

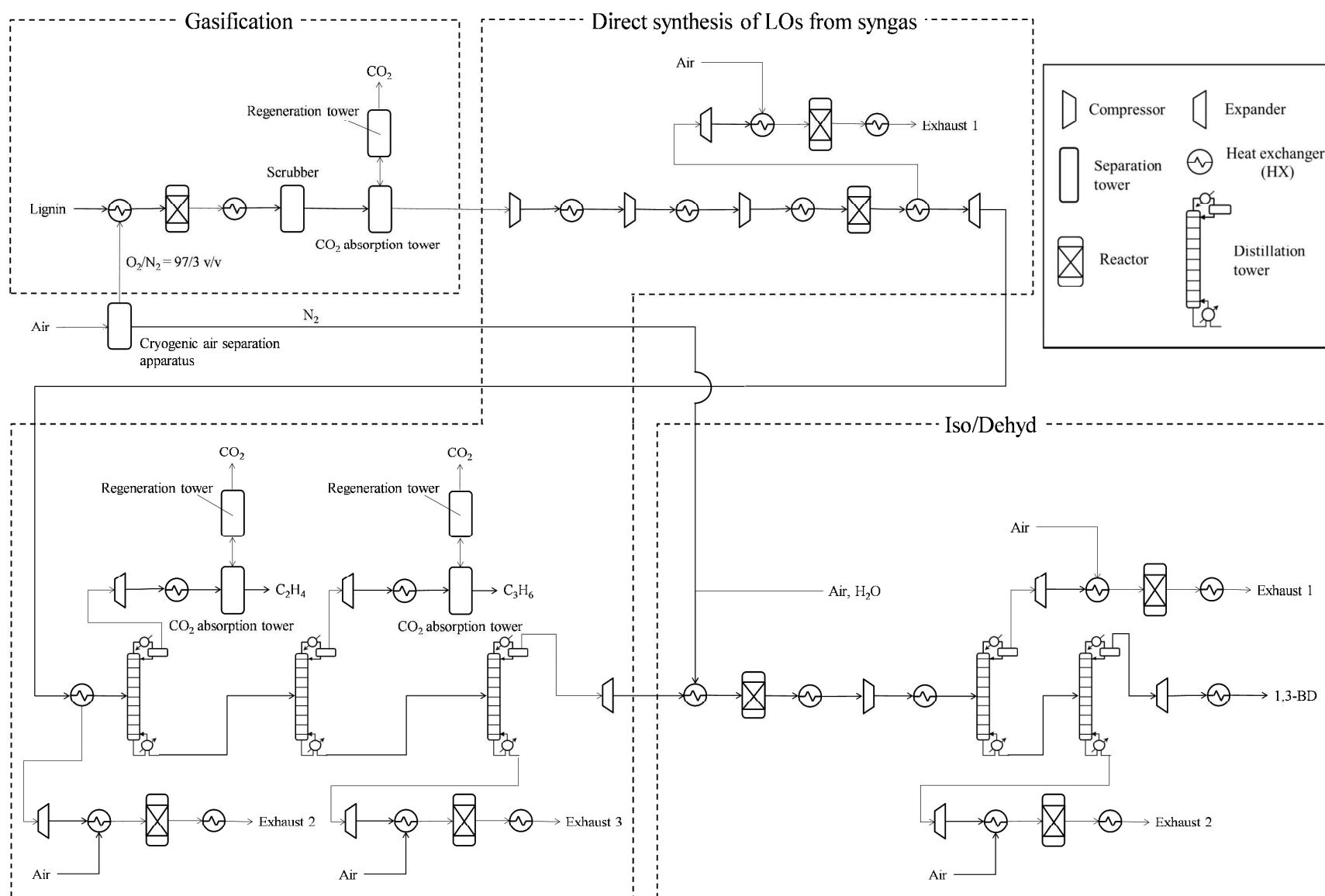


Figure S2. Schematic flow diagram for Syn-LOs.

