Yeast Saccharomyces cerevisiae is an important industrial host for production of enzymes, pharmaceutical and nutraceutical ingredients and recently also commodity chemicals and biofuels. Here, we review the advances in modeling and synthetic biology tools and how these tools can speed up the development of yeast cell factories. We also present an overview of metabolic engineering strategies for developing yeast strains for production of polymer monomers: lactic, succinic, and cis,cis-muconic acids. S. cerevisiae has already firmly established itself as a cell factory in industrial biotechnology and the advances in yeast strain engineering will stimulate development of novel yeast-based processes for chemicals production.