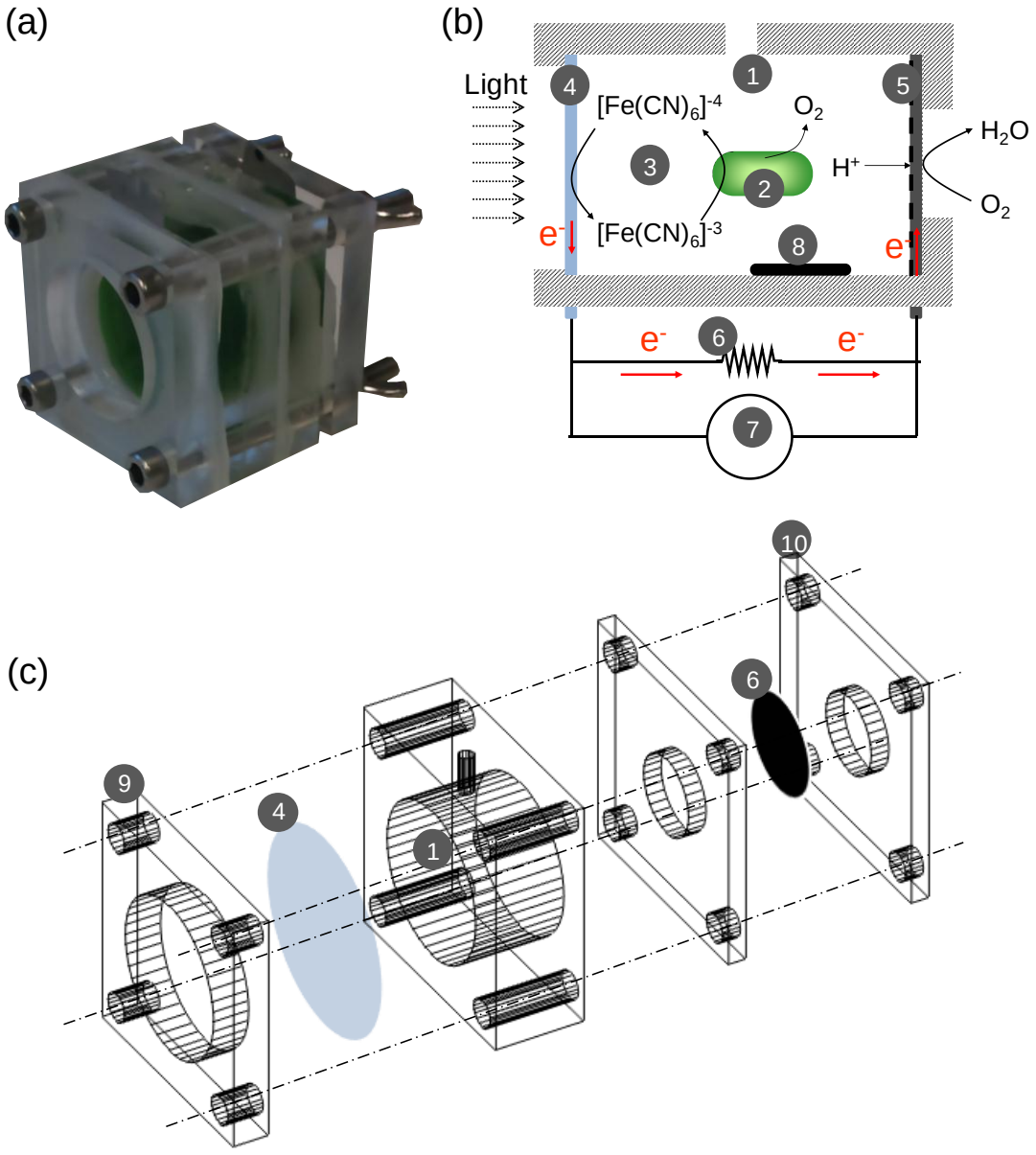
