We demonstrate a novel mechanism for rewiring natural cellular responses to particular cellular states, termed embedded genomic tags. Specifically, we designed new sensor technology for endogenous gene expression via co-expression of synthetic guide RNA (sgRNA) and/or miRNA along with the endogenous genes. Using precise genomic integration downstream of a gene of interest, the corresponding endogenous mRNA self-cleaves to create two separate transcripts, one encoding the original endogenous gene and a second encoding a cassette comprising synthetic sgRNA or miRNA transcripts. We introduce a synthetic poly(A) sequence between these transcripts to regulate the 3’ poly(A) processing of the modified endogenous gene transcript, such that the self-cleaved endogenous mRNA maintains its wildtype properties, including nuclear export and translational ability. The second transcript, which is downstream of the synthetic poly(A) sequence, contains a cassette of sgRNA or miRNA elements that combine with dCas9 or miRNA processing machinery to activate or inhibit any gene of interest. By placing embedded genomic tags downstream of multiple genes, the embedded genomic tags can implement multi-input logic functions for rewiring cellular responses.