Table 1. Overview of quantitative PPR features

Reported numbers of PPRs per cell				
PPRs/cell	**PPR type**	**Organism**	**Method**	**Refs**
10^4	Proteorhodopsin	*Pelagibacter ubique*	Laser flash induced spectroscopy	[80]
2.4×10^4	Proteorhodopsin	Uncultivated γ-proteobacterium EBAC31A08	Laser flash induced spectroscopy	[47]
4×10^4	Proteorhodopsin	*Shewanella oneidensis* MR-1 (engineered)	Spectroscopy	[7]
$5.22\times10^4\pm3.07\times10^4$	Proteorhodopsin	*Winogradskyella* sp. PG-2	Spectroscopy	[81]
Reported proton-pumping rates per PPR				
Proton- pumping rate (H^+/PPR/min)	**PPR type**	**Organism**	**Method**	**Refs**
204	Bacteriorhodopsin	*Halobacterium salinarum*	Liposomes	[82]
124±73	Proteorhodopsin	*Winogradskyella* sp. PG-2	Cells	[81]
30	Xanthorhodopsin (*Gloeobacter* rhodopsin)	*Escherichia coli* (engineered)	Spheroplast vesicles[a]	[83]
Estimate for a feasible PPR proton flux per cell				
Assumed PPRs per cell[b]		**Assumed proton- pumping rate per PPR (H^+/PPR/min)[c]**	**Estimated proton-pumping rate per cell**	
			(H^+/cell/min)	**(mmol H^+/g DW/h)[d]**
10^5		300	6.0×10^7	10

[a]For this measurement, *Gloeobacter* rhodopsin was reconstituted with retinal, but without its antenna pigment, echinenone.

[b]An ~100% higher number of PPRs per cell than the highest value reported in literature for natural hosts is assumed to be feasible by PPR overexpression in, for example, *E. coli*.

[c]50% higher proton flux per PPR than reported in literature is assumed to be feasible at high light intensities.

[d]A cell dry weight (DW) of 3×10^{-13} g DW/cell is assumed for *E. coli* (http://bionumbers.hms.harvard.edu//bionumber.aspx?id=103904&ver=16).

7 Johnson, E.T. *et al.* (2010) Enhancement of survival and electricity production in an engineered bacterium by light-driven proton pumping. *Appl. Environ. Microbiol.* 76, 4123–4129

47 Béja, O. *et al.* (2001) Proteorhodopsin phototrophy in the ocean. *Nature* 411, 786–789

80 Giovannoni, S.J. *et al.* (2005) Proteorhodopsin in the ubiquitous marine bacterium SAR11. *Nature* 438, 82–85

81 Yoshizawa, S. *et al.* (2012) Diversity and functional analysis of proteorhodopsin in marine Flavobacteria. *Environ. Microbiol.* 14, 1240–1248

82 Mogi, T. *et al.* (1988) Aspartic acid substitutions affect proton translocation by bacteriorhodopsin. *Proc. Natl. Acad. Sci. U.S.A.* 85, 4148–4152

83 Kawanabe, A. *et al.* (2009) Engineering an inward proton transport from a bacterial sensor rhodopsin. *J. Am. Chem. Soc.* 131, 16439–16444