transformer fluids may behave under real loading and operating conditions. M&I material, a local company based at Trafford park, manufactured the natural esters used for this project and would stand to benefit if it's found they are suitable for use in distribution transformers.