



SUSTAINABLE BIOENERGY
SYSTEMS FOR OUR
LOW-CARBON FUTURE

BioSusTOil

Developing Sustainable Power Transformer Oil in Support of National Grid Decarbonisation

Dr Amir Badiee

Dr Nikola Chalashkanov

University of Lincoln

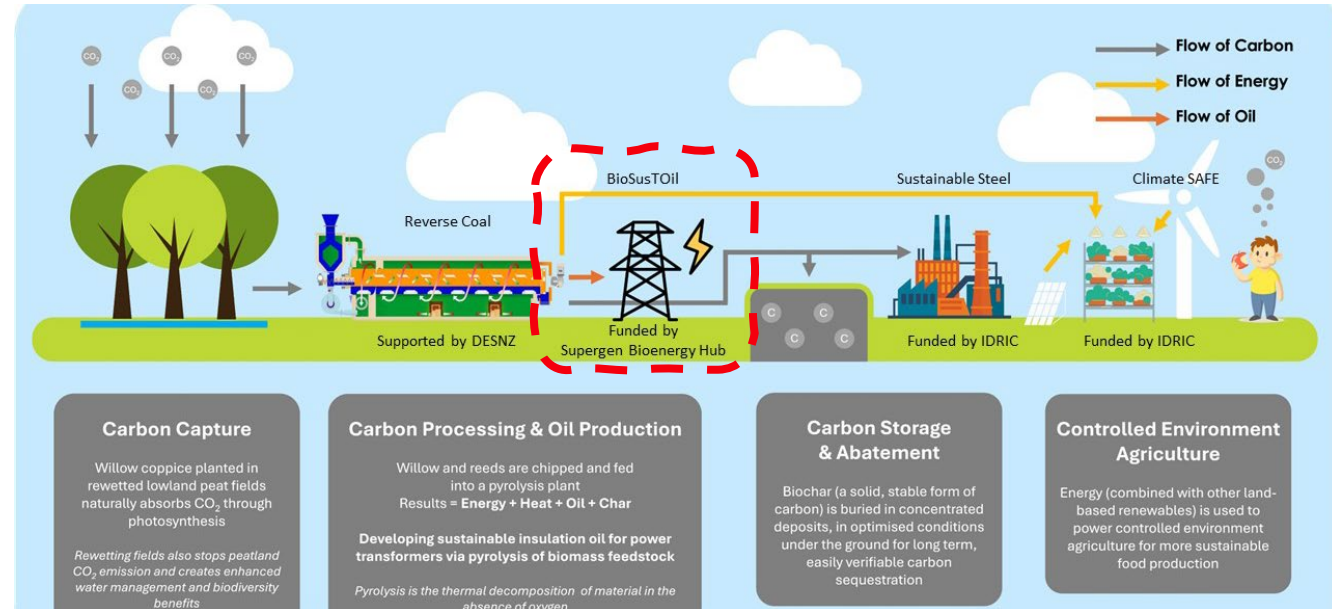
Dr Scott Banks

Aston University



Lapwing
Estate

- The UK aims to achieve **50GW of offshore wind by 2030**, requiring **six times more transmission infrastructure**.
- Power transformers and the use of mineral oil contributes to about **4% of grid-related emissions**.
- This poses environmental risks due to its potential for spills and non-renewable nature.



Project Goal:

- To evaluate the feasibility of producing bio-based insulating oils from sustainably sourced biomass pyrolysis for application in power transformers.

