

Supplementary information

The environmental biorefinery: state of the art on the production of hydrogen and value-added biomolecules in mixed-culture fermentation

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Table S1: Technology readiness level (TRL) scale according to the European Commission

TRL	Description
1	Basic principles observed
2	Technology concept formulated
3	Experimental proof of concept
4	Technology validated in lab
5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
7	System prototype demonstration in operational environment
8	System complete and qualified
9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies)

Table S2: Patent database

Priority date	Title	Patent number	Patent status
2015	System and method for bio-electrochemical water oxidation	EP3075884 A1;	Application (EP)
2015	Food waste fermentation device using soil microbes and livestock manure composting device, biofield generator suitable for same, microbial cell suitable for same and microbial condenser suitable for same	WO2016129846 A1;	Application (WO)
2015	Processing of biomass materials	WO2016160955 A1;	Application (WO)
2015	Process for producing polyhydroxyalkanoates from precursors obtained by anaerobic fermentation from fermentable biomass	US2016251474 A1; WO2016135396 A1; FR3033168 B1;	Application (US; WO) Active (FR 2017)
2014	Conversion of biomass, organic waste and carbon dioxide into synthetic hydrocarbons	US2016186072 A1; WO2016101076 A1;	Application (US; WO)
2014	Maximizing production of hydrogen from waste materials by active removal of hydrogen	WO2016040074 A1;	Application (WO)
2014	Device for high-efficiency biological hydrogen and methane production	TW201602017 A;	Application (TW)
2014	Method for producing hydrogen by means of dark fermentation from biomass from the wine-producing industry, without using a microbial consortium	WO2016030623 A1;	Application (WO)
2014	Processes for controlling the concentration of co-produced oxygenated organics in anaerobic fermentation broths for the bioconversion of syngas to product oxygenated organic compound	US2016010123 A1; WO2016007659 A1;	Application (US; WO)
2014	Microorganism co-culture system and uses of the same	US2016068919 A1; CN105400860 A; TW201610165 A;	Application (US; CN; TW)

2014	Biofilm process for treating water with continuous or semi-continuous production of biomass with enhanced polyhydroxyalkanoate content	WO2016020816 A3;	Application (WO) Withdrawn (EP 2017)
2014	Wastewater treatment method	TW201545995 A;	Application (TW)
2014	The production of hydrogen and other gaseous or liquid products in an accelerated bioprocess	CA2944425 A1; WO2015158950 A1;	Application (CA; WO)
2014	Process for producing biohydrogen and biomethane	MD4362 C1;	Active (MD 2016)
2014	Process for phototrophic production of phas and h2 gas from wide range of organic waste	WO2015123522 A1;	Application (WO)
2014	A method for improving the methane production rate through acidification pretreatment of hydrogen production of kitchen waste and sludge	CN104561222 A; WO2015143906 A1;	Application (CN; WO)
2013	Facilities for resource-recycling biotechnical hydrogen production from biomass	JP2015089945 A;	Application (JP)
2013	Biohydrogen production method and reactor	US2015111273 A1; CA2926577 A1; WO2015058295 A1; BR112016008913 A1; AU2014339713 A1; SG11201603032X A; KR20160068965 A; CN105722986 A; IL245228 A; EP3060672 A1; IN201617015900 A; VN48590 A; CU20160053 A7;	Application (US; CA; WO; BR; AU; SG; KR; CN; IL; IN; CU) Withdrawn (EP 2017)
2013	Circulatory bio hydrogen production facility using biomass	JP2015025172 A;	Application
2013	Method and system for production of hydrogen, methane, volatile fatty acids, and alcohols from organic material	CA2919263 A1; WO2015010192 A1; BR112016001701 A1; EP3024940 A1; US2016186218 A1; IN201617004244 A; JP2016532441 A;	Application (CA; WO; BR; IN; JP) Active (US 2017) Withdrawn (EP 2017)
2013	Bioelectrochemical system having polyvalent ion removing function	WO2014196825 A1; EP3006407 A1; CN105555715 A; US2016137536 A1;	Application (WO; EP; CN; US)
2013	Hydrogen production from dark fermentation of high-protein material under anaerobic condition	KR20140112292 A; KR101472379 B1;	Active (KR 2014)
2013	Method and plant for continuously producing hydrogen (h2) and methane (ch4) from zootechnical effluents	WO2014147558 A1; EP2976430 A1;	Application (WO; EP)
2013	Digester assemblies to provide renewable resources	US2014273196 A1; WO2014160252 A1; US9127244 B2;	Application (WO) Active (US 2015)
2013	Method for production of n-propanol and other c3-carbon containing products from syngas by symbiotic arrangement of c1-fixing and c3-producing anaerobic microorganism cultures	US2014273123 A1; WO2014140336 A1; CN105722987 A;	Application (US; WO; CN)
2013	Method for producing hydrocarbides	CA2908125 A1; WO2014170603 A1; FR3004727 B1; BR112015026341 A1; CN105264120 A; EP2986758 A1; US2016068866 A1;	Application (CA; WO; BR; CN; EP) Active (FR 2015; US 2017)
2013	Method for producing ethanol from organic waste, and facility for implementing said method	WO2014108653 A1; FR3000965 B1; EP2943574 A1;	Application (WO; EP) Active (FR 2015)
2013	Method for producing hydrogen gas using thermophilic granulated microorganism complex and hydrogen produced thereby	KR101299115 B1;	Active (KR 2013)
2013	Enhanced sewage biological nitrogen and phosphorus removal method based on polyhydroxyalkanoates metabolic regulation	CN103332829 B; WO2015000266 A1; EP3018105 A1;	Application (WO; EP) Active (CN 2015)
2012	Production of hydrogen using an anaerobic biological process	US2014157777 A1; US9506084 B2;	Active (US 2016)
2012	Microbial consortium for the production of hydrogen	WO2014033345 A1; ES2456776 B1;	Application (WO) Active (ES 2015)
2012	Microbial electrosynthetic cells	CA2880297 A1; WO2014043690 A1; EP2895594 A4; US2015259669 A1;	Application (CA; WO) Active (US 2018) Withdrawn (EP 2017)
2012	Method for producing c2 oxygenates by fermentation using high oxidation state sulfur	CA2877566 A1; US2014017747 A1; WO2014011867 A1; BR112014004951 A1; US2014220649 A1; AU2013290132 B2; CN104619849 A; EP2872638 A4; MX2015000452 A; US9212375 B2; RU2015104355 A;	Application (CA; WO; BR; CN; MX) Active (US 2015; AU 2017; RU 2018) Withdrawn (EP 2018)
2012	A fermentation process	CA2892303 C; WO2014088427 A1; AU2012396327 A1; BR112015013011 A1; KR20150091110 A; EP2929038 A4; CN104995306 A; US2015337343 A1; IN4745DELNP2015 A; JP2016500258 A; EA201591043 A1;	Application (WO; KR; EP; CN; US; IN; JP; EA) Active (CA 2016; AU 2017)
2012	System and Method for Producing Ethanol and Biogas	CA2823196 A1; US2014065685 A1; BR102013021902 A2;	Active (BR 2015) Withdrawn (CA 2014; US 2014)
2012	Microbial electrolysis cells and methods for the production of	US2013256149 A1; US9216919 B2;	Active (US 2015)