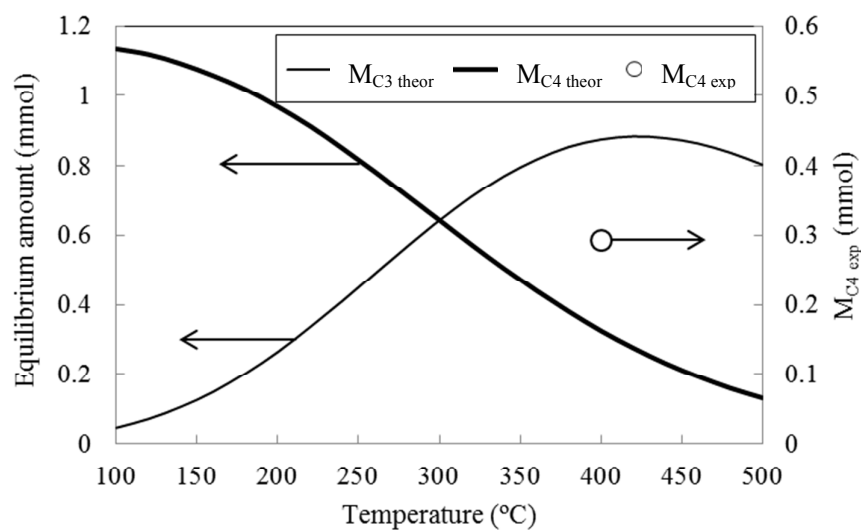


Figure S3. Effect of temperature on equilibrium amount and experimental $n\text{-C}_4\text{H}_8$ amount in the LO synthesis from MeOH.

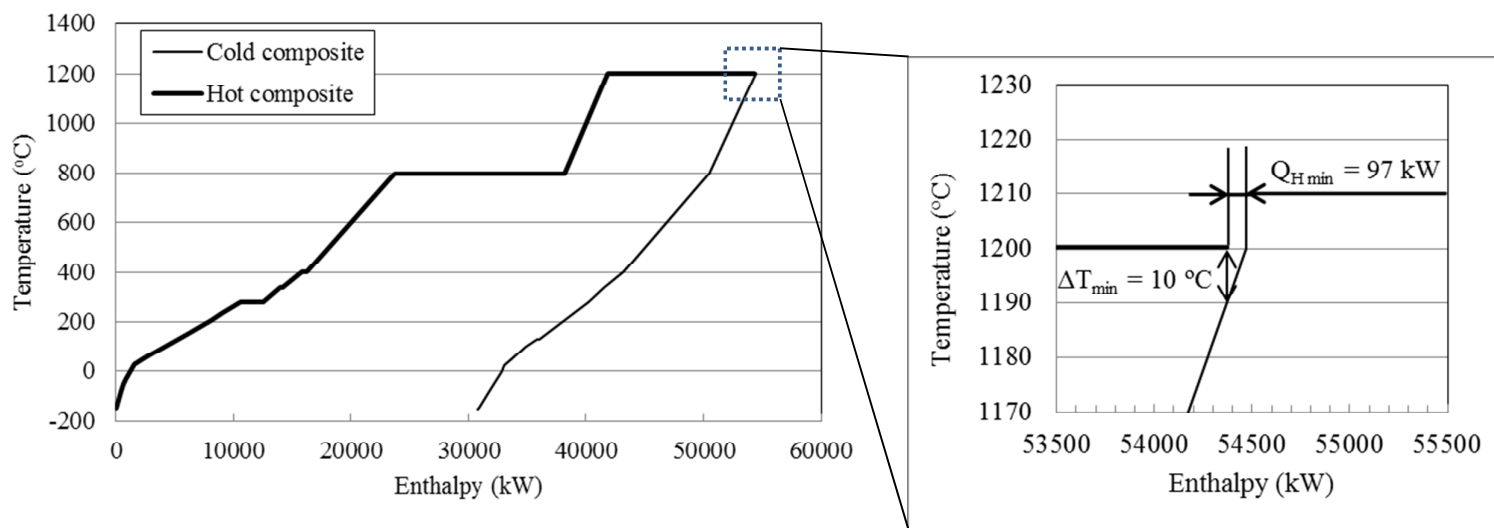


Figure S4. Composite curves for SC-Syn-DME.

