Abstract for Public Release

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Project Title: All-Polyester Multilayer Plastics ('All-polyester MLPs'): A Redesign for Inherently Recyclable Plastics

Project Goals: The **overall goal** of this project include:

i) to produce 'all-polyester MLPs' exhibiting packaging performance (e.g., sealing, barrier, mechanical, etc.) that matches or exceeds that of the commercial 5-12 layers MLPs; and
ii) to provide multiple end-of-life solutions (e.g., chemical and mechanical recycling) for the proposed 'all-polyester MLPs'

To achieve these goals, key objectives are:

- **Task 1** – Design, fabricate, and test the performance of inherently recyclable 'all-polyester MLPs' at the lab- and the pilot-scale.
- **Task 2** – Establish protocols for: **i)** mechanical recycling of 'all-polyester MLPs' matching the performance of virgin poly(ethylene terephthalate) films; and **ii)** rapid depolymerization 'all-polyester MLPs' and recovery of the catalyst.
- **Task 3** – Perform system modeling, life cycle assessment, and techno-economic analysis of the newly engineered 'all-polyester MLPs' from production to recycling for taking socially responsible and economically correct decisions.

Benefits and Outcomes – Our immediate market for the proposed 'all-polyester MLPs' is their entry into flexible MLPs packaging, which will then be extended to rigid MLPs packaging. Thus, this project targets on the enormous 100 million tons/year MLPs packaging market. If the proposed technology captures 20% of the existent MLP market (44 billion pounds/year), this will generate a revenue of ~**$44 billion/year.** Another promising aspect of this project is the recycling of 'all-polyester MLPs' (mechanically into films as replacements for virgin poly(ethylene terephthalate) films; and chemically into feedstock monomers for remaking of the virgin quality plastic). Every year, 6.6 billion lbs/year post-industrial scrap is produced from conventional MLPs which is difficult to reuse. The proposed 'all-polyester MLPs' makes the reuse of this post-industrial scrap very feasible and at 50% of post-industrial MLPs scrap recycling will thus offer various benefits including: **1)** suppling **3.3 billion lbs/year** of material for packaging manufacturing; **2)** conserving **>15.8 billion MJ/year** of energy; **3)** saving **>3.3 billion lbs/year** of feedstock chemicals, which otherwise would not be used for the generation of virgin materials for PET films; **4)** >**2.6 billion lbs/year** of CO_2 year that is currently generated by virgin resin synthesis will be eliminated; and **5)** workforce development for domestic manufacturing. Multiple patent applications are expected from the development of 'all-polyester MLPs' and their recycling to feedstock monomers and films. Overall, this work will strengthen the position of US manufacturers by enabling them to produce inherently recyclable MLPs at competitive prices in the global marketplace. This DOE funding is critically important to make a team of experts from various disciplines to realize the objectives of this highly practical and much-needed work.

Major Participants: Michigan State University, USA; Pacific Northwest National Laboratory, USA; Amcor, USA; and Indorama, USA.