chemical products			
2012	Anaerobic treatment method and device of organic waste	JP2013013896 A; JP5711192 B2;	Active (JP 2015)
2012	Process for anaerobic production of biohydrogen from organic waste	MD4217 C1;	Active (MD 2013)
2012	Method for producing lactic acid using continuous anaerobic reactors	KR101271005 B1;	Active (KR 2013)
2012	Treatment of biomass	CA2867650 A1; WO2013128390 A1; AU2013227278 B2; SG11201405057Y A; EP2820139 A4; KR20150004796 A; US2015050707 A1; CN104379754 A; JP2015515262 A; HK1205759 A1;	Application (CA; WO; EP; US; CN; JP; HK) Active (AU 2017; SG 2018) Withdrawn (KR 2018)
2012	Method and system for electro-assisted hydrogen production from organic material	CA2860463 A1; US2013217089 A1; WO2013120206 A1; AU2013220906 B2; BR112014020962 A1; CN104245944 A; EP2814971 A4; IN7590DEN2014 A; US9458474 B2; US2016333379 A1;	Application (CA; WO; BR; CN; EP; IN) Active (US 2016; AU 2016)
2012	Method for improving production of bio-hydrogen from waste water containing protein	CN102747106 B; WO2014005484 A1; US2015184200 A1;	Application (WO) Active (CN 2013; US 2017)
2011	Development of a combined biohydrogen and methane production unit using two-stage anaerobic co-digestion process	IN4505CHE2011 A;	Application (IN)
2011	Method and apparatus for anaerobically digesting organic material	US2013137153 A1;	Application (US)
2011	Crude glycerol fermenting process for the production of ethanol and hydrogen	ITRM20110480 A1; WO2013038435 A1; EP2756088 A1; US2014295515 A1;	Application (WO) Withdrawn (EP 2017; US 2016)
2011	Pre-thermal treatment of microalgae and high temperature and high efficiency hydrogen/methane fermentation process using waste heat of power-plant effluent gas	KR101181834 B1;	Active (KR 2012)
2011	Treatment method and treatment apparatus of organic waste	JP2012183510 A; JP5726576 B2;	Active (JP 2015)
2011	Apparatus for producing biohydrogen and biomethane from organic substance	LV14431 B;	Active (2012)
2011	Method and apparatus for manufacturing a hydroxycarboxylic acid product and use of bleaching filtrate	FI20115496 A; WO2012160255 A1; UY34085 A;	Application (FI; WO; UY)
2010	PROCESS FOR PRODUCTION OF HYDROGEN AND VOLATILE GREASY ACIDS	BRPI1005215 A8;	-
2010	Methods and systems for the production of alcohols and/or acids	CA2789333 C; CA2836686 C; WO2012054806 A3; TW201231669 A; AU2011316899 B2; US2013112576 A1; CN103270164 B; EA201390593 A1; US2013316411 A1; EA024224 B1;	Application (WO) Active (CA 2015; AU 2014; CN 2016; EA 2016)
2010	Bio-electrochemical systems	WO2012054629 A3; EP2630088 A4; US2014069806 A1;	Application (WO; US) Active (EP 2017)
2010	hydrogen and methane gas producing device using two phase anaerobic digestion reactor	KR20120033081 A; KR101185225 B1;	Active (KR 2012)
2010	Method of treating municipal wastewater and producing biomass with biopolymer production potential	CA2808142 A1; WO2012023114 A1; AU2011292811 B2; KR20130048248 A; EP2606007 A1; US2013199997 A1; CN103298753 B; JP2013537483 A; BR112013003609 A2; KR20150141194 A; JP5855102 B2;	Application (CA; WO; BR) Active (CN 2015; JP 2016; Withdrawn (EP 2017; US 2017) Rejected (KR 2016)
2010	Method for producing energy-rich gases from lignocellulosic material streams	WO2012003556 A1; BR112012016005 A2;	Application (WO, BR)
2010	Continuous Process and device of production of ethanol from [organico] garbage and other residues of biomass	BRPI1000194 A2;	Application (BR)
2010	Production of polyhydroxyalkanoates	GB201004096 D0; GB2478588 A; WO2011112154 A1; AU2011224898 A1; SG184015 A1; EP2545179 A4; JP2013521802 A; US2013164800 A1;	Application (WO, AU, SG) Withdrawn (GB 2015; EP 2014; US 2014) Rejected (JP 2014)
2009	A bioelectrochemical cell system	WO2011011829 A1; AU2010278674 A1;	Application (WO; AU)
2009	Alcohol production process	WO2011002318 A1; US2011212433 A1; EP2449121 A4; CN102471783 A; KR20120055549 A; US2013252230 A1; US8906655 B2; IN646DEN2012 A;	Application (WO; EP; CN; IN) Active (KR 2017; US 2014)
2009	Bio-electrochemical device and method for upgrading a fluid	NL2003812 C; WO2011062485 A3; EP2502301 A2;	Application (WO) Active (NL 2011) Withdrawn (EP 2017)
2009	A method for dihydrogen gas production	TW201107480 A; TWI406949 B;	Active (TW 2013)
2009	Methods for selectively producing hydrogen and methane	US2011033908 A1; WO2011017292 A1;	Application (WO; AR)

