

Table 1. Oxidation/reduction midpoint potentials for the reactions in reverse methanogenesis pathway.

Oxidant	Reductant	Em(mv)
CoM-S-S-CoB	CoM-SH + CoB-SH	-140
F420	F420H ₂	-380
Fd _{ox}	Fd _{red}	-520
MQ	MQH ₂	-80
NO ₃ ⁻	NO ₂ ⁻	+420

Table 2. Gibbs free energy of the reactions in reverse methanogenesis pathway in *M. nitroreducens*. The Gibbs free energy of Mcr, Mtr and Mer + Mtd + Mch, Ftr + Fmd are published values. HdrDE, HdrABC, NarGH and Fqo are calculated with the published standard midpoint potentials presented in Supplementary Table 1, using $\Delta G = -n F \Delta E$. F is the Faraday constant, 0.09648kJ/eV, n is the number of moles of electrons transferred in the reaction.

Enzyme	Reaction	$\Delta G^{\circ'}$ (kJ/mol)
Mcr	CH ₄ [c] + CoM-S-S-CoB[c] <=> CoB-SH[c] + CH ₃ -CoM[c]	+45
Mtr	CH ₃ -CoM[c] + H ₄ MPT[c] + 2 Na ⁺ [e] <=> CH ₃ -H ₄ MPT[c] + CoM-SH[c] + 2 Na ⁺ [c]	+30
HdrDE	CoB-SH[c] + CoM-SH[c] + 2 H ⁺ [e] + MQ[c] <=> CoM-S-S-CoB[c] + MQH ₂ [c] + 2 H ⁺ [c]	-11.58
HdrABC	CoB-SH[c] + CoM-SH[c] + 2 Fd _{red} [c] + 2 F420[c] <=> CoM-S-S-CoB[c] + 2 Fd _{ox} [c] + 2 F420H ₂ [c]	+38.59
NarGH	NO ₃ ⁻ [e] + MQH ₂ [c] + 4 H ⁺ [c] <=> NO ₂ ⁻ [e] + MQ[c] + H ₂ O[c] + 4 H ⁺ [e]	-96.48
Mer+Mtd +Mch	CH ₃ -H ₄ MPT[c] + 2 F420[c] <=> CHO-H ₄ MPT[c] + 2 F420H ₂ [c]	-5.3
Ftr+Fmd	CHO-H ₄ MPT[c] + Fd _{ox} [c] + H ₂ O[c] <=> CO ₂ [c] + H ₄ MPT[c] + Fd _{red} [c]	-32
Fqo	F420H ₂ [c] + MQ[c] + 3 H ⁺ [c] <=> F420[c] + MQH ₂ [c] + 3 H ⁺ [e]	-57.87