Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology. This journal is © The Royal Society of Chemistry 2018

1 Pages: 5 Figures: 4; Table: 1 2 **Supporting Information** 3 4 5 Anaerobic membrane gas extraction facilitates thermophilic hydrogen 6 production from Clostridium thermocellum 7 8 Scott Singer¹, Lauren Magnusson², Dianxun Hou¹, Jonathan Lo², Pin-Ching Maness^{2*} and Zhiyong Jason 10 Ren^{1,3*} 11 Department of Civil, Environmental, and Architectural Engineering, University of Colorado Boulder, Boulder, Colorado 80309, United States 13 ² National Renewable Energy Laboratory, Biosciences Center, Golden, Colorado 80401, United 14 States 15 ³Department of Civil and Environmental Engineering, Princeton University, Princeton, New 16 Jersey, 08544, United States 17 *Corresponding Authors National Renewable Energy Laboratory, Biosciences Center, Golden, Colorado 80401, United States Phone: 303-384-6114, Email: PinChing.Maness@nrel.gov 20 UCB 607, SEEC S291B, University of Colorado, Boulder, CO 80309 21 22 Phone: 303-492-4137, Email: zhiyong.ren@colorado.edu

28 Supplemental Figures

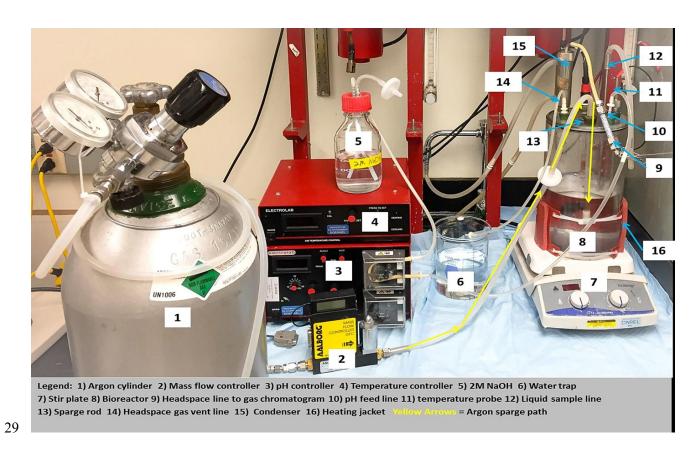
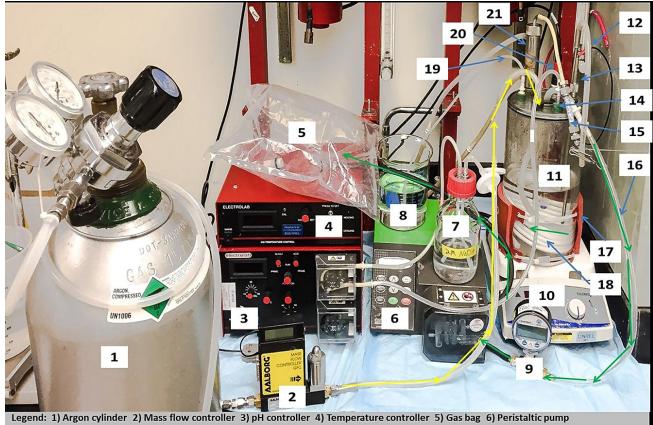


Figure S1: Fermentation setup for the AF.



Legend: 1) Argon cylinder 2) Mass flow controller 3) pH controller 4) Temperature controller 5) Gas bag 6) Peristaltic pump
7) 2M NaOH 8) Water trap 9) Pressure gauge 10) Stir plate 11) Bioreactor 12) Liquid sample line 13) Temperature probe 14) pH feed line
15) Headspace line to gas chromatogram 16) Membrane gas extraction line 17) Heating jacket 18) Hydrophobic membrane
19) Headspace vent line 20) pH probe 21) Condenser

Green Arrows = Membrane Effluent Path Yeliow Arxows = Argon sparge path

Figure S2: Fermentation setup for the AnMBR.

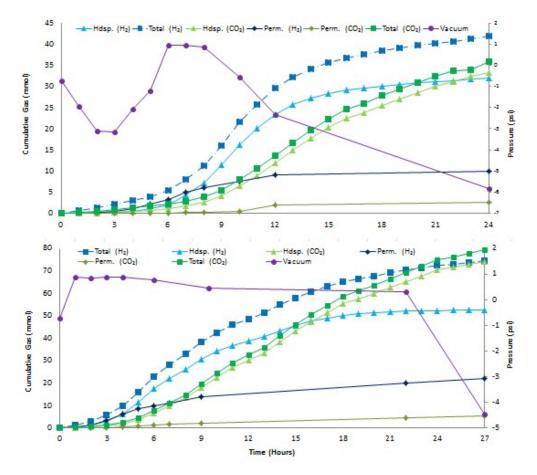


Figure S3: Cumulative AnMBR gas production and vacuum pressure vs. time on (A) Cellobiose (B) and on Avicel.

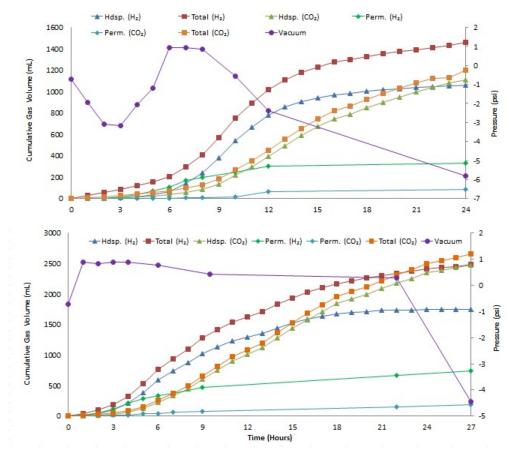


Figure S4: Cumulative volumetric AnMBR gas production and vacuum pressure vs. time on (A) Cellobiose (B) and on Avicel.

Table S1. Comparison of theoretically estimated and experimentally measured H₂ yields.

| Substrate | Reactor Mode | H2 Yield | Substrate | Reactor Mode | H₂ Yield |
|-----------|-----------------|------------------------|-----------|-----------------|-----------|
| | | (mmol H ₂ / | | | (mmol H2/ |

| | mmol Hexose) | | | | | | | |
|-----------------------|--------------|------------------|------------|-----------------------|-------|------------------|------------|--|
| Cellobiose (5 g/L) | AF | Theoretical | 0.66 | Cellobiose (5 g/L) | AnMBR | Theoretical | 0.70 | |
| | AF | Measured | 0.43 ± 13% | | AnMBR | Measured | 0.68 ± 30% | |
| | | % of Theoretical | 65% ± 13% | | | % of Theoretical | 97% ± 30% | |
| Avicel (5 g/L) | AF | Theoretical | 1.23 | Avicel (5 g/L) | AnMBR | Theoretical | 1.84 | |
| | AF | Measured | 0.76 ± 3% | | AnMBR | Measured | 1.21 ± 13% | |
| | | % of Theoretical | 62% ± 3% | | | % of Theoretical | 66% ± 13% | |