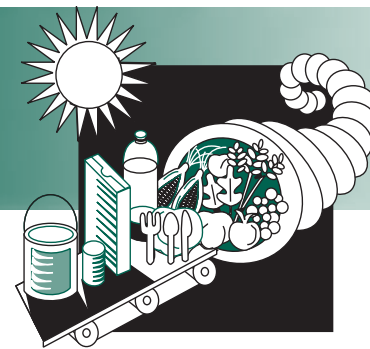


# AGRICULTURE

## Project Fact Sheet



## 1,3-PROPANEDIOL MADE FROM FERMENTATION- DERIVED MALONIC ACID

### BENEFITS

- Enhanced processability
- Lower production costs
- Superior polymer properties
- Improved national energy security
- Potential 2020 target market is 500 million lb per year
- Projected 2020 fossil fuel displacement is 10.4 trillion Btu

### APPLICATIONS

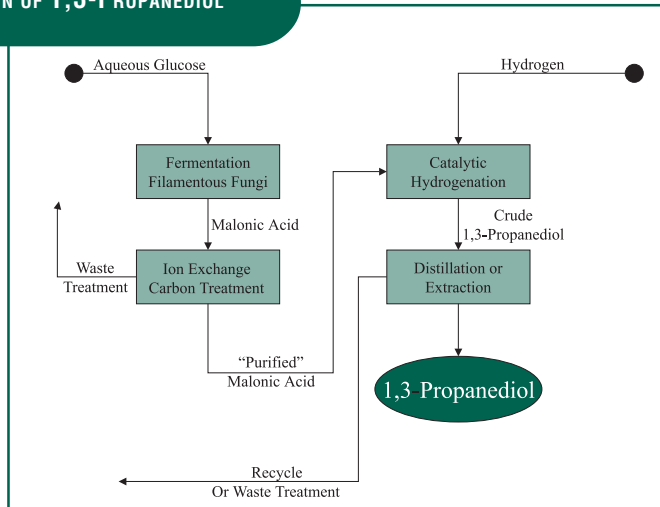
Thermoplastics such as PET are used in many applications offering a large market for biomass-based PTT from 1,3-propanediol. Research on filamentous fungi may be also applied in the future to the fermentation of renewable resources to other commodity chemicals.

## IMPROVED FERMENTATION PROCESS WILL ENHANCE PRODUCTION OF NEW RENEWABLE RESOURCE-BASED PLASTIC

Polyethylene terephthalate (PET) and nylon are two of the polymers that surround us in our every day life. PET is used to produce items such as beverage bottles and fleece clothing while nylon fibers are found in carpets, activewear/outerwear, backpacks, luggage, and footwear. Polytrimethylene terephthalate (PTT), a new, fast-growing variation of PET, can be used in both PET and nylon applications and offers enhanced properties such as a lower melting temperature, improved interaction with dye compounds, and greater fiber resilience and stretch recovery. These improved properties of PTT contribute to a lower production cost and a superior product.

One of the chemical precursors of PTT is 1,3-propanediol (PDO). PDO is currently made from ethylene oxide or propylene, both of which are fossil fuel-derived, but researchers are developing a fermentation/catalytic process that will use renewable resources as the feedstock. Fungi strains developed by the Pacific Northwest National Laboratory (PNNL) will be used to ferment agricultural feedstocks to malonic acid, which will then be catalytically converted to PDO. Production has been limited by the low yield of current fungi strains, but this project will focus on filamentous fungi. Relatively little is known about filamentous fungi, but it has proven successful in industrial-scale citric acid production. Initial studies indicate that the malonic acid production may be optimized to high yields, showing promise of a renewable route to PDO that is competitive with the fossil fuel-based route.

### PRODUCTION OF 1,3-PROPANEDIOL



Fermentation and catalytic processes are used to convert biomass sugars to 1,3 propanediol.



## Project Description

**Goal:** To develop and demonstrate a new process for producing 1,3-propanediol (PDO), a commodity chemical, from agriculturally-derived biomass at a lower cost than from petrochemicals.

Researchers at PNNL will identify the fungal strains capable of converting glucose to malonic acid, the precursor of PDO. The strains capable of at least a 50% conversion of glucose to malonic acid will be selected for strain improvement to maximize the production of malonic acid and suppress the production of unwanted compounds. A yield greater than 70% is the technical target. The fungal strains that meet the 70% conversion will be used to design a fermentation process in which process parameters will be optimized for the greatest yield of malonic acid, minimal production of co-products, elimination of fouling agents, and most efficient recovery of the acid. The National Corn Growers Association (NCGA) will coordinate industry participation in the fermentation process engineering step.

PNNL will develop catalysts to convert malonic acid to PDO. The catalysts to be used in the reaction optimization and subsequent process development and scale-up will be selected based on conversion, selectivity, and yield and will meet an 85% selectivity target. Independent process economic analysts, with input from NCGA and industrial partners, will develop an economic model that will be continuously refined throughout process development and used in the decision to proceed to the industrial fermentation design and process scale-up step.

## Progress and Milestones

Year 1:

- At least one organism will be identified that meets the 50% conversion of glucose to malonic acid target.
- A catalyst system will be developed that demonstrates 85% selectivity to PDO from pure malonic acid.

Year 2:

- At least one organism will be conditioned and a process defined to achieve economic targets of 70% yield for malonic acid production.
- Processes will deliver malonic acid of suitable purity and concentration to maintain catalyst activity and selectivity while meeting economic targets.
- Economic models will show that the optimized and integrated fermentation-catalyst system is economically competitive with petrochemical technology at an appropriate scale.



### PROJECT PARTNERS

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