Fast Pyrolysis Sample

Feedstock: Ash

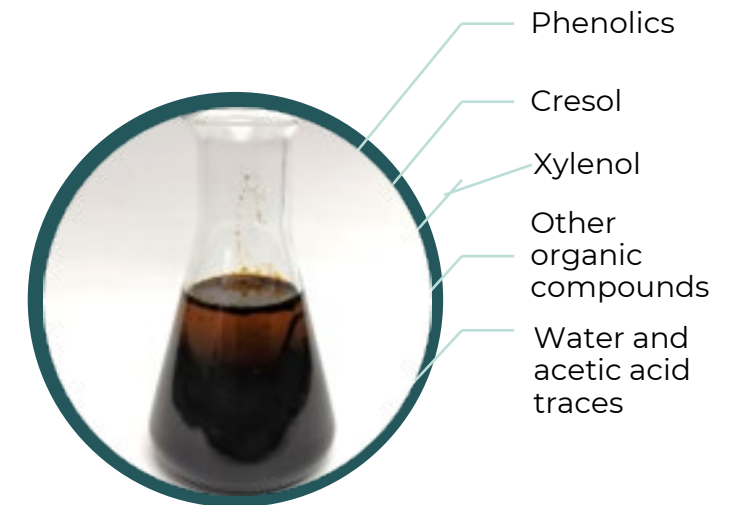
Process Parameters: 500°C - 1.5 s hot vapour residence time



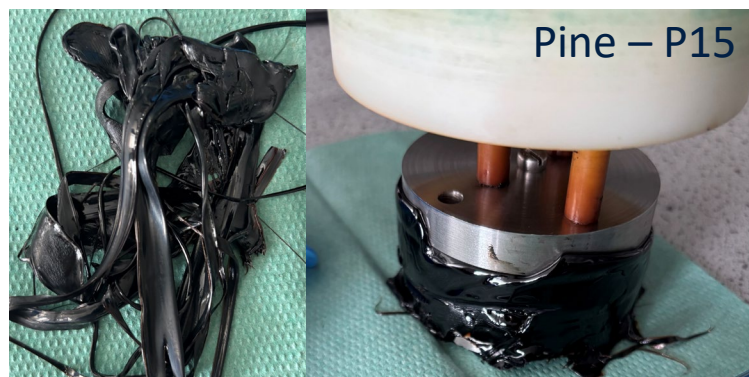
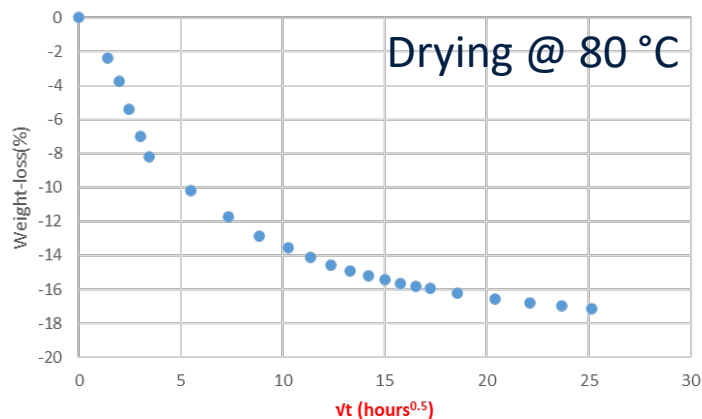
Intermediate Pyrolysis

Feedstock: Pinewood (P-15)

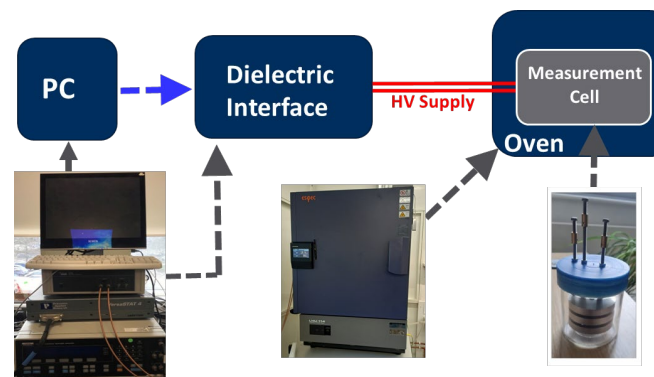
Process Parameters: 500°C - 20 mins solid residence time