	from biomass feedstocks using an anaerobic biological system	AR077702 A1; US8246828 B2;	Withdrawn (US 2016)
2009	Improved fermentation of gaseous substrates	WO2011028137 A1; TW201114886 A; US2011244538 A1; AU2010290201 B2; US8178330 B2; CN102498214 B; EP2519641 B1; NZ598279 A; TW1490328 B;	Application (WO) Active (US 2012; AU 2013; CN 2013; EP 2014; NZ 2013; TW 2015)
2009	Process for the production of polyhydroxyalkanoates	WO2011031566 A1; US2012165500 A1;	Application (WO) Withdrawn (US 2014)
2009	Diphasic algal culture system	WO2010150190 A3; AU2010264093 B2; AP201206098 D0; IN0165MUMNP2012 A; CN102575209 B; ZA201200430 B; AP3236 A;	Application (WO; IN) Active (CN 2016; ZA 2014) Withdrawn (AU 2018)
2009	Microbial electrolytic cell	WO2010117864 A1; US2012082869 A1;	Application (WO) Withdrawn (US 2014)
2009	System and method for producing hydrogen and methane	KR100967919 B1;	Active (KR 2010)
2009	Method for energetic, waste-free recycling of vegetable raw materials, which are converted into energy source e.g. ethanol and methane and into a fertilizer, comprises hydrolyzing vegetable raw materials, and fermenting	DE102009024423 A1;	Withdrawn (DE 2012)
2009	Semi-continuous process for hydrogen production from organic waste	EP2246436 A1;	Withdrawn (EP 2011)
2009	Method for treating glycerol	JP2010193767 A;	Application (JP)
2009	System and method for hydrogen production	KR100941214 B1;	Active (KR 2010)
2009	Integrated system for hydrogen and methane production from industrial organic wastes and biomass	CA2751046 A1; WO2010085893 A1; AU2010207871 B2; EP2391706 A4; CN102300977 B; US2012009643 A1; IN1716MUMNP2011 A; BRPI1007417 A2; US8900840 B2; US2014370587 A1; US2016068794 A1; US9303242 B2;	Application (WO; EP; IN; BR) Active (CA 2017; AU 2015; CN 2015; US 2014)
2009	Compositions and methods for conversion of lignocellulosic material to fermentable sugars and products produced therefrom	CA2755449 C; WO2010107944 A1; US2010248320 A1; AU2010226673 A1; EP2408924 A1; TR201109113 T1; CN102449156 A; VN29679 A; MX2011009745 A; JP2012520682 A; BRPI1012700 A2; TH120309 A; RU2011139512 A; US8658407 B2;	Application (WO; AU; TR; CN; VN; MX; JP; BR; TH; RU) Active (CA 2015; US 2014) Withdrawn (EP 2013)
2009	Bioreactor process for production of hydrogen from biomass	WO2010131224 A3; EP2430145 A2; US2012088266 A1; CN102459563 B; IN9826DELNP2011 A; US9222108 B2;	Application (WO; IN) Active (EP 2017; US 2015; CN 2016)
2009	Method for recovering and producing ethanol and oil	WO2010084589 A1; KR20110105838 A; EP2390014 A4; CN102292170 B; US2012034667 A1; BRPI0924092 A1; US8722372 B2; KR101612875 B1;	Application (WO; EP; BR) Active (KR 2016; CN 2014; US 2014)
2008	Process for the production of chemicals	CA2747212 A1; WO2010068994 A1; AU2009328649 A1; EP2373832 A1; CN102282295 A; US2011315560 A1; JP2012512326 A; BRPI0923180 A1;	Application (WO; CN; JP; BR) Withdrawn (CA 2014; AU 2014; EP 2014; US 2015)
2008	Production of methanol or methanol derivatives	WO2010068979 A1;	Application (WO)
2008	Microbial electrolytic cell	WO2010045072 A3;	Application (WO)
2008	Three stage, multiple phase anaerobic digestion system and method	CA2732681 A1; WO2010014919 A1; US2011136213 A1; US8765449 B2; US2014315292 A1;	Application (WO) Active (US 2014) Withdrawn (CA 2014)
2008	Biomass alcohol manufacturing method	WO2009122728 A1; US2011053234 A1; JP5142347 B2; US8993283 B2;	Application (WO) Active (US 2015; JP 2013)
2008	Production of hydrogen and/or ethanol by the anaer	TW200936762 A; TWI354704 B;	Active (TW 2011)
2008	Alcohol production process	US2009275787 A1; US8119844 B2;	Active (US 2012)
2008	Systems and methods for anaerobic digestion and collection of products	GB0915377 D0; GB2464585 B; AU2009308085 B2; CA2741199 C; WO2010047815 A3; AP201105689 D0; EP2361229 A4; CN102227383 B; HK1143609 A1; US2014154754 A1; AP3504 A;	Application (WO; AP; EP; HK) Active (GB 2012; AU 2014; CA 2016; CN 2014)
2007	Method and apparatus for membrane-based, two-stage gas production from solid biomaterials	US8093041 B1; US2012107895 A1; US8343749 B2;	Active (US 2013)
2007	Method and device for microbial production of a certain product and methane	DE102007048277 A1; WO2009047275 A8; EP2198034 A2; CN101861394 A; US2010285548 A1; BRPI0818613 A1; US8426162 B2;	Application (WO; CN; BR) Withdrawn (DE 2012; EP 2014) Active (US 2013)

2007	Microbial hydrogen-producing process and system thereof	US2009035812 A1; TW200907051 A; US8003344 B2;	Active (US 2011) Rejected (TW 2011)
2007	Method for producing hydrogen from organic wastes	US2008277337 A1; US7901916 B2;	Active (US 2011)
2007	Method for producing bio-hydrogen using iron dust	KR100853715 B1;	Active (KR 2008)
2007	Alcohol production process	WO2008115080 A1; NZ553984 A; US2010105115 A1; US8293509 B2;	Application (WO) Active (NZ 2009; US 2012)
2007	A system for bioelectrochemical hydrogen production using sun light	KR100841736 B1;	Active (KR 2008)
2007	Concurrent anaerobic digestion and fermentation of lignocellulosic feedstocks	AU2008255540 B2; CA2687916 C; WO2008144903 A1; EP2158167 A4; CN101711229 B; JP2010528593 A; US2011236946 A1; NZ581476 A; IN8516DELNP2009 A; BRPI0812072 A2;	Application (WO; IN; BR) Active (AU 2014; CA 2016; CN 2012) Withdrawn (EP 2014; JP 2013; US 2015; NZ 2015)
2007	Membrane supported bioreactor for conversion of syngas components to liquid products	US2008305539 A1; US2008305540 A1; WO2008154301 A1; US2009017514 A1; US2009029434 A1; US2009104676 A1; US2010047886 A1; WO2010048421 A3; US7923227 B2; WO2011068576 A1; US2011183390 A1; US8017384 B2; CN102197138 B; US2011256597 A1; US8101387 B2; US8198055 B2; US8541214 B2; US8828692 B2; US2014377822 A1;	Application (WO) Active (US 2012; CN 2014)
2007	Energy efficient methods to produce products	AU2008212826 A1; CA2676982 A1; US2008193989 A1; WO2008098254 A3; MX2009008496 A; EP2121946 A4; CN101646776 A; JP2010517581 A; BRPI0806417 A2; NZ578813 A; US8329436 B2; US2013189752 A1;	Application (WO; CN; JP; BR) Active (US 2012; MX 2013) Withdrawn (AU 2014; CA 2014; EP 2014; NZ 2015)
2007	Process for the poduction of biogas and amino acids from a hydrolysate	EP1980620 B1; DE102007017184 A1; CN101307333 B; BRPI0801142 A2; US2009098598 A1; US8318465 B2; DK1980620 T3; ES2542692 T3;	Application (DE ; BR) Active (EP 2015; CN 2014; US 2012; DK 2015; ES 2015)
2007	Apparatus and method for biohydrogen production	GB0705583 D0; US2008233624 A1;	Withdrawn (GB 2011; US 2011)
2006	Production of hydrogen and methane from wastewater streams	WO2008081292 A3; EP2109589 B1; ZA200903628 B; ES2477329 T3;	Application (WO) Active (ZA 2010; EP 2014; ES 2014)
2006	Process and apparatus for producing hydrogen from sewage sludge	US2008152967 A1; WO2008083008 A1; IN4443CHENP2009 A; EP2132362 A4;	Application (WO) Withdrawn (US 2012; IN 2017; EP 2013)
2006	Hydrogen production method for increasing hydrogen production yield using a trickling bed reactor	KR100813151 B1;	Active (KR 2008)
2006	Device for the combined production of hydrogen and methane by fermentation of biological starting materials, comprises fermentation container, and units for discharge of liquid conversion products and for restraint of micro organisms	DE102006035213 B4;	Active (DE 2012)
2006	A novel treatment method for wastewater with a high concentration of organics and its equipment	TW200742737 A;	Rejected (TW 2010)
2006	Process for enhancing anaerobic biohydrogen production	US7232669 B1; TW200734464 A; TW1307364 B;	Active (US 2007; TW 2009)
2006	Process for over-production of hydrogen	AU2007216223 B2; CA2642247 A1; A8; EP1989287 A2; KR20080108990 A; CN101384696 B; IN1127MUM2006 A; JP2009544276 A; US2009325255 A1; BRPI0706993 A2; IN272988 B;	Application (KR; BR) Active (CN 2013; IN 2016) Withdrawn (AU 2017; CA 2017; EP 2017; JP 2014; US 2017)
2005	Method for obtaining hydrogen and methane from bioresidues, includes two phases, where in former phase aqueous suspension of bioresidues is introduced in reactor, and crushed to obtain particle size less than five millimeter	ES2292312 B1;	Active (ES 2009)
2005	Anaerobic phased solids digester for biogas production from organic solid wastes	WO2007075762 A3; US2007158264 A1; US7556737 B2;	Application (WO) Active (US 2009)
2005	Hydrogen fermentor and method of producing hydrogen	WO2007060791 A1; TW200724674 A; IN5298DELNP2008 A; CN101312795 A; US2009263876 A1; US7968322 B2; BRPI0618883 A2; JP5374044 B2;	Application (WO; CN) Active (US 2011; JP 2013) Withdrawn (IN) Rejected (TW 2012)
2005	Process for enhancing anaerobic biohydrogen production	TWI271380 B; TW200724483 A;	Active (TW 2007)
2005	Method for producing hydrogen from biomass	JP2007159534 A; JP5334077 B2;	Withdrawn (JP 2016)
2005	Hydrogen generating system	JP2007159457 A;	Rejected (2011)

