

# From biodiesel residues to bioPCMs with tailored phase-change properties

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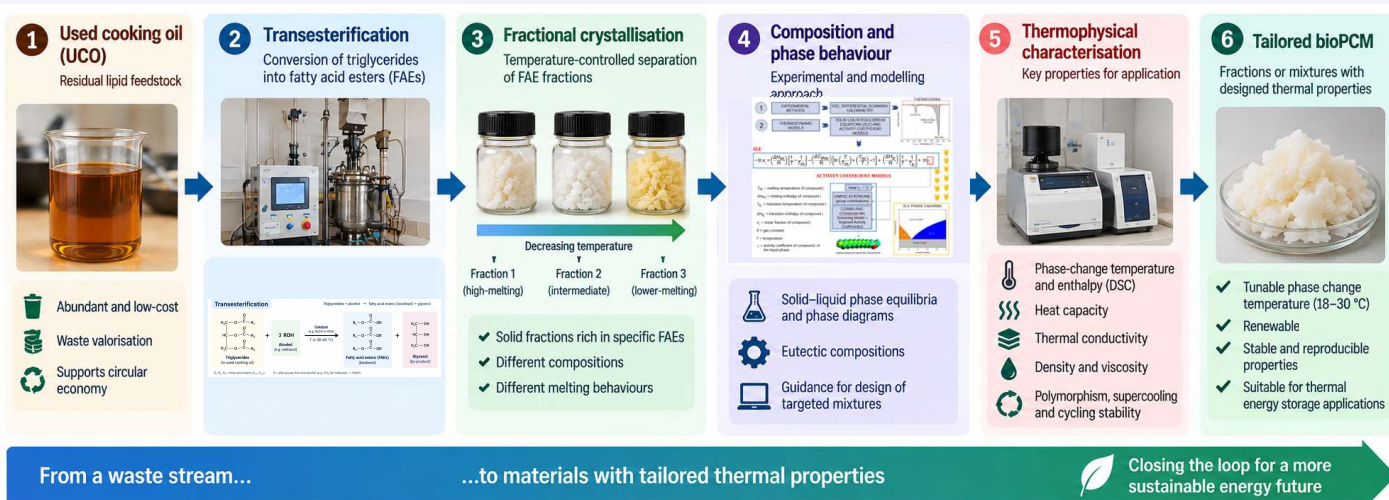
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## 1. RESEARCH APPROACH

Our research focuses on developing sustainable bio-based phase change materials (bioPCMs) through the valorisation of used cooking oils and fats (UCO). UCO is converted into biodiesel and subsequently fractionated by controlled cooling to recover fatty-acid-ester-rich fractions that are normally removed because of their detrimental effect on biodiesel cold-flow properties. Instead of treating these fractions as low-value by-products, we explore their potential as renewable PCMs and develop strategies to tailor their phase-change behaviour to specific thermal applications. By combining phase-equilibrium studies, thermodynamic modelling and advanced thermophysical characterisation, we aim to establish composition–phase behaviour–property relationships that enable the development of waste-derived bioPCMs with controlled and reproducible thermal properties.

## 2. METHODOLOGY & RESEARCH CAPABILITIES

Used cooking oils (UCO) are first converted into fatty acid esters (FAEs) by transesterification and subsequently subjected to temperature-controlled fractional crystallisation to obtain fractions with different compositions and phase-change behaviours. The recovered fractions are chemically characterised and their solid–liquid phase behaviour is investigated experimentally and through thermodynamic modelling to establish relationships between composition and phase-change properties and to guide the formulation of mixtures with tailored transition temperatures. Experimental phase diagrams and eutectic compositions are determined by low-rate DSC, while polymorphism, supercooling and thermal cycling stability are also assessed. Finally, the selected bioPCMs are fully characterised in terms of their thermophysical and transport properties—including phase-change enthalpy, heat capacity, thermal conductivity, density and viscosity—to identify formulations with controlled and reproducible properties for thermal energy storage applications.



## 3. FUNDING

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