



Renewable Innovation - FDME

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ADM: A History of Biorefinery Innovation

- ~\$64 B in revenues FY18, Net earning of ~\$2 B, Operating profit of ~\$3 B
- 250 ingredient manufacturing facilities, 500+ Crop procurement locations, 38 innovation centers, 32k employees, World's premier crop transportation network
- Founded in 1902 as a linseed crushing operation
- ADM's Daily Processing Capacity:



75,000 MT



95,000 MT



27,000 MT



current



ADM

Supermarket to the world

(1962-2001)

Archer-
Daniels-
Midland

(Before 1962)



ADM Sustainable Materials

Direct Replacements

- Majority of Development
- Meet specifications and must be competitive in current markets
- Lower GHG footprint in comparison to petroleum analogs
- Example: **Propylene Glycol**, Acrylic Acid, Adipic Acid, HMDA

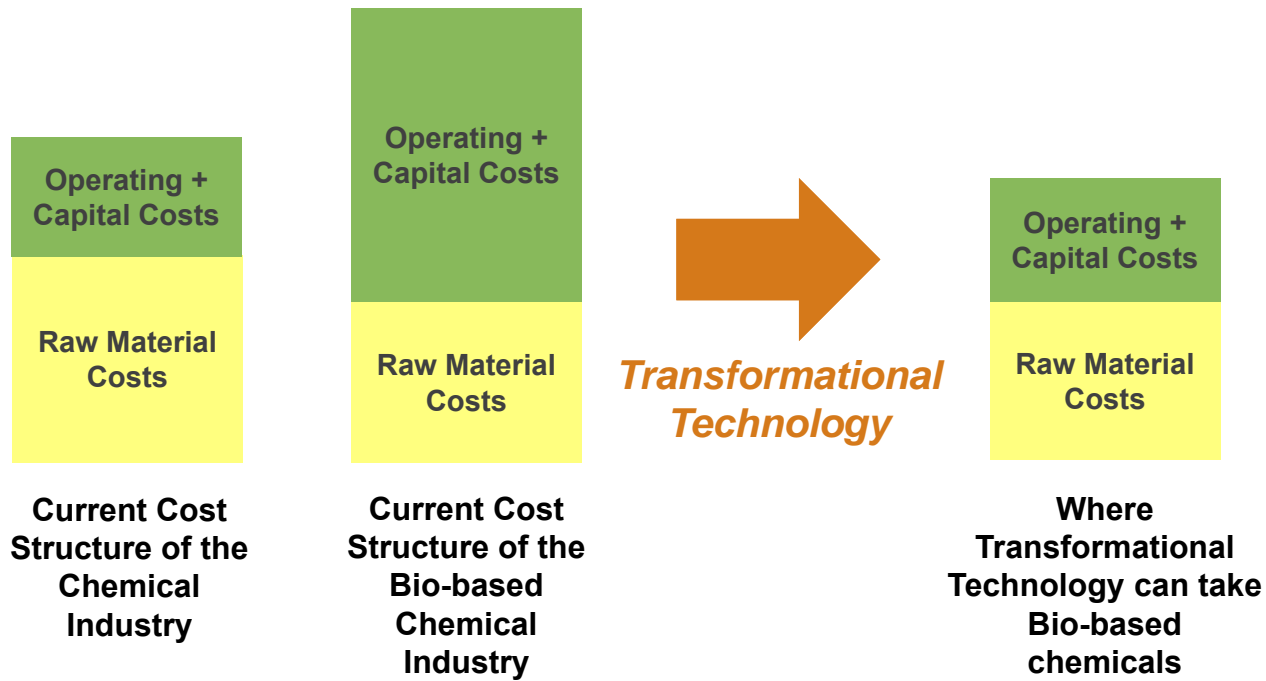
Bioadvantaged Molecules

- New intermediates not readily accessible from petrochemical routes
- Must have additional performance or environmental/health attributes
- Examples: **FDME**, Glucaric Acid



Transformational Technology Impact on Costs:

We need to drive innovation and technology to be competitive using renewable feedstocks



A photograph showing a worker in a high-visibility vest operating a boom lift to clean the side of a white airplane. The worker is positioned on the lift, which is extended over the aircraft. The lift's arm is white and has various cables and hoses attached. The airplane's fuselage is white and has a row of windows visible. The background is a clear sky. The ADM logo is visible in the top right corner of the image area.