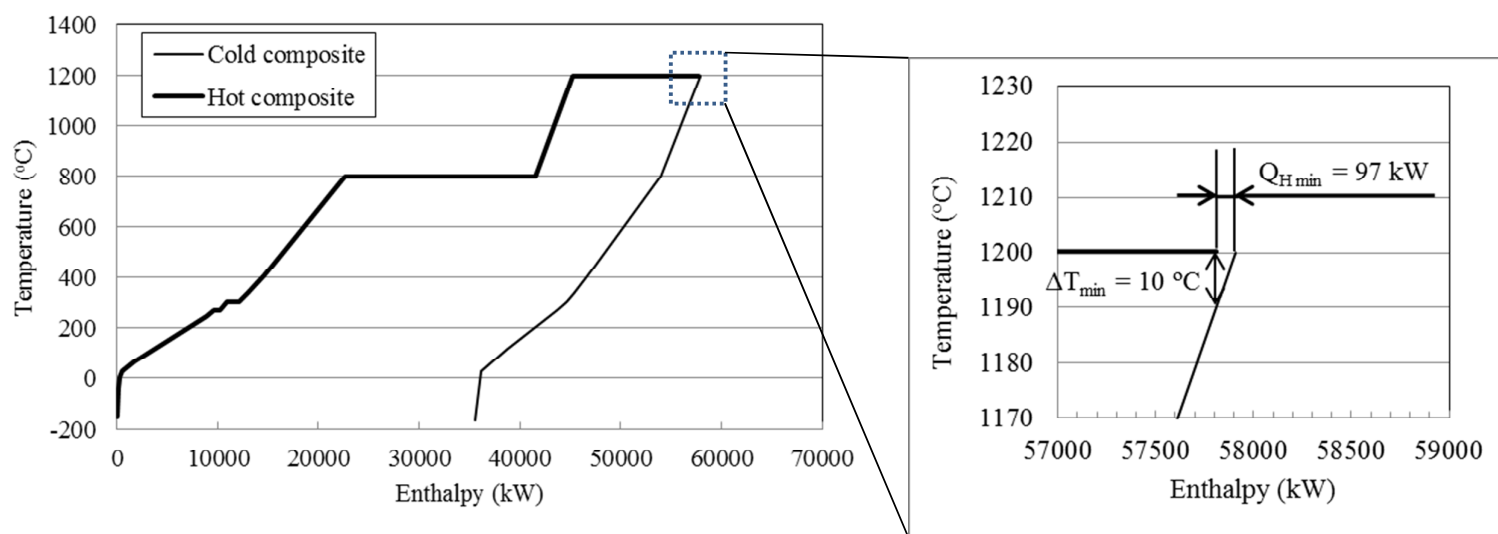


Figure S5. Composite curves for SC-Syn-MeOH.

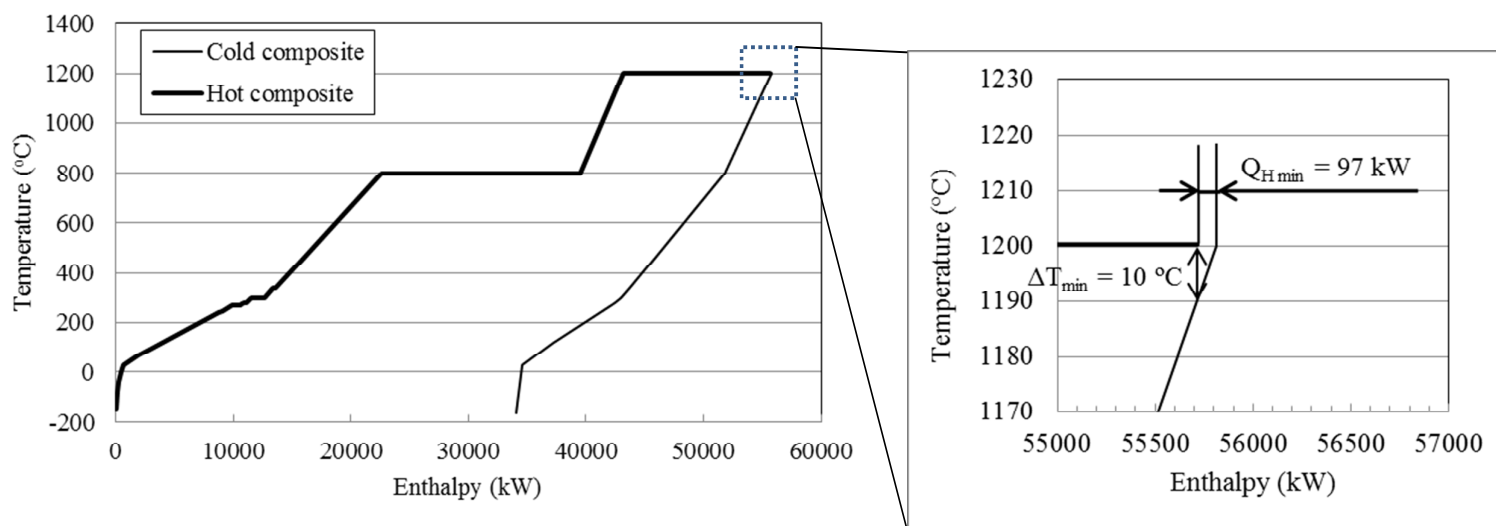


Figure S6. Composite curves for TH-Syn-MeOH.