2005	Hydrogen fermentation method	JP2007098239 A;	Rejected (2011)
2005	Methods for manufacturing hydrogen using anaerobic digestion	US2006289355 A1; US7540961 B2;	Active (US 2009)
2005	Anaerobic production of hydrogen and other chemical products	CA2605468 C; WO2006119052 A3; EP1877565 A4; US2008311640 A1; US8501463 B2;	Application (WO) Active (CA 2016; US 2013) Withdrawn (EP 2012)
2005	Continuous anaerobic hydrogen-fermenting process for treating organic waste and method of producing hydrogen gas	KR100553231 B1;	Active (KR 2006)
2005	Producing Method of Hydrogen Gas Using Anaerobic Microorganism Complex	KR20060110394 A; KR100719485 B1;	Active (KR 2007)
2005	Method for Preparation of Anaerobic Microorganism Complex for Hydrogen Production	KR20060110393 A; KR100680625 B1;	Active (KR 2007)
2005	Two-stage fermentation process and assembly to generate hydrogen and methane from biological residues	DE102005012367 A1;	Rejected (DE 2009)
2005	Treatment method of organic waste accompanied by hydrogen production by microorganisms	JP2006223962 A;	Rejected (JP (2010)
2004	Process for microbial production of hydrogen and methane fuels	US7575907 B1;	Active (US 2009)
2004	Nutrient salt formula for hydrogen production of anaerobic organism	TW200606127 A;	Rejected (TW 2008)
2004	Method for continuously producing hydrogen	JP2006042691 A;	Rejected (JP 2010)
2004	Method for producing biological fuel	CA2579192 A1; WO2006029971 A3; BE1016178 A3; EP1797164 B1;	Application (WO) Active (BE 2006; EP 2016) Withdrawn (CA 2011)
2004	Hydrogen production by anaerobic co-digestion of Organic waste	KR20050099847 A; KR100622994 B1;	Active (KR 2006)
2004	Biogas Production Method Using Food Waste	KR20050092272 A; KR100592491 B1;	Active (KR 2006)
2004	Hydrogen fermentation method	JP2005211782 A;	Refused (JP 2009)
2004	Hydrogen production apparatus	JP2005200283 A;	-
2003	Bio-electrochemical process for producing hydrogen	CA2531682 C; WO2005005981 A3; EP1656557 B1; CN1856706 B; US2007042480 A1; JP2007528709 A; US7439047 B2; AT491156 T; DE602004030454 D1; HK1092215 A1;	Application (WO) Active (CA 2013; EP 2010; CN 2010; US 2008; DE 2010) Withdrawn (AT 2011)
2003	Method and apparatus for anaerobically treating organic waste	JP2005125149 A; JP5121111 B2;	Active (JP 2013)
2003	Hydrogen and methane two-stage fermentation treatment method for waste bread	JP2005066420 A;	Rejected (JP 2008)
2003	Microbial production of hydrogen under anaerobic condition	TW200417533 A; TWI256946 B;	Active (TW 2006)
2002	Improved biological production of hydrogen and co-production of methane	TW200404046 A; SG111965 A1; TWI308904 B;	Active (TW 2009)
2001	Method for producing hydrogen by microbial group and the same hydrogen-fermenting microbial group	JP2002272491 A; JP3885868 B2;	Active (JP 2007)
2000	Process for production of hydrogen from anaerobically decomposed organic material	CA2399400 C; WO200156938 A1; AU2122100 A; KR20020082221 A; BR0017078 B1; EP1263686 B1; JP2003521258 A; CN1437564 A; RU2002123368 A; MXPA02007361 A; CN1243669 C; AT346826 T; DE60032179 T2; IN1359CHENP2002 A; RU2295502 C2; ES2275490 T3; IN210786 B; IL151008 B; KR100808736 B1; BRPI0017078 A2; JP4285933 B2; IN1997CHENP2009 A; IN2531CHENP2005 A; IN250915 B;	Application (WO) Active (CA 2011; KR 2007; JP 2009; CN 2006; MX 2007; DE 2007; ES 2007; IN 2012) Withdrawn (AU 2006; EP 2015; RU 2014)
1999	Production of hydrogen and/or methane of plant body	JP2000232891 A; JP3739584 B2;	Withdrawn (JP 2015)

The patent status column was assessed in March 2018. Years indicated near country abbreviations in this column correspond to the date of the last status update.

