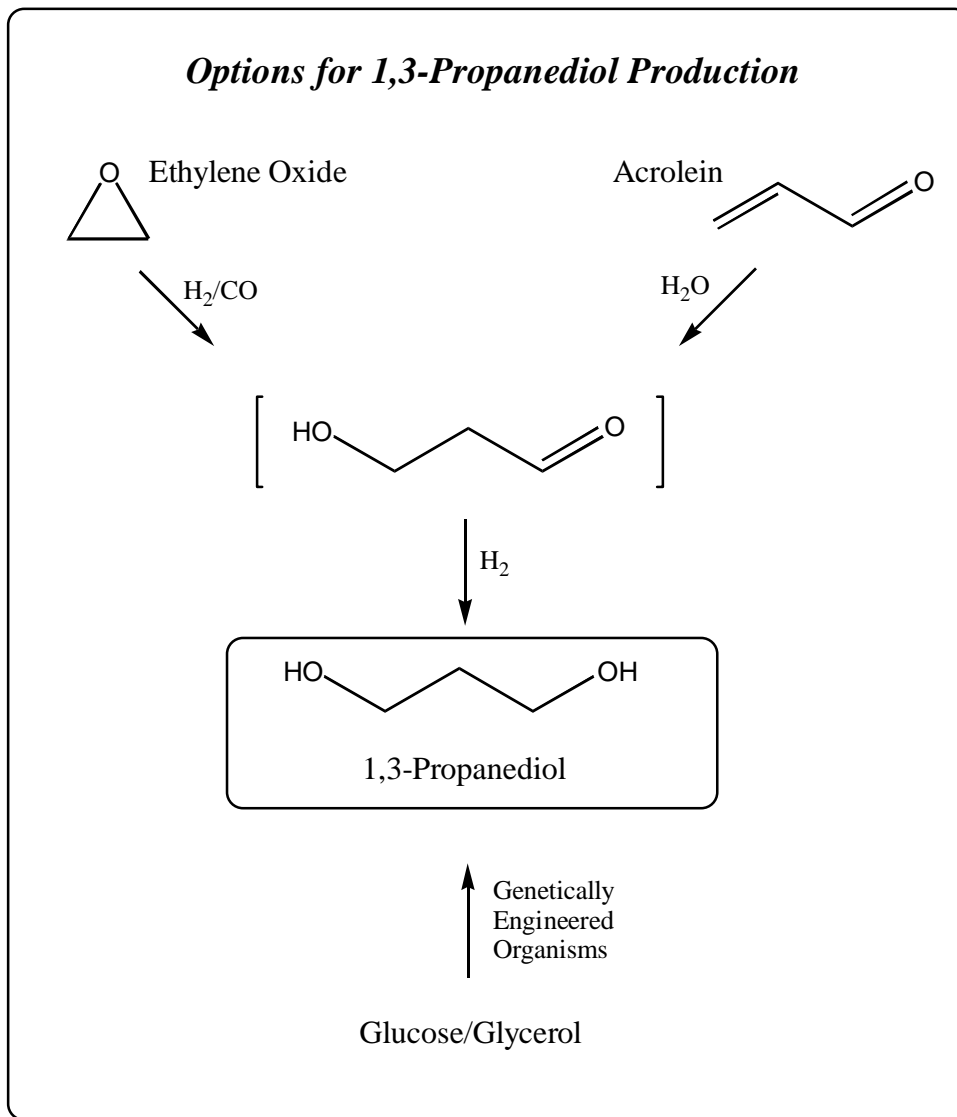


Biotransformation Routes to 1,3-Propanediol (97/98S4)

1,3-Propanediol (PDO), or trimethylene glycol (TMG) as it is otherwise known, is currently being used to make the new polyester polytrimethylene terephthalate (PTT). PTT is being developed for the carpet fiber sector and marketed by Shell Chemical Company under the tradename Corterra™. PDO has other potential applications besides PTT. If PDO is considered to be a C₃ analogue of 1,4-butanediol, then there are a host of derivative possibilities. These include thermoplastic polyurethanes, copolyester ethers, engineering polymers, etc.

There are currently two petrochemical routes to the PDO monomer. Shell has developed a process based on ethylene oxide, while Degussa developed a process based on acrolein. Recently, DuPont acquired the Degussa technology. DuPont has also committed itself to the development of a production process for PDO based on renewable feedstocks. It has strengthened its efforts by forming a strategic collaboration with Genencor. This collaboration has been aimed at producing PDO in a one-step fermentation process from corn-sugar, in preference to glycerol, as a feedstock. This could have economic advantages in terms of raw material costs. There are, however, significant difficulties in doing this, especially as glucose or fructose appears to suppress PDO formation in most organisms while others will not utilize these simple sugars for growth at all. However, in a recent DuPont patent, it has been revealed that it has been possible to clone the genes encoding for the diol formation into an organism which uses glucose as a substrate. One of the engineered strains of *E. coli* was reported to produce up to 0.6 g/l of PDO when grown in shake flask culture with 3.6 g/l glucose as the sole carbon source. Obviously, such titres would need to be improved and the stability of such strains proven for application at an industrial scale. It is thought that the DuPont fermentation route is still some time before commercialization. Indeed, the company, as mentioned above, has recently acquired extra-non-biological-PDO capacity from Degussa.

Acquisition of the Degussa acrolein based route to PDO allows DuPont to compete with Shell in the short term while they continue to develop a biotech route for the long term.



Based on patent literature and discussions with the biotech industry, Chem Systems has devised flowsheets and cost of production estimates for batch and continuous fermentation processes for PDO. Cost of production estimates have been developed through further genetic engineering, cloning, etc. The biotransformation routes to PDO have been subsequently compared against those based on petrochemical feedstocks. The source of PDO as a component of the cost of PTT production has also been considered.