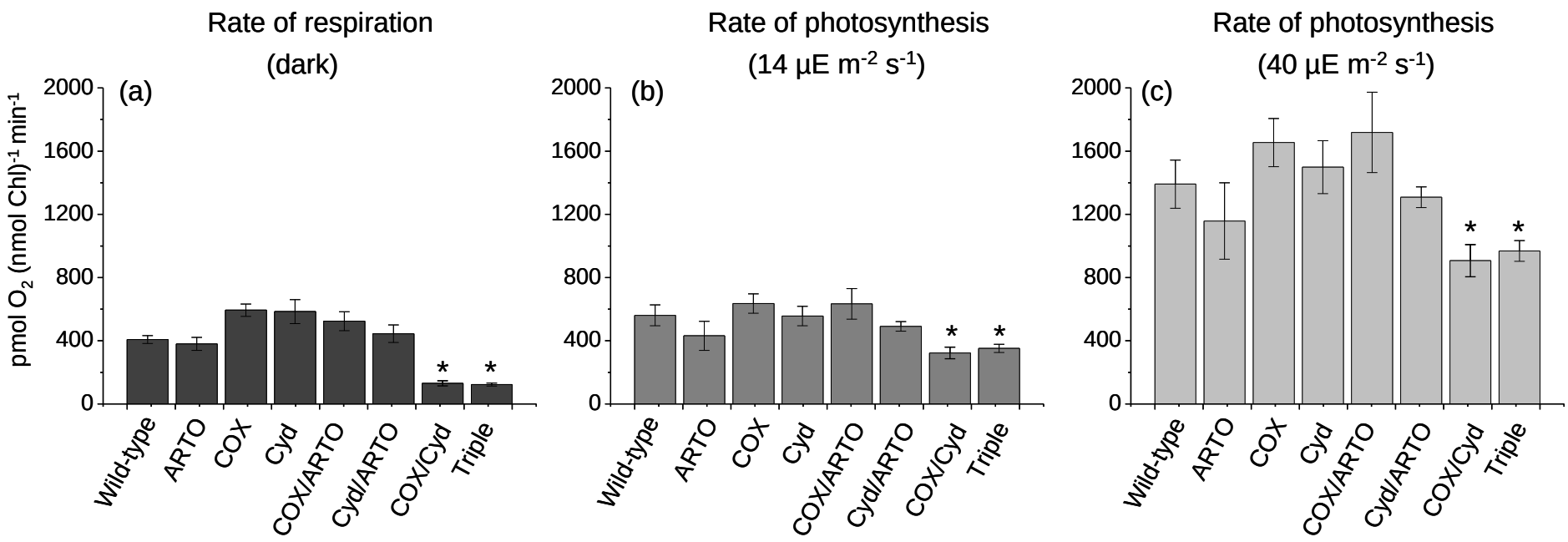
Supplementary Table 1 – Formulae