Table S3: Scientific article database

Date	Title	DOI
2017	Effects of pH and substrate concentrations on dark fermentative biohydrogen production from xylose by extreme thermophilic mixed culture	10.1007/s11274-016-2178-1
2017	Factors affecting on hythane bio-generation via anaerobic digestion of mono-ethylene glycol contaminated wastewater: Inoculum-to-substrate ratio, nitrogen-to-phosphorus ratio and pH	10.1016/j.biortech.2016.10.026
2017	Hydrogen production from starch by co-culture of <i>Clostridium acetobutylicum</i> and <i>Rhodobacter sphaeroides</i> in one step hybrid dark- and photofermentation in repeated fed-batch reactor	10.1016/j.biortech.2016.10.060
2017	Long-term operation of microbial electrosynthesis cell reducing CO ₂ to multi-carbon chemicals with a mixed culture avoiding methanogenesis	10.1016/j.bioelechem.2016.09.001
2016	High-purity propionate production from glycerol in mixed culture fermentation	10.1016/j.biortech.2016.08.026
2016	Regulation of acidogenic metabolism towards enhanced short chain fatty acid biosynthesis from waste: Metagenomic profiling	10.1039/c5ra24254a
2016	Cell wash-out enrichment increases the stability and performance of biohydrogen producing packed-bed reactors and the community transition along the operation time	10.1016/j.renene.2016.05.082
2016	The type of carbohydrates specifically selects microbial community structures and fermentation patterns	10.1016/j.biortech.2016.09.084
2016	Dark fermentative hydrogen and ethanol production from biodiesel waste glycerol using a co-culture of <i>Escherichia coli</i> and <i>Enterobacter</i> sp.	10.1016/j.fuel.2016.08.043
2016	Mesophilic and Thermophilic Biohydrogen Production from Xylose at Various Initial pH and Substrate Concentrations with Microflora Community Analysis	10.1021/acs.energyfuels.5b02143
2016	High rate hydrogen fermentation of cello-lignin fraction in de-oiled jatropha waste using hybrid immobilized cell system	10.1016/j.fuel.2016.05.088
2016	Short-chain fatty acids production and microbial community in sludge alkaline fermentation: Long-term effect of temperature	10.1016/j.biortech.2016.03.138
2016	Performance and microbial community analysis in alkaline two-stage enhanced anaerobic sludge digestion system	10.1016/j.bej.2015.10.004
2016	Microbial responses to various process disturbances in a continuous hydrogen reactor fed with galactose	10.1016/j.jbiosc.2016.08.006
2016	Evaluation of different pretreatments on organic matter solubilization and hydrogen fermentation of mixed microalgae consortia	10.1016/j.ijhydene.2016.05.195
2016	Changes in microbial community during hydrogen and methane production in two-stage thermophilic anaerobic co-digestion process from biowaste	10.1016/j.wasman.2016.01.016
2016	Pretreatment conditions of rice straw for simultaneous hydrogen and ethanol fermentation by mixed culture	10.1016/j.ijhydene.2015.10.147
2016	Process enhancement of hydrogen and methane production from palm oil mill effluent using two-stage thermophilic and mesophilic fermentation	10.1016/j.ijhydene.2016.05.037
2016	Co-generation of biohydrogen and biomethane through two-stage batch co-fermentation of macro- and micro-algal biomass	10.1016/j.biortech.2016.06.092
2016	Optimum alcohol concentration for chain elongation in mixed-culture fermentation of cellulosic substrate	10.1002/bit.26024
2016	Two-stage thermophilic fermentation and mesophilic methanogenic process for biohythane production from palm oil mill effluent with methanogenic effluent recirculation for pH control	10.1016/j.ijhydene.2016.07.095
2016	Potential and optimization of two-phase anaerobic digestion of oil refinery waste activated sludge and microbial community study	10.1038/srep38245
2016	Fermentative biohydrogen and biomethane co-production from mixture of food waste and sewage sludge: Effects of physiochemical properties and mix ratios on fermentation performance	10.1016/j.apenergy.2016.10.003
2016	Boosting dark fermentation with co-cultures of extreme thermophiles for biohythane production from garden waste	10.1016/j.biortech.2016.07.096
2016	High-rate hydrogen production from galactose in an upflow anaerobic sludge blanket reactor (UASBr)	10.1039/c6ra09298e
2016	Critical analysis of hydrogen production from mixed culture fermentation under thermophilic condition (60°C)	10.1007/s00253-016-7482-z
2016	Production of Bio-Based Hydrogen Enriched Methane from Waste Glycerol in a Two Stage Continuous System	10.1007/s12649-016-9538-9
2016	Consistent 1,3-propanediol production from glycerol in mixed culture fermentation over a wide range of pH	10.1186/s13068-016-0447-8
2016	Single-stage and two-stage anaerobic digestion of extruded lignocellulosic biomass	10.1016/j.apenergy.2016.10.039
2016	Comparison of various carbohydrates for hydrogen production in microbial electrolysis cells	10.1080/13102818.2015.1081078
2016	Increased performance of hydrogen production in microbial electrolysis cells under alkaline conditions	10.1016/j.bioelechem.2016.01.003
2016	Fermentative hydrogen production in an up-flow anaerobic biofilm reactor inoculated with a co-culture of <i>Clostridium acetobutylicum</i> and <i>Desulfovibrio vulgaris</i>	10.1016/j.biortech.2016.09.072
2016	Biochemical hydrogen and methane potential of sugarcane syrup using a two-stage anaerobic fermentation process	10.1016/j.indcrop.2015.12.002
2016	Microbial dynamics of the extreme-thermophilic (70 °C) mixed culture for hydrogen production in a chemostat	10.1016/j.ijhydene.2016.04.085
2016	Towards biohythane production from biomass: Influence of operational stage on anaerobic fermentation and microbial community	10.1016/j.ijhydene.2015.06.045

