For an industrial fermentation process, it can be advantageous to decouple cell growth from product formation. This decoupling would allow for the rapid accumulation of biomass without inhibition from product formation, after which the fermentation can be switched to a mode where cells would grow minimally and primarily act as catalysts to convert substrate into desired product. The switch in fermentation mode should preferably be accomplished without the addition of expensive inducers. A common cell factory Saccharomyces cerevisiae is a Crabtree-positive yeast and is typically fermented at industrial scale under glucose-limited conditions to avoid the formation of ethanol. In this work, we aimed to identify and characterize promoters that depend on glucose concentration for use as dynamic control elements. Through analysis of mRNA data of S. cerevisiae grown in chemostats under glucose excess or limitation, we identified 34 candidate promoters that strongly responded to glucose presence or absence. These promoters were characterized in small-scale batch and fed-batch cultivations using a quickly maturing rapidly degrading green fluorescent protein yEGFP3-Cln2PEST as a reporter. Expressing 3-hydroxypropionic acid (3HP) pathway from a set of selected regulated promoters allowed for suppression of 3HP production during glucose-excess phase of a batch cultivation with subsequent activation in glucose-limiting conditions. Regulating the 3HP pathway by the ICL1 promoter resulted in 70% improvement of 3HP titer in comparison to PGK1 promoter.