Ferricyanide reduction rate	$Rate = \sum_{i=2}^{4}\left(\frac{([F]_i - [F]_{i-1})}{(t_i - t_{i-1})} \cdot \frac{2}{([C]_i + [C]_{i-1})} \cdot \frac{(t_i - t_{i-1})}{t_4}\right)$ $\equiv \sum_{i=2}^{4}\left(\frac{2 \cdot ([F]_i - [F]_{i-1})}{([C]_i + [C]_{i-1}) \cdot t_4}\right)$	Where t_i is the time at which the i^{th} sample was taken, and $[F]_i$ and $[C]_i$ are respectively the concentrations of ferricyanide and chlorophyll in that sample.
Photosynthetic oxygen evolution model	$P = P_m \cdot \tanh\left(\frac{I}{I_k}\right)$	P is the rate of photosynthetic oxygen evolution at light intensity I, P_m is the maximal rate, I_k is a constant which describes the minimum light intensity required to photosynthetic oxygen evolution (x-axis intercept). Values of P_m and I_k that would create a curve which fitted the data best were found using a least squares method.
Ohm's law	$V = I \cdot R$	V is voltage, I is current, R is resistance.
Power from Ohm's law	$P = I \cdot V \equiv \frac{V^2}{R}$	P is power.



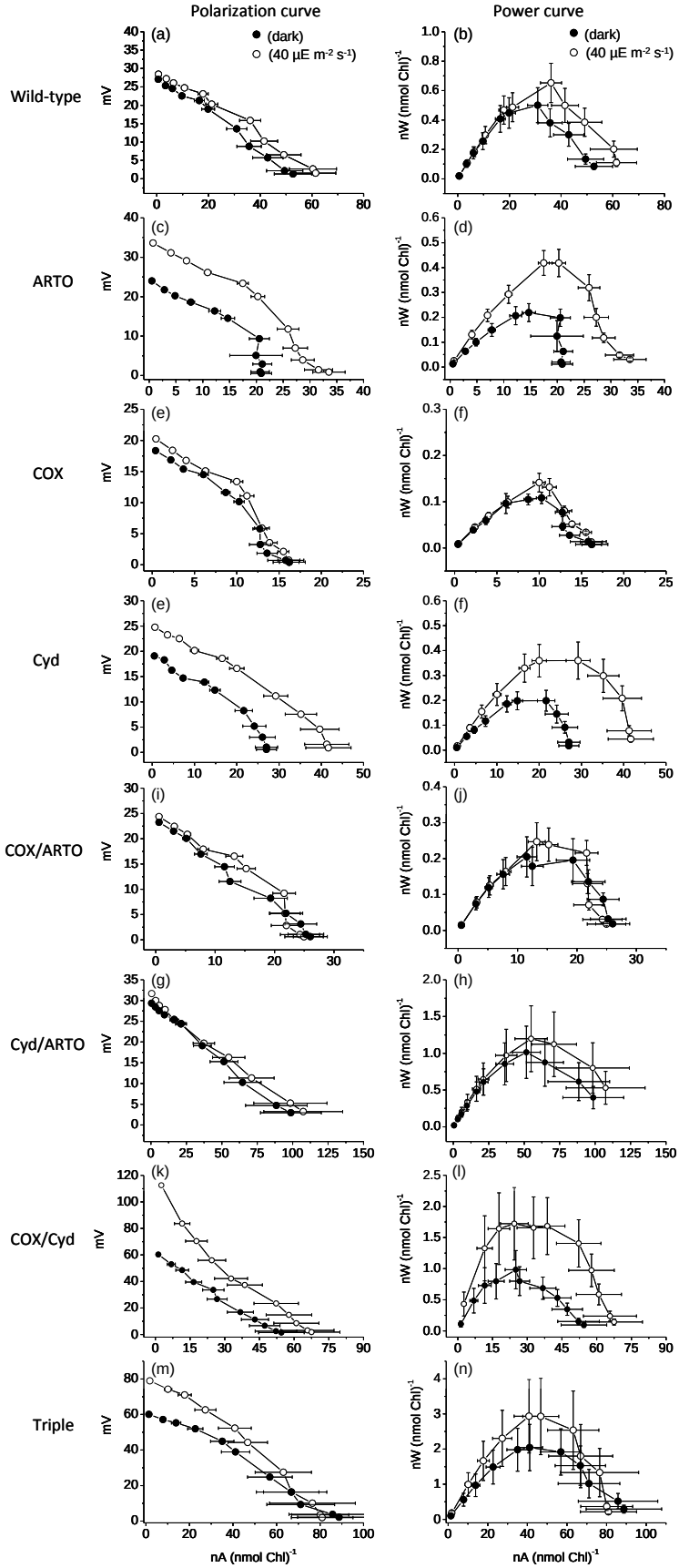
Supplementary Figure 1 – The BPV device

(**a**) Photograph of the BPV device. (**b**) Principle of operation: within the anodic chamber (1) the cyanobacterial cells (2) reduce ferricyanide to ferrocyanide (3). This electron carrier shuttles electrons from the photosynthetic material to the transparent ITO anode (4). Simultaneously, protons (H^+) diffuse from the anodic chamber across the proton exchange membrane to the cathodic membrane (5). After reaching the anode, electrons travel through an external load (6) to the cathode (5), where they are combined with oxygen and protons to re-form water. The difference in potential between anode and cathode is monitored by a precision data logger (7). Cyanobacterial cells are kept in suspension by a magnetic stirrer (8) placed underneath the anodic chamber. (**c**) Exploded view of a BPV device. The front clamp (9) permits light to enter the anodic chamber (1) of the BPV. The back clamp (10) has holes to allow oxygen to contact the cathode and water to escape.



