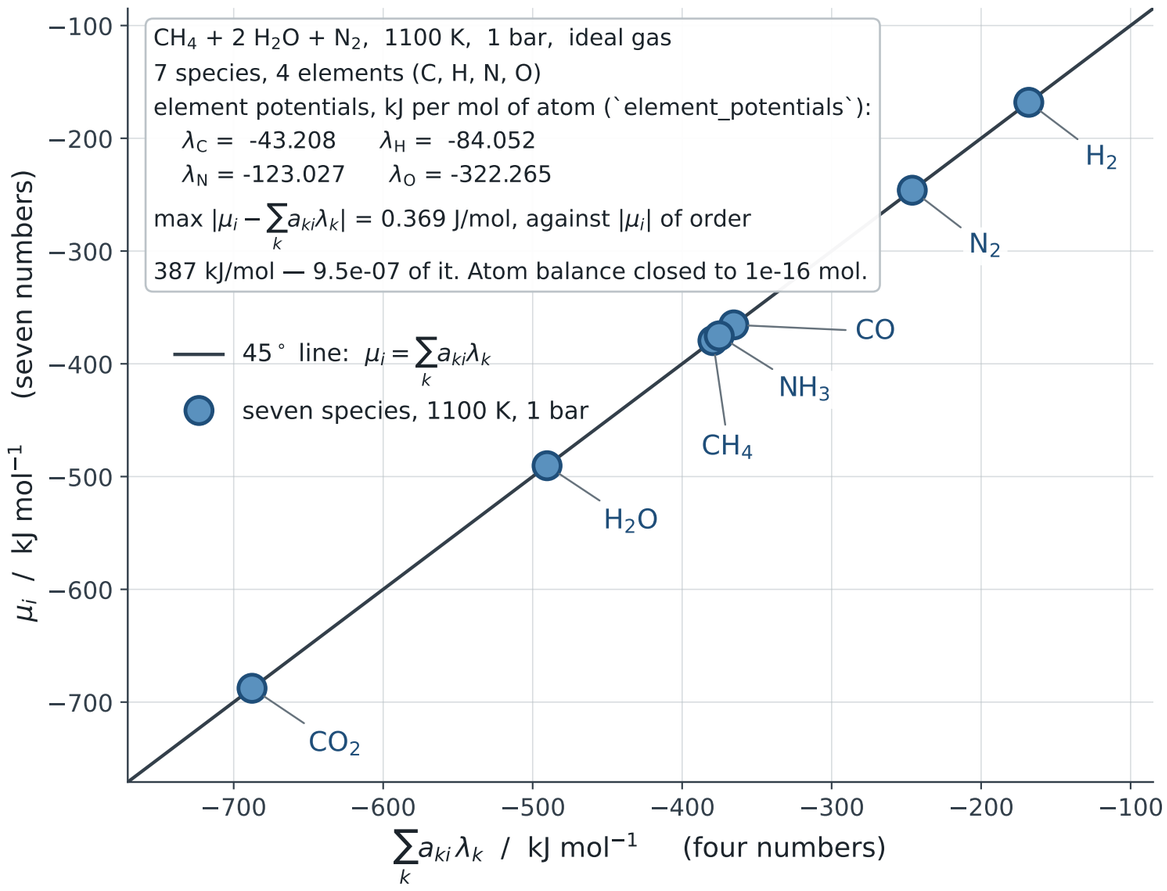
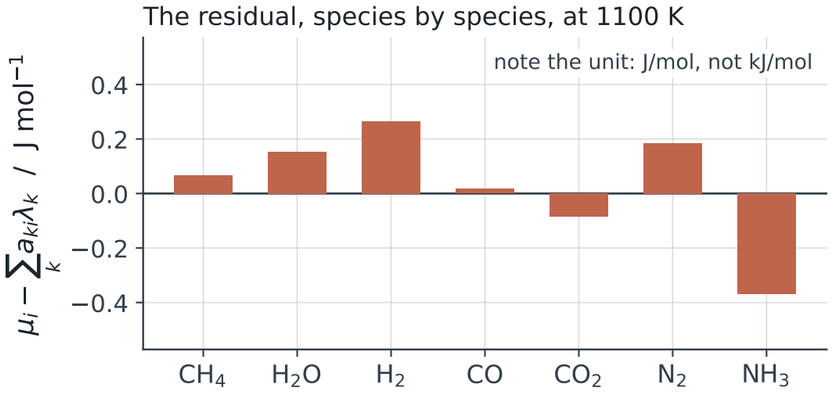
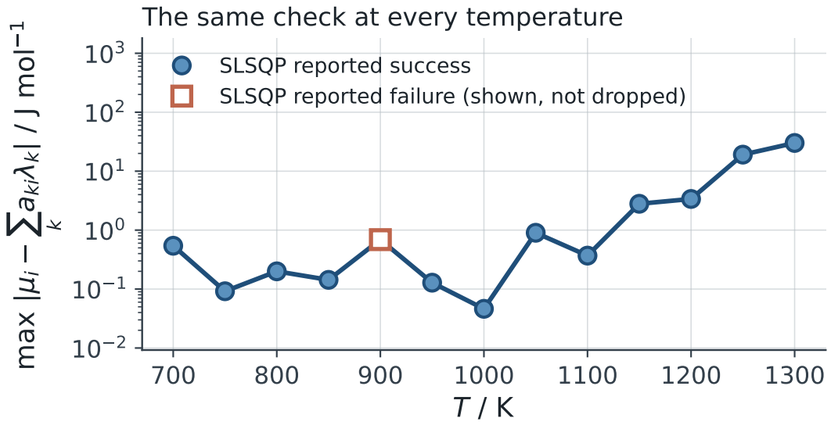
Seven chemical potentials, four numbers: at equilibrium a species carries no information beyond the atoms it is made of







Formation properties from `chemicals`. The minimisation is `reaction.gibbs_minimise` (SLSQP on $\ln n$ subject to $An = b$); the multipliers are the least-squares solution of $A^{\mathrm{T}}\lambda = \mu$ and are never used to obtain the composition, so the residual above is an independent check. O_2 and NO were removed from the species list: their equilibrium mole fractions here are of order 10^{-25} and 10^{-8}, and the minimiser cannot resolve $\ln n$ for a species that contributes nothing to G.

Equilibrium composition at 1100 K, 1 bar: CH_4 0.00046471, H_2O 0.13416, H_2 0.53216, CO 0.13323, CO_2 0.033135, N_2 0.16681, NH_3 4.8673e-05.