ADM Progress in Sustainable Materials



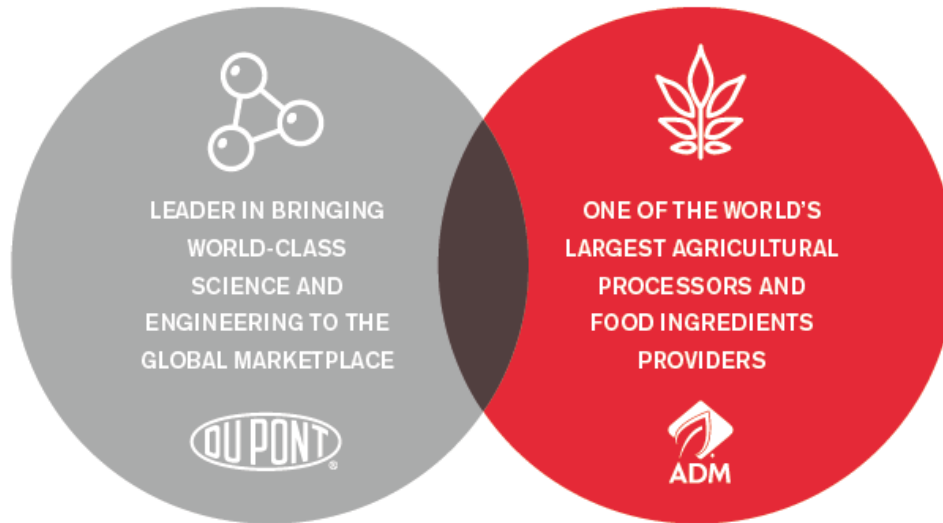
ADM Sustainable Materials

- Industrial Ethanol (USP, Industrial)
- Glycols (USP PG, PGI)
- Glycerin (USP)
- Sorbitol (USP)
- Industrial Oils
- Dispersants
- Xanthan Gum
- Citric Acid
- Envirostrip®
 - www.envirostrip.com
- Starch Portfolio
- Proteins
- Bioplasticizers

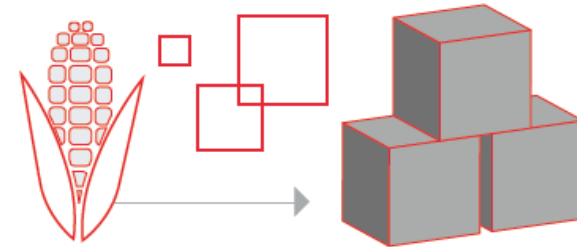


ADM and DuPont Announce FDME

A REVOLUTIONARY PARTNERSHIP BETWEEN TWO SCIENTIFIC LEADERS IS BRINGING A NEW MOLECULE TO MARKET



With their combined expertise in agriculture and food science, the two companies developed an innovative new process for turning fructose into biomaterial – specifically, the molecule furan dicarboxylic methyl ester (FDME) – a building-block that can be converted into a number of high-value, bio-based chemicals or materials.



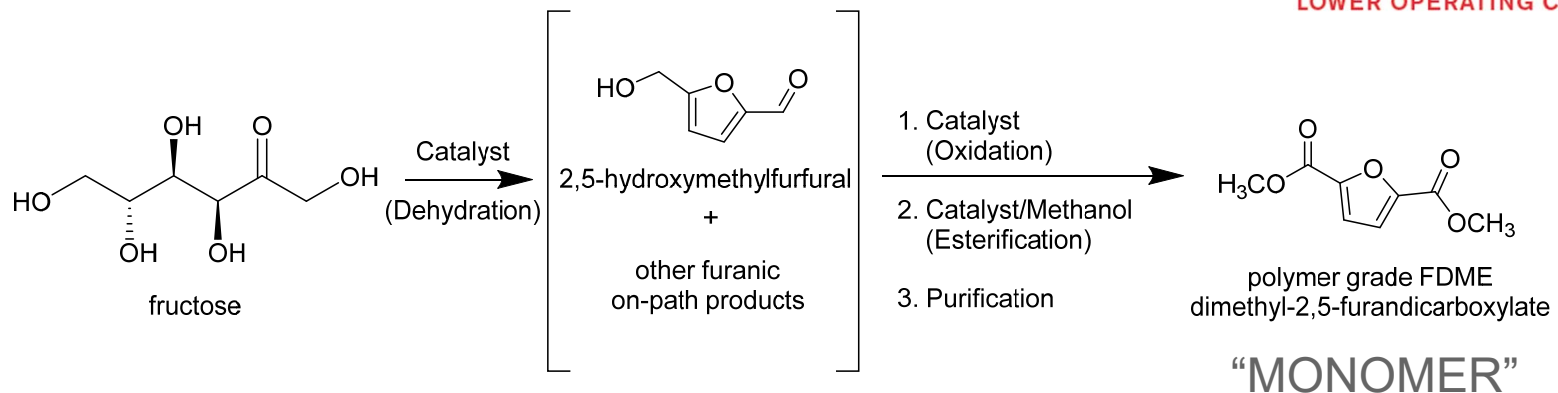
THIS SCIENTIFIC BREAKTHROUGH OPENS THE DOOR TO NEW POLYMER GROUPS AND HAS CREATED A MORE EFFICIENT, ECONOMICALLY VIABLE PROCESS.