Supplementary Figure 2 – Oxygen consumption and production rates

The data are averages of at least three biological replicates; error bars show standard error of the mean. An asterisk indicates that an ANOVA test found the value was significantly different from the group of samples containing the wild-type with a p-value of less than or equal to 5%. For comparisons to other work, the conversion factor from pmol O_2 (nmol chl)$^{-1}$ min^{-1} to µmol O_2 (mmol chl)$^{-1}$ hr^{-1} is 0.06, and to µmol O_2 (mg chl)$^{-1}$ hr^{-1} is 67.2.



Supplementary Figure 3 – Power curves from BPV devices operating with terminal oxidase mutants

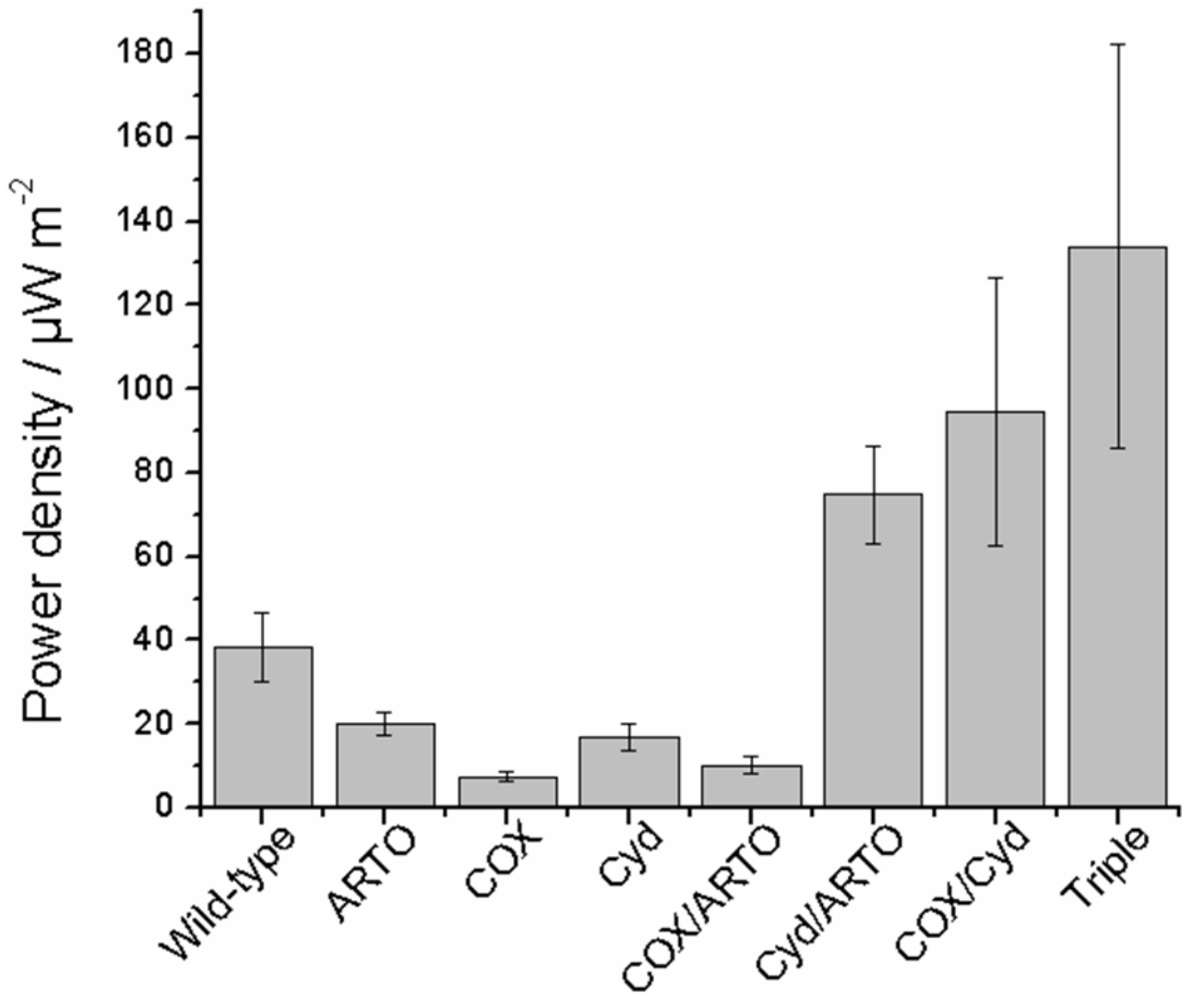
Parts (**a**), (**c**), (**e**), (**g**), (**i**), (**k**), and (**m**) are polarisation curves taken at the end of the dark period (filled circles) and or light period (open circles). Parts (**b**), (**d**), (**f**), (**h**), (**j**), (**l**), and (**n**) are the resulting power curves.