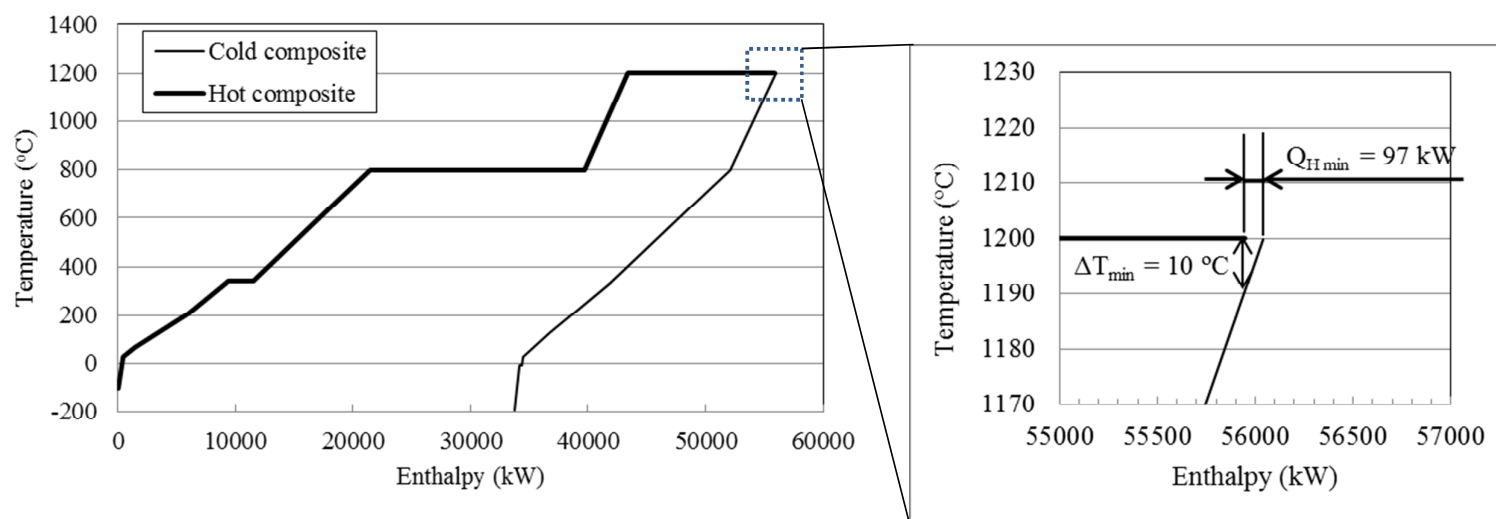


Figure S7. Composite curves for SC-Syn-LOs.