2016	Fermentative production of hydrogen in presence of modified mesoporous silica SBA-15	10.1016/j.ijhydene.2016.05.112
2016	Combining the enrichment and accumulation step in non-axenic PHA production: Cultivation of <i>Plasticicumulans acidivorans</i> at high volume exchange ratios	10.1016/j.jbiotec.2016.06.016
2016	Effect of volatile fatty acids mixtures on the simultaneous photofermentative production of hydrogen and polyhydroxybutyrate	10.1007/s00449-016-1691-9
2016	Transcriptomic responses of the interactions between <i>Clostridium Cellulovorans</i> 743b and <i>Rhodopseudomonas Palustris</i> CGA009 in a cellulose-grown coculture for enhanced hydrogen production	10.1128/AEM.00789-16
2016	Product Diversity Linked to Substrate Usage in Chain Elongation by Mixed-Culture Fermentation	10.1021/acs.est.5b06021
2016	Single and two-stage anaerobic digestion for hydrogen and methane production from acid and enzymatic hydrolysates of Agave tequilana bagasse	10.1016/j.ijhydene.2015.11.016
2016	Enrichment of secondary wastewater sludge for production of hydrogen from crude glycerol and comparative evaluation of mono-, co- and mixed-culture systems	10.3390/ijms17010092
2016	Photo-fermentative hydrogen production from enzymatic hydrolysate of corn stalk pith with a photosynthetic consortium	10.1016/j.ijhydene.2016.07.129
2016	Microbial dynamics in ethanol fermentation from glycerol	10.1016/j.ijhydene.2016.04.188
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2016	Optimization of biohydrogen yield produced by bacterial consortia using residual glycerin from biodiesel production	10.1016/j.biortech.2016.07.141
2016	Hydrogen gas production from waste peach pulp by dark fermentation and electrohydrolysis	10.1016/j.ijhydene.2015.11.170
2016	Characterization of hydrogen production by the co-culture of dark-fermentative and photosynthetic bacteria	10.1007/s11164-016-2656-y
2016	Mesophilic biogenic H ₂ production using galactose in a fixed bed reactor	10.1016/j.ijhydene.2016.07.203
2016	Concomitant biohydrogen and poly-beta-hydroxybutyrate production from dark fermentation effluents by adapted <i>Rhodobacter sphaeroides</i> and mixed photofermentative cultures	10.1016/j.biortech.2016.03.017
2016	Methanol as an alternative electron donor in chain elongation for butyrate and caproate formation	10.1016/j.biombioe.2016.07.008
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2016	Microbial removal of carboxylic acids from 1,3-propanediol in glycerol anaerobic digestion effluent by PHAs-producing consortium	10.1016/j.bej.2016.04.031
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2016	Design, implementation and assessment of a novel bioreactor for fermentative biohydrogen process development	10.1016/j.ijhydene.2016.04.208
2016	Feasibility study of SCFAs production from microalgae during hydrogen fermentation	10.1016/j.ijhydene.2015.10.135
2016	Biohydrogen Production from Liquid and Solid Fractions of Sugarcane Bagasse After Optimized Pretreatment with Hydrochloric Acid	10.1007/s12649-016-9494-4
2016	Comparison of micro-aerobic and anaerobic fermentative hydrogen production from corn straw	10.1016/j.ijhydene.2016.01.141
2016	Hydrolysis-acidogenesis of food waste in solid-liquid-separating continuous stirred tank reactor (SLS-CSTR) for volatile organic acid production	10.1016/j.biortech.2015.10.017
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2016	Enhanced biohydrogen production from corn stover by the combination of <i>Clostridium cellulolyticum</i> and hydrogen fermentation bacteria	10.1016/j.jbiosc.2016.03.014
2016	A new biological process for short-chain fatty acid generation from waste activated sludge improved by <i>Clostridiales</i> enhancement	10.1007/s11356-016-7579-z
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2015	Optimization of substrate composition for biohydrogen production from buffalo slurry co-fermented with cheese whey and crude glycerol, using microbial mixed culture	10.1016/j.ijhydene.2014.11.008
2015	Sequential fermentative and phototrophic system for hydrogen production: An approach for Brazilian alcohol distillery wastewater	10.1016/j.ijhydene.2015.06.003
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2015	Adaptation of acidogenic sludge to increasing glycerol concentrations for biohydrogen production	10.1007/s00253-015-6832-6
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2015	Effects of anti-foaming agents on biohydrogen production	10.1016/j.biortech.2016.02.121
2015	Production of medium-chain volatile fatty acids by mixed ruminal microorganisms is enhanced by ethanol in co-culture with <i>Clostridium kluyveri</i>	10.1016/j.biortech.2014.10.054
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2015	CO ₂ -free biohydrogen production by mixed dark and photofermentation bacteria from sorghum starch using a modified simple purification and collection system	10.1016/j.energy.2015.05.044
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2015	Improved cellulose conversion to bio-hydrogen with thermophilic bacteria and characterization of microbial community in continuous bioreactor	10.1016/j.biombioe.2015.02.010
2015	Bioaugmentation of <i>Lactobacillus delbrueckii</i> ssp. <i>bulgaricus</i> TISTR 895 to enhance bio-hydrogen production of <i>Rhodobacter sphaeroides</i> KKU-PS5	10.1186/s13068-015-0375-z
2015	Thermophilic fermentative biohydrogen production from xylan by anaerobic mixed cultures in elephant dung	10.1080/15435075.2014.887567
2015	Hydrogen photoproduction by co-culture <i>Clostridium butyricum</i> and <i>Rhodobacter sphaeroides</i>	10.1016/j.ijhydene.2015.08.086
2015	Hydrogen and lipid production from starch wastewater by co-culture of anaerobic sludge and oleaginous microalgae with simultaneous COD, nitrogen and phosphorus removal	10.1016/j.watres.2015.08.057
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2015	Sequential fermentative and phototrophic system for hydrogen production: An approach for Brazilian alcohol distillery wastewater	10.1016/j.ijhydene.2015.06.003
2015	Identification of <i>Candida tropicalis</i> BH-6 and Synergistic Effect with <i>Pantoea agglomerans</i> BH-18 on Hydrogen Production in Marine Culture	10.1007/s12010-014-1436-7
2015	Thermophilic anaerobic co-digestion of organic fraction of municipal solid waste (OFMSW) with food waste (FW): Enhancement of bio-hydrogen production	10.1016/j.biortech.2015.07.011
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2015	Biohydrogen production by co-fermentation of crude glycerol and apple pomace hydrolysate using co-culture of <i>Enterobacter aerogenes</i> and <i>Clostridium butyricum</i>	10.1016/j.biortech.2015.06.095
2015	Suppression of methanogenesis in hydrogen fermentation by intermittent feeding	10.1080/10934529.2015.1074480
2015	Efficient Anaerobic Co-Digestion of Municipal Food Waste and Kitchen Wastewater for Bio-Hydrogen Production	10.1080/15435075.2014.909357
2015	Third generation biohydrogen production by <i>Clostridium butyricum</i> and adapted mixed cultures from <i>Scenedesmus obliquus</i> microalga biomass	10.1016/j.fuel.2015.02.093
2015	Integrated treatment of municipal sewage sludge by deep dewatering and anaerobic fermentation for biohydrogen production	10.1007/s11356-014-3514-3
2015	Impact of pH management interval on biohydrogen production from organic fraction of municipal solid wastes by mesophilic thermophilic anaerobic codigestion	10.1155/2015/590753
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2015	Evaluation of different support materials used with a photo-fermentative consortium for hydrogen production	10.1016/j.ijhydene.2015.08.057
2015	Exploitation of algal-bacterial associations in a two-stage biohydrogen and biogas generation process	10.1186/s13068-015-0243-x
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2014	Hydrogen production from diluted and raw sugarcane vinasse under thermophilic anaerobic conditions	10.1016/j.ijhydene.2014.04.104
2014	Co-fermentation of glucose, starch, and cellulose for mesophilic biohydrogen production	10.1016/j.ijhydene.2014.10.079
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2014	Batch fermentative hydrogen production utilising sago (<i>Metroxylon</i> sp.) starch processing effluent by enriched sago sludge consortia	10.1016/j.ijhydene.2014.10.015
2014	Butyric acid fermentation of sodium hydroxide pretreated rice straw with undefined mixed culture	10.4014/jmb.1309.09078
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2014	Using a statistical approach to model hydrogen production from a steam exploded corn stalk hydrolysate fed to mixed anaerobic cultures in an ASBR	10.1016/j.ijhydene.2014.04.115
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2014	Effect of organic loading rate on continuous hydrogen production from food waste in submerged anaerobic membrane bioreactor	10.1016/j.ijhydene.2014.08.022
2014	Use of mixed culture bacteria for photofermentive hydrogen of dark fermentation effluent	10.1016/j.biortech.2014.03.065
2014	Polyhydroxyalkanoate (PHA) production from sludge and municipal wastewater treatment	10.2166/wst.2013.643
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2014	Enhancement in hydrogen production by co-cultures of <i>Bacillus</i> and <i>Enterobacter</i>	10.1016/j.ijhydene.2014.07.084
2014	Trehalose enhancing microbial electrolysis cell for hydrogen generation in low temperature (0°C)	10.1016/j.biortech.2014.05.018
2014	The source of inoculum plays a defining role in the development of MEC microbial consortia fed with acetic and propionic acid mixtures	10.1016/j.jbiotec.2014.04.016
2014	Gamma irradiation as a pretreatment method for enriching hydrogen-producing bacteria from digested sludge	10.1016/j.ijhydene.2014.01.147
2014	Ultrasonic pretreatment for an enhancement of biohydrogen production from complex food waste	10.1016/j.ijhydene.2014.03.105
2014	Enriching hydrogen-producing bacteria from digested sludge by different pretreatment methods	10.1016/j.ijhydene.2014.01.145
2014	Effect of system optimizing conditions on biohydrogen production from herbal wastewater by slaughterhouse sludge	10.1016/j.ijhydene.2014.02.026
2014	Impacts of pH, temperature, and pretreatment method on biohydrogen production from organic wastes by sewage microflora	10.1186/2251-6832-5-6
2014	Optimization of high-solid waste activated sludge concentration for hydrogen production in microbial electrolysis cells and microbial community diversity analysis	10.1016/j.ijhydene.2014.09.163
2014	Vegetable waste as substrate and source of suitable microflora for bio-hydrogen production	10.1016/j.renene.2014.01.013
2014	Revealing the factors influencing a fermentative biohydrogen production process using industrial wastewater as fermentation substrate	10.1186/s13068-014-0139-1
2014	Fermentative hydrogen production from carob pod: A typical mediterranean forest fruit	10.1007/s12649-014-9295-6
2014	Dynamic microwave-assisted alkali pretreatment of cornstalk to enhance hydrogen production via co-culture fermentation of <i>Clostridium thermocellum</i> and <i>Clostridium thermosaccharolyticum</i>	10.1016/j.biombioe.2014.03.053
2014	Ecobiotechnological Strategy to Enhance Efficiency of Bioconversion of Wastes into Hydrogen and Methane	10.1007/s12088-014-0467-7
2014	Systematic approach to assess biohydrogen potential of anaerobic sludge and soil rhizobia as biocatalysts: Influence of crucial factors affecting acidogenic fermentation	10.1016/j.biortech.2014.02.097
2014	A novel way to utilize hydrogen and carbon dioxide in acidogenic reactor through homoacetogenesis	10.1016/j.biortech.2014.02.014
2014	From hypertrophic lagoons to bioenergy production	NA
2014	Total solid content drives hydrogen production through microbial selection during thermophilic fermentation	10.1016/j.biortech.2014.05.078
2014	Co-producing hydrogen and methane from higher-concentration of corn stalk by combining hydrogen fermentation and anaerobic digestion	10.1016/j.ijhydene.2014.02.089
2014	Biohydrogen and polyhydroxyalkanoate co-production by <i>Enterobacter aerogenes</i> and <i>Rhodobacter sphaeroides</i> from <i>Calophyllum inophyllum</i> oil cake	10.1016/j.biortech.2014.04.104
2014	Ammonia as carbon-free substrate for hydrogen production in bioelectrochemical systems	10.1016/j.ijhydene.2014.05.176 Short Communication
2014	Influence of setup and carbon source on the bacterial community of biocathodes in microbial electrolysis cells	10.1016/j.enzmictec.2014.04.019
2014	Modeling and Optimization of Biohydrogen Production from De-oiled <i>Jatropha</i> Using the Response Surface Method	10.1007/s13369-014-1502-z
2014	Enhanced bio-hydrogenesis by co-culturing photosynthetic bacteria with acidogenic process: Augmented dark-photo fermentative hybrid system to regulate volatile fatty acid inhibition	10.1016/j.ijhydene.2014.01.196
2014	Dark fermentation from real solid waste. Evolution of microbial community	10.1016/j.biortech.2013.10.063