	Ferricyanide reduction rate - pmol $[Fe(CN)_6]^{3-}$ min^{-1} (nmol chl)$^{-1}$								
	Dark			Light - 14 µE m^{-2} s^{-1}			Light - 40 µE m^{-2} s^{-1}		
Strain	**Average**	**SEM**	**N**	**Average**	**SEM**	**N**	**Average**	**SEM**	**N**
Wild-type	2.0	0.4	8	6.2	1.2	4	13.7	1.4	4
ARTO	7.9*	1.4	8	8.5	2.0	4	14.3	0.2	4
COX	7.1*	1.1	8	15.6*	1.9	4	25.3	3.2	4
Cyd	7.4*	1.8	7	15.1	4.4	3	14.7	1.3	4
COX/ARTO	11.6*	1.5	8	13.4	4.4	4	20.2	2.2	3
Cyd/ARTO	17.3*	5.2	15	14.2	1.9	8	44.6	13.8	8
COX/Cyd	38.2*	3.4	11	8.1	0.2	4	35.7	8.4	8
Triple	46.5*	5.7	11	7.1	2.0	4	27.2	4.9	8

	% electrons to ferricyanide								
	Dark			Light - 14 µE m^{-2} s^{-1}			Light - 40 µE m^{-2} s^{-1}		
Strain	**Average**	**SEM**	**N**	**Average**	**SEM**	**N**	**Average**	**SEM**	**N**
Wild-type	0.13	0.03	8	0.23	0.07	4	0.33	0.04	4
ARTO	0.60*	0.15	6	0.41	0.10	3	0.66	0.19	3
COX	0.33*	0.07	7	0.75	0.14	4	0.36	0.04	3
Cyd	0.30*	0.03	7	0.57	0.09	3	0.32	0.03	4
COX/ARTO	0.64*	0.13	7	0.40	0.12	4	0.53	0.01	3
Cyd/ARTO	0.93*	0.31	13	0.82	0.14	8	0.87	0.35	6
COX/Cyd	8.10*	1.42	11	0.78	0.07	4	0.88	0.18	8
Triple	10.49*	1.67	10	0.59	0.25	4	0.84	0.18	6

Supplementary Table 2 - Ferricyanide reduction data

An asterisk indicates that an ANOVA test found the value differed significantly from the group of samples containing the wild-type with a p-value of less than or equal to 5%. SEM = Standard error of the mean.



Supplementary Figure 4 – Raw BPV Power Output

Data are averages of peak power produced at the end of a period of illumination from at least four biological replicates; error bars indicate standard error of the mean; power is normalised to anode area; cell density was 2 ± 0.3 (nmol chl) ml^{-1}.

	Ferricyanide reduction rate – pmol $[Fe(CN)_6]^{3-}$ min^{-1} $(nmol\ chl)^{-1}$		
Strain	**Dark**	**Light - 14 µE m^{-2} s^{-1}**	**Light - 40 µE m^{-2} s^{-1}**
Wild-type	2.0 ± 0.4	6.2 ± 1.2	14 ± 1.4
Triple	46 ± 5.7	7.1 ± 2.0	27 ± 4.9
M55	100 ± 19	61 ± 16	34 ± 4.0

Supplementary Table 3 – Ferricyanide reduction; comparison with M55