The ADM-DuPont Process Advantage



HIGHER YIELDS AND
LOWER OPERATING COSTS



Highlights:

- Elimination of intermediate, on-path product purification steps
- Oxidation converts all on-path products to target molecule
- Energy produced in the oxidation step is integrated into the process



PTF: 100% Renewable Polyester with Superior Barrier Performance

Polytrimethylene Furandicarboxylate (PTF)

A novel polyester made from FDME and Bio-PDO™ (1,3-propanediol)



Superior gas barrier properties



Provides lightweighting and smarter packaging

Recyclable polymer



More packaging with recycled materials

100% renewable polymer



Enables use of more sustainable materials



Fibers



Packaging



Engineering Polymers



Barrier Performance of Selected Polyesters Relative to PET



	PET	Sorona® (PTT)	PEN	PTF
Composition	EG-TPA	PDO-TPA	EG-NDA	PDO-FDCA
O ₂ barrier (relative to PET)	1	~2	~6	~8-15
CO ₂ barrier (relative to PET)	1	~2	~6	~8-15

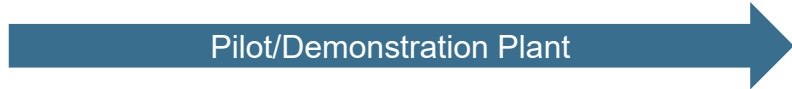
All Bio



Combination of FDME and Bio-PDO™ provides significantly differentiated performance



FDME Path Forward



Commercial scale

Lab scale

- Process concept and feasibility demonstrated

✓ **Completed**



Pilot

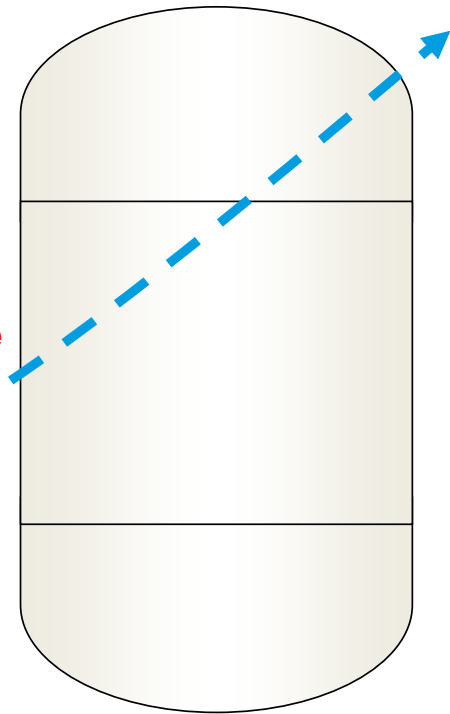
- Developing energy and material balance for continuous process
- De-risking Process

Market Development

- Fully Integrated Process
- Refining commercial estimates
- De-risking Product

✓ **Construction Complete**
✓ **Operating Plant**
✓ **Demonstrated Quality**

60 MT/yr



FDME Pilot/Market Development Plant



The Response



"A route to polymers that can not only compete with the massively produced and used PET (i.e. "the clear plastic bottle stuff"), but can even exceed it on a performance basis? As was said in Vince Vaughn's and Jon Favreau's breakthrough movie Swingers: That's so money." –



"Potential to expand the materials landscape in the 21st century with exciting and truly novel, high-performance renewable materials." –



"A breakthrough process with the potential to widen the materials landscape." –



"DuPont and ADM have game-changing platform technology based on long sought-after molecule." –



"This means that PTF a good choice for customers in the beverage packaging industry looking to improve the shelf life of their products." –



"New Bioplastic Mashup Spells Doom For Petrochemical Industry" –



INDUSTRIAL BIOSCIENCES

Turning a nice story into results...



ADM Decatur, IL Glycols Facility: 100,000MT Capacity

- Innovation
- Investment
- Partnerships