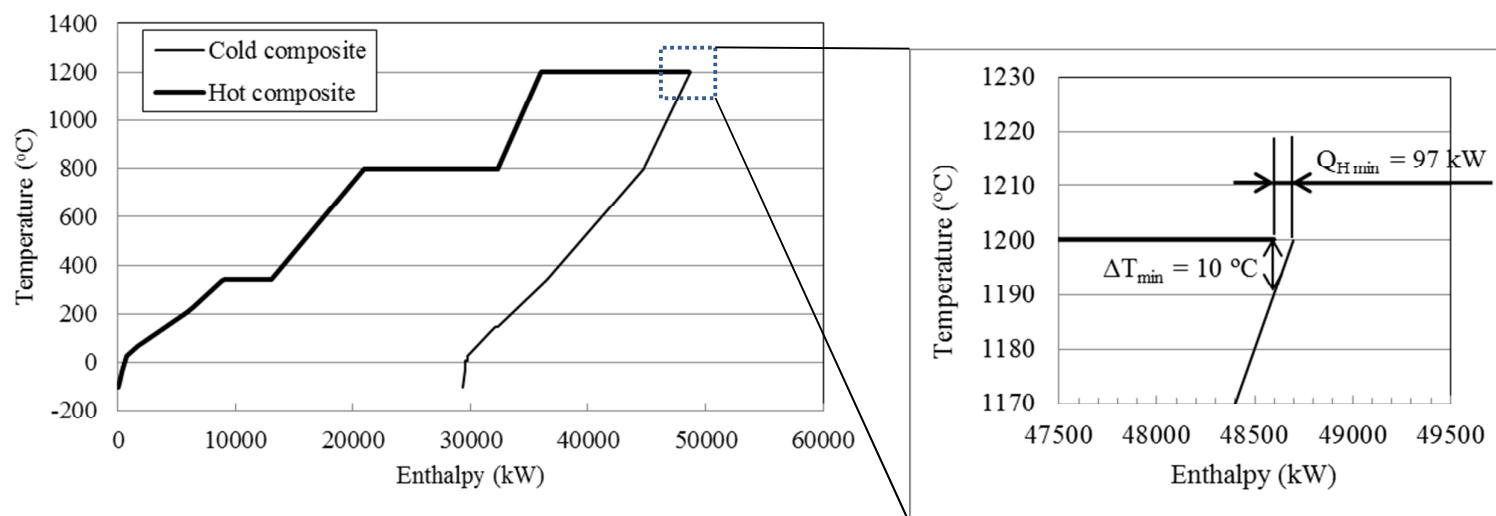


Figure S8. Composite curves for Imp-Syn-LOs.

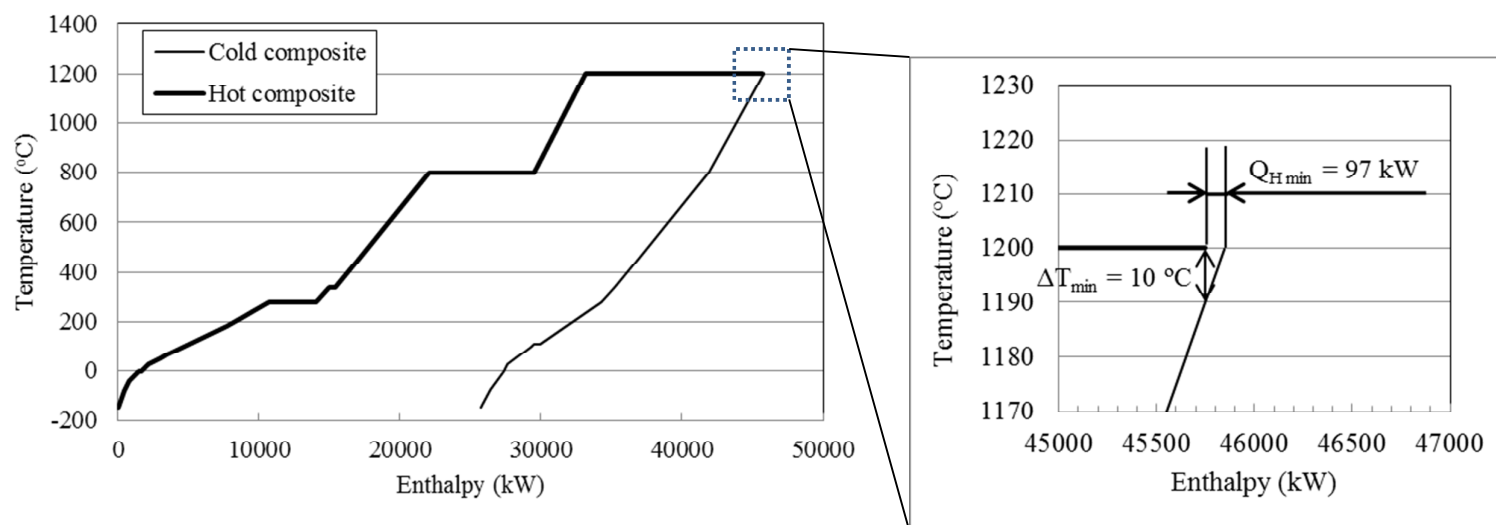


Figure S9. Composite curves for Imp TH-Syn-DME.