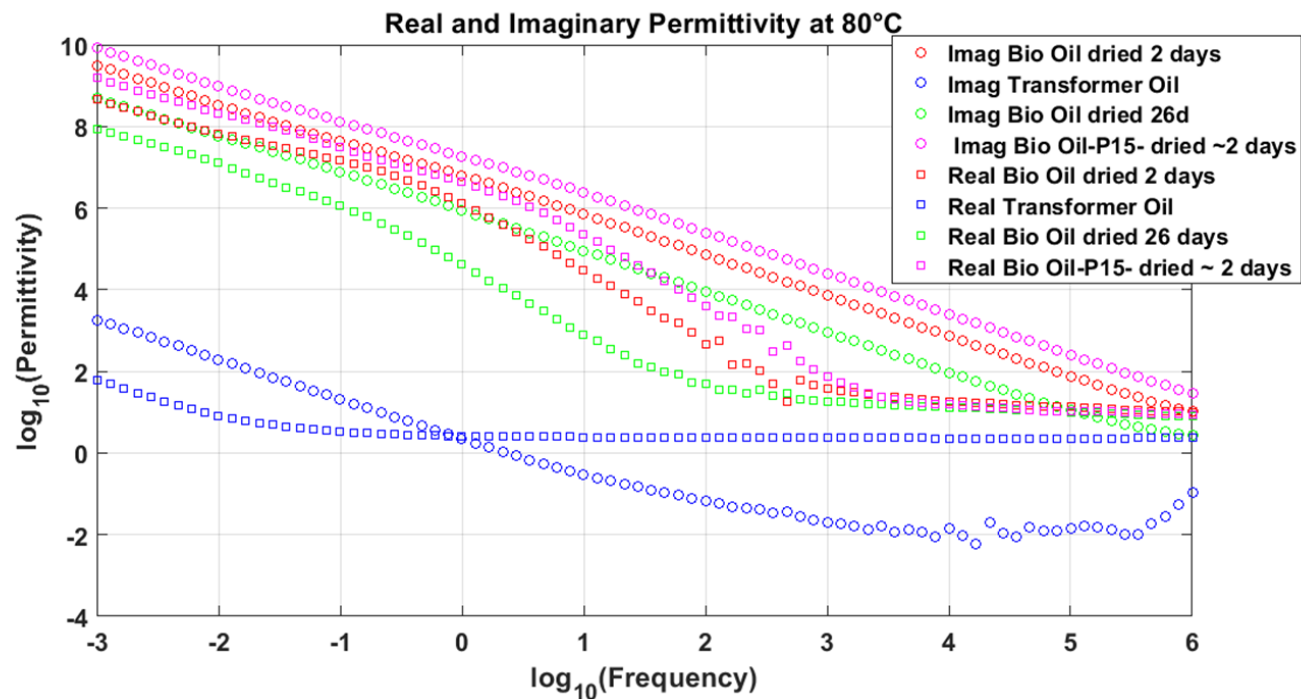
Testing



The bio-oil solidifies at room temperature, transitioning near 55°C.



Dielectric measurement



- Rethinking ingredients, and formats to align with Climate, Nature, fossil-based materials, and Livelihoods goals.
- Deep/strategic partnerships is required for innovation and commercialisation.
- Increasing scrutiny on ingredients, emissions, and sourcing along with the safety and changing regulations needs to be embedded in the material development.

Technical summary:

- The bio-oils contain high amount of water ~ 18%.
- Drying greatly enhances dielectric permittivity and overall insulating performance.
- Feedstock and pyrolysis types have a significant impact on the oil quality.
- Further process optimisation is needed to meet industry standards.
- De-oxygenation and chemical refinement can further improve oil quality.
- Currently looking for opportunities to further progress with the oil development.



Funding opportunity

Unlocking the full potential of nature-based engineering

Opportunity status:	Open
Funders:	Engineering and Physical Sciences Research Council (EPSRC)
Funding type:	Grant
Total fund:	£6,000,000
Maximum award:	£481,251
Publication date:	28 August 2025
Opening date:	28 August 2025 9:00am UK time
Closing date:	23 October 2025 4:00pm UK time

Timeline

28 August 2025 9:00am	Opening date
25 September 2025 4:00pm	Intention to submit due
23 October 2025 4:00pm	Closing date