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2013	Altering protein conformation to improve fermentative hydrogen production from protein wastewater	10.1016/j.watres.2013.06.047
2013	Selective carboxylate production by controlling hydrogen, carbon dioxide and substrate concentrations in mixed culture fermentation	10.1016/j.biortech.2013.03.063
2013	Effect of hydraulic retention time on biohydrogen and volatile fatty acids production during acidogenic digestion of dephenolized olive mill wastewaters	10.1016/j.biombioe.2012.10.028
2013	Microbial consortia for hydrogen production enhancement	10.1007/s00284-013-0328-3
2013	Fermentative hydrogen production from beet sugar factory wastewater treatment in a continuous stirred tank reactor using anaerobic mixed consortia	10.1007/s11783-012-0456-1
2013	Effects of inoculum and indigenous microflora on hydrogen production from the organic fraction of municipal solid waste	10.1016/j.ijhydene.2013.06.137
2013	Cellulosic hydrogen production and microbial community characterization in hyper-thermophilic continuous bioreactor	10.1016/j.ijhydene.2013.04.041
2013	Enrichment of activated sludge for enhanced hydrogen production from crude glycerol	10.1016/j.ijhydene.2012.11.069
2013	Short-chain fatty acid production from different biological phosphorus removal sludges: The influences of PHA and gram-staining bacteria	10.1021/es304673s
2013	A comparison of treatment techniques to enhance fermentative hydrogen production from piggery anaerobic digested residues	10.1016/j.ijhydene.2013.05.013
2013	Promoting chain elongation in mixed culture acidification reactors by addition of ethanol	10.1016/j.biombioe.2012.11.019
2013	Biological hydrogen production by anaerobic digestion of food waste and sewage sludge treated using various pretreatment technologies	10.1007/s10532-013-9623-8
2013	Enhanced start-up of anaerobic facultatively autotrophic biocathodes in bioelectrochemical systems	10.1016/j.jbiotec.2013.10.001
2013	Bio-hydrogen production during acidogenic fermentation in a multistage stirred tank reactor	10.1016/j.ijhydene.2012.11.077
2013	Optimizing the production of hydrogen and 1,3-propanediol in anaerobic fermentation of biodiesel glycerol	10.1016/j.ijhydene.2012.12.135
2013	Enhancement effect of silver nanoparticles on fermentative biohydrogen production using mixed bacteria	10.1016/j.biortech.2013.05.042
2013	Specific inhibition of biohydrogen-producing <i>Clostridium</i> sp. after dilute-acid pretreatment of sunflower stalks	10.1016/j.ijhydene.2013.07.018
2013	Production of acetate from carbon dioxide in bioelectrochemical systems based on autotrophic mixed culture	10.4014/jmb.1304.04039
2013	A versatile and robust aerotolerant microbial community capable of cellulosic ethanol production	10.1016/j.biortech.2012.10.164
2013	A farm-scale pilot plant for biohydrogen and biomethane production by two-stage fermentation	10.4081/jae.2013.(s1):e115
2013	Continuous biohydrogen production from fruit wastewater at low pH conditions	10.1007/s00449-012-0832-z
2013	Bioelectrochemical systems for simultaneously production of methane and acetate from carbon dioxide at relatively high rate	10.1016/j.ijhydene.2012.12.107
2013	Fermentative hydrogen production under moderate halophilic conditions	10.1016/j.ijhydene.2013.08.035
2013	High rate heptanoate production from propionate and ethanol using chain elongation	10.1016/j.biortech.2013.02.085
2013	Biohydrogen production from food waste in batch and semi-continuous conditions: Evaluation of a two-phase approach with digestate recirculation for pH control	10.1016/j.ijhydene.2013.01.078
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2013	Hydrogen and methane production from untreated rice straw and raw sewage sludge under thermophilic anaerobic conditions	10.1016/j.ijhydene.2013.04.079
2013	Enhancement of batch biohydrogen production from prehydrolysate of acid treated oil palm empty fruit bunch	10.1016/j.ijhydene.2013.01.154
2013	Chain elongation of acetate and ethanol in an upflow anaerobic filter for high rate MCFA production	10.1016/j.biortech.2012.10.165
2013	Enhanced butanol production by coculture of <i>Clostridium beijerinckii</i> and <i>Clostridium tyrobutyricum</i>	10.1016/j.biortech.2013.06.023
2013	Sub-dominant bacteria as keystone species in microbial communities producing bio-hydrogen	10.1016/j.ijhydene.2013.02.008
2013	Formation of hydrogen-producing granules and microbial community analysis in a UASB reactor	10.1016/j.renene.2012.10.051
2013	Relative effect of different inorganic acids on selective enrichment of acidogenic biocatalyst for fermentative biohydrogen production from wastewater	10.1016/j.biortech.2013.08.021
2013	Interactions between <i>Clostridium beijerinckii</i> and <i>Geobacter metallireducens</i> in co-culture fermentation with anthrahydroquinone-2, 6-disulfonate (AH2QDS) for enhanced biohydrogen production from xylose	10.1002/bit.24627

2013	Polyhydroxyalkanoates production by a mixed photosynthetic consortium of bacteria and algae	10.1016/j.biortech.2013.01.050
2013	Decreased hydrogen production leads to selective butanol production in co-cultures of <i>Clostridium thermocellum</i> and <i>Clostridium saccharoperbutylacetonicum</i> strain N1-4	10.1016/j.jbiosc.2012.08.020
2013	Bioelectrochemical production of caproate and caprylate from acetate by mixed cultures	10.1021/sc300168z
2013	Influence of linoleic acid, pH and HRT on anaerobic microbial populations and metabolic shifts in ASBRs during dark hydrogen fermentation of lignocellulosic sugars	10.1016/j.ijhydene.2012.11.137
2013	Dark fermentative bio-hydrogen production: Effects of substrate pre-treatment and addition of metal ions or L-cysteine	10.1016/j.fuel.2013.04.063
2013	Lignocellulosic hydrolysates and extracellular electron shuttles for H ₂ production using co-culture fermentation with <i>Clostridium beijerinckii</i> and <i>Geobacter metallireducens</i>	10.1016/j.biortech.2013.07.106
2013	Ozone pretreatment of wheat straw for enhanced biohydrogen production	10.1016/j.ijhydene.2013.06.063
2013	A novel anaerobic co-culture system for bio-hydrogen production from sugarcane bagasse	10.1016/j.biortech.2013.07.018
2013	Two-stage alkaline-enzymatic pretreatments to enhance biohydrogen production from sunflower stalks	10.1021/es402863v
2013	Optimization of hybrid inoculum development techniques for biohydrogen production and preliminary scale up	10.1016/j.ijhydene.2013.06.129
2013	Optimization of biological hydrogen production for anaerobic co-digestion of food waste and wastewater biosolids	10.1016/j.biortech.2012.12.069
2013	Regulation of biohydrogen production by heat-shock pretreatment facilitates selective enrichment of <i>Clostridium</i> sp.	10.1016/j.ijhydene.2013.10.046
2013	Biohydrogen production by a mixed photoheterotrophic culture obtained from a Winogradsky column prepared from the sediment of a southern Brazilian lagoon	10.1016/j.renene.2012.07.011
2013	Microbial community structure and dynamics in two-stage vs single-stage thermophilic anaerobic digestion of mixed swine slurry and market bio-waste	10.1016/j.watres.2013.01.007
2013	Production of hydrogen and methane by one and two stage fermentation of food waste	10.1016/j.ijhydene.2013.05.047
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2012	Enhanced production of volatile fatty acids (VFAs) from sewage sludge by beta-cyclodextrin	10.1016/j.biortech.2011.08.122
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2012	Construction of hydrogen fermentation from garbage slurry using the membrane free bioelectrochemical system	10.1016/j.jbiosc.2012.02.028

