SUMMARY
Trojan Horse Repeat Sequences for Triggered Chemical Recycling of Polyesters for Films and Bottles

Applicant: Iowa State University
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This BOTTLE project (Topic Area 1a) will develop highly recyclable (at least 50% and up to 100%) biobased polyesters (at least 50 wt % non-food starch-based terephthalate) that are functionally equivalent or superior to, and compatible with, poly(ethylene terephthalate) (PET). Archer-Daniels Midland (ADM) will develop scalable pathways for processing non-food starches obtained as coproducts of vegetable protein production from peas, wheat, beans and other crops to upgradable furan- and phthalate-based building blocks, including the furan dimethyl esters and terephthalates ADM has developed previously from corn sugars. Iowa State University (ISU) will use these building blocks to design highly recyclable PET/TH copolymers through "trojan horse" (TH) repeat sequences that enable *quantitative* chemical depolymerization triggered by *specific* yet *mild* conditions, enabling facile raw material recovery and repolymerization to *virgin* material. Diageo and 3M will holistically evaluate PET/THs as bottles and films from perspectives of performance, aesthetics, compatibility with existing infrastructure and recycling streams, regulatory considerations and life cycle impacts. Promising candidates will be brought to multikilogram-scale by 3M and processed to bottle (Diageo) and biaxially oriented film (3M) prototypes for further evaluation. Diageo will evaluate bottle prototypes for suitability as packaging for its products. 3M will evaluate prototypes as carrier films, release liners, and optical films that are used for adhesive tapes and electronic devices. Technoeconomic analysis will demonstrate the economic potential of the materials and life cycle assessments will model the carbon and energy savings of the PET/TH copolymers over the entire life cycle. The research partnership is comprised of entities representing the entire supply chain of the proposed plastics, ensuring that the research and development efforts account for all aspects of bringing a new polymer to market.