**REDOX HALF-REACTION REDUCTION POTENTIALS AND FREE ENERGIES[1]**

| Redox Pair (ox/red) | Electron donor compound | $E_O$' (volt) | $\Delta G_O$' (kJ/$e^-$) |
|---|---|---|---|
| $CO_2/CH_2O$ | carbohydrate | -0.43 | +41.5 |
| $CO_2/CH_3OH$ | methanol | -0.39 | +37.5 |
| $CO_2/CH_3COCOO^-$ | pyruvate | -0.37 | +35.8 |
| $CO_2/CH_2CHOHCOO^-$ | lactate | -0.34 | +32.9 |
| $CO_2/C_{16}H_{24}O_5N_4$ | protein | -0.333 | +32.2 |
| $CO_2/C_{10}H_{19}O_3N$ | domestic wastewater BOD | -0.33 | +31.8 |
| $CO_2/CH_3CH_2OH$ | ethanol | -0.33 | +31.8 |
| $CO_2/CH_3COO^-$ | acetate | -0.29 | +28.0 |
| $CO_2/C_2H_5COO^-$ | propionate | -0.29 | +28.0 |
| $CO_2/C_8H_{16}O$ | Oil and Grease | -0.29 | +28.0 |
| $CO_2/CH_4$ | methane | -0.25 | +24.1 |
| $SO_4^{2-}/HS^-$ | sulfide | -0.217 | +20.9 |
| $NO_3^-/NH_4^+$ | ammonium | +0.36 | -34.7 |
| $NO_3^-/N_2$ | nitrogen | +0.75 | -72.4 |
| $Fe^{3+}/ Fe^{2+}$ | ferrous iron | +0.77 | -74.3 |
| $O_2/H_2O$ | water | +0.82 | -79.1 |

<u>Examples of use of redox energetic in biological processes</u>

$0.25CO_2 + H^+ + e^- \rightarrow 0.25CH_2O + 0.25H_2O$ $\Delta G_O' = 41.5$
(carbon fixation requires a lot of energy; carbohydrate oxidation yields energy)

$0.2\ NO_3^- + 1.2H^+ + e^- \rightarrow 0.1N_2 + 0.6H_2O$ $\Delta G_O' = -72.4$
(denitrification yields energy, nitrogen oxidation consumes energy)

$0.25O_2 + H^+ + e^- \rightarrow 0.5H_2O$ $\Delta G_O' = -79.1$
(reduction of oxygen, e.g., respiration, yields more energy than denitrification, while production of oxygen from water, e.g., photosynthesis, takes energy)

1. Values for pH=7, F = 96.5 kJ/volt, $\Delta G_O$' sign convention for reduction half-reaction