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2012	Statistical optimization of biohydrogen and ethanol production from crude glycerol by microbial mixed culture	10.1016/j.ijhydene.2012.02.106
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2012	Effects of pretreatment of natural bacterial source and raw material on fermentative biohydrogen production	10.1016/j.ijhydene.2011.04.050
2012	Effect of sludge recirculation on characteristics of hydrogen production in a two-stage hydrogen-methane fermentation process treating food wastes	10.1016/j.ijhydene.2011.12.123
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2012	Biohydrogen production from arabinose and glucose using extreme thermophilic anaerobic mixed cultures	10.1186/1754-6834-5-6
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2012	Effect of different gas releasing methods on anaerobic fermentative hydrogen production in batch cultures	10.1007/s11783-012-0403-1
2012	By-products inhibition effects on bio-hydrogen production	10.1016/j.ijhydene.2011.12.032
2012	Syntrophic metabolism of a co-culture containing <i>Clostridium cellulolyticum</i> and <i>Rhodospseudomonas palustris</i> for hydrogen production	10.1016/j.ijhydene.2012.05.100
2012	Co-culture of <i>Clostridium thermocellum</i> and <i>Clostridium thermosaccharolyticum</i> for enhancing hydrogen production via thermophilic fermentation of cornstarch waste	10.1016/j.ijhydene.2012.04.115
2012	Innovative self-powered submersible microbial electrolysis cell (SMEC) for biohydrogen production from anaerobic reactors	10.1016/j.watres.2012.02.038
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2012	Hydrogen production from butyrate by a marine mixed phototrophic bacterial consort	10.1016/j.ijhydene.2011.11.101
2012	Hydrogen and volatile fatty acid production during fermentation of cellulosic substrates by a thermophilic consortium at 50 and 60°C	10.1016/j.biortech.2011.11.013
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2012	Effects of pretreatment method of natural bacteria source on microbial community and bio-hydrogen production by dark fermentation	10.1016/j.ijhydene.2012.01.010
2012	Assessing the impact of palmitic, myristic and lauric acids on hydrogen production from glucose fermentation by mixed anaerobic granular cultures	10.1016/j.ijhydene.2012.09.116
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2012	Effect of enzyme addition on fermentative hydrogen production from wheat straw	10.1016/j.ijhydene.2012.04.083
2012	Effects of heat treatment on microbial communities of granular sludge for biological hydrogen production	10.2166/wst.2012.336

2012	Biohydrogen production by anaerobic co-digestion of press mud and domestic sewage	10.1504/IJEW.2012.048323
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2012	Hydrogen production by anaerobic co-digestion of rice straw and sewage sludge	10.1016/j.ijhydene.2011.10.116
2012	Hydrogen production and microbial diversity in sewage sludge fermentation preceded by heat and alkaline treatment	10.1016/j.biortech.2012.01.048
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2012	Hydrogen production from food wastes and gas post-treatment by CO ₂ adsorption	10.1016/j.wasman.2011.09.003
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2011	A pilot-scale high-rate biohydrogen production system with mixed microflora	10.1016/j.ijhydene.2010.07.115
2011	Co-digestion of swine manure and corn stover for bioenergy production in MixAlco™ consolidated bioprocessing	10.1016/j.biombioe.2011.06.053
2011	Performance and microbial community analysis of two-stage process with extreme thermophilic hydrogen and thermophilic methane production from hydrolysate in UASB reactors	10.1016/j.biortech.2010.12.009
2011	Phase holdups and microbial community in high-rate fermentative hydrogen bioreactors	10.1016/j.ijhydene.2010.09.059
2011	Biohydrogen and methane production by co-digestion of cassava stillage and excess sludge under thermophilic condition	10.1016/j.biortech.2010.12.012
2011	H ₂ consumption by anaerobic non-methanogenic mixed cultures	10.2166/wst.2011.214
2011	Biohydrogen production from desugared molasses (DM) using thermophilic mixed cultures immobilized on heat treated anaerobic sludge granules	10.1016/j.ijhydene.2011.06.130
2011	Optimization of fermentative biohydrogen production by response surface methodology using fresh leachate as nutrient supplement	10.1016/j.biortech.2011.03.002
2011	Enhanced biohydrogen production from tofu residue by acid/base pretreatment and sewage sludge addition	10.1016/j.ijhydene.2011.03.085
2011	Performance and population analysis of hydrogen production from sugarcane juice by non-sterile continuous stirred tank reactor augmented with <i>Clostridium butyricum</i>	10.1016/j.ijhydene.2010.05.120
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2011	Enhancement of bioenergy production from organic wastes by two-stage anaerobic hydrogen and methane production process	10.1016/j.biortech.2011.02.012
2011	Effects of various pretreatment methods of anaerobic mixed microflora on biohydrogen production and the fermentation pathway of glucose	10.1016/j.ijhydene.2010.09.092
2011	Thermophilic, anaerobic co-digestion of microalgal biomass and cellulose for H ₂ production	10.1007/s10532-010-9419-z
2011	Fermentative hydrogen production by <i>Clostridium butyricum</i> and <i>Escherichia coli</i> in pure and cocultures	10.1016/j.ijhydene.2011.05.189
2011	Comparative study of biological hydrogen production by pure strains and consortia of facultative and strict anaerobic bacteria	10.1016/j.biortech.2010.11.094
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2011	Bioplastic production using wood mill effluents as feedstock	10.2166/wst.2011.358
2011	Biohydrogen production from mixed xylose/arabinose at thermophilic temperature by anaerobic mixed cultures in elephant dung	10.1016/j.ijhydene.2011.03.098
2011	Direct fermentation of <i>Laminaria japonica</i> for biohydrogen production by anaerobic mixed cultures	10.1016/j.ijhydene.2011.01.125
2011	Bio-hydrogen behavior of suspended and attached microorganisms in anaerobic fluidized bed	10.1016/j.ijhydene.2010.10.004
2011	Revivability of fermentative hydrogen producing bioreactors	10.1016/j.ijhydene.2010.11.038
2011	Hydrogen production by mixed bacteria through dark and photo fermentation	10.1016/j.ijhydene.2010.10.007
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2011	Biohydrogen production from dairy processing wastewater by anaerobic biofilm reactors	NA
2011	Feasibility of hydrogen production from ripened fruits by a combined two-stage (dark/dark) fermentation system	10.1016/j.biortech.2010.08.047
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