Table S1 Mass balance for gasification

Input			MW	C	H	O	N	Na	K	C	H	O	N	Na	K
	kg/h	kmol/h	kg/kmol							kg/h	kg/h	kg/h	kg/h	kg/h	kg/h
Lignin (daf)	4125.0	24.8	166	10	14	2				2981.9	347.9	795.2	0.0	0.0	0.0
Ash (Na ₂ O)	20.8	0.3	62			1		2		0.0	0.0	5.4	0.0	15.5	0.0
Ash (K ₂ O)	20.8	0.2	94			1			2	0.0	0.0	3.5	0.0	0.0	17.3
H ₂ O	4166.7	231.5	18		2	1				0.0	463.0	3703.7	0.0	0.0	0.0
O ₂	4771.1	149.1	32			2				0.0	0.0	4771.1	0.0	0.0	0.0
N ₂	129.1	4.6	28				2			0.0	0.0	0.0	129.1	0.0	0.0
sum	13233.5	410.6								2981.9	810.9	9278.9	129.1	15.5	17.3
Output			MW	C	H	O	N	Na	K	C	H	O	N	Na	K
	kg/h	kmol/h	kg/kmol							kg/h	kg/h	kg/h	kg/h	kg/h	kg/h
CO	4419.5	157.8	28	1		1				1894.1	0.0	2525.4	0.0	0.0	0.0
CO ₂	3988.7	90.7	44	1		2				1087.8	0.0	2900.9	0.0	0.0	0.0
H ₂	330.4	165.2	2		2					0.0	330.4	0.0	0.0	0.0	0.0
H ₂ O	4324.0	240.2	18		2	1				0.0	480.4	3843.5	0.0	0.0	0.0
N ₂	129.1	4.6	28				2			0.0	0.0	0.0	129.1	0.0	0.0
Ash (Na ₂ O)	20.8	0.3	62			1		2		0.0	0.0	5.4	0.0	15.5	0.0
Ash (K ₂ O)	20.8	0.2	94			1			2	0.0	0.0	3.5	0.0	0.0	17.3
sum	13233.4	658.5								2981.9	810.9	9278.8	129.1	15.5	17.3
In/Out	1.000									1.000	1.000	1.000	1.000	1.000	1.000

Table S2 Mass balance for SC-Syn-DME

DME synthesis reaction for SC-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	4419.5	157.8	28	1		1		1894.1	0.0	2525.4	0.0
CO ₂	398.9	9.1	44	1		2		108.8	0.0	290.1	0.0
H ₂	330.4	165.2	2		2			0.0	330.4	0.0	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
H ₂ O	61.7	3.4	18		2	1		0.0	6.9	54.8	0.0
sum	5339.6	340.2						2002.9	337.3	2870.4	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	2346.8	83.8	28	1		1		1005.8	0.0	1341.0	0.0
CO ₂	1010.0	23.0	44	1		2		275.5	0.0	734.6	0.0
H ₂	117.0	58.5	2		2			0.0	117.0	0.0	0.0
H ₂ O	330.2	18.3	18		2	1		0.0	36.7	293.5	0.0
DME	1310.5	28.5	46	2	6	1		683.8	170.9	455.8	0.0
MeOH	90.9	2.8	32	1	4	1		34.1	11.4	45.5	0.0
CH ₄	5.1	0.3	16	1	4			3.8	1.3	0.0	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	5339.6	219.9						2002.9	337.3	2870.3	129.1
In/Out	1.000							1.000	1.000	1.000	1.000
LO synthesis reaction from DME for SC-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	25.5	0.9	28	1		1		10.9	0.0	14.6	0.0
CO ₂	503.4	11.4	44	1		2		137.3	0.0	366.1	0.0
H ₂	0.3	0.2	2		2			0.0	0.3	0.0	0.0
H ₂ O	13.6	0.8	18		2	1		0.0	1.5	12.1	0.0
DME	1241.8	27.0	46	2	6	1		647.9	162.0	431.9	0.0
MeOH	90.9	2.8	32	1	4	1		34.1	11.4	45.4	0.0
CH ₄	0.2	0.0	16	1	4			0.2	0.1	0.0	0.0
N ₂	14423.4	515.2	28				2	0.0	0.0	0.0	14423.4
sum	16299.2	558.2						830.4	175.2	870.2	14423.4

[illegible]

Output			MW	C	H	O	N	C	H	O	N
		kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	979.6	35.0	28				2	0.0	0.0	0.0	979.6
O ₂	30.8	1.0	32			2		0.0	0.0	30.8	0.0
H ₂ O	299.8	16.7	18		2	1		0.0	33.3	266.5	0.0
n-C ₄ H ₁₀	28.3	0.5	58	4	10			23.4	4.9	0.0	0.0
n-C ₄ H ₈	33.4	0.6	56	4	8			28.6	4.8	0.0	0.0
n-C ₅ H ₁₀	34.3	0.5	70	5	10			29.4	4.9	0.0	0.0
1,3-BD	138.1	2.6	54	4	6			122.8	15.3	0.0	0.0
CO ₂	30.8	0.7	44	1		2		8.4	0.0	22.4	0.0
sum	1575.0	57.4						212.6	63.2	319.6	979.6
In/Out	1.000							1.000	1.000	1.000	1.000

Table S3 Mass balance for TH-Syn-DME

DME synthesis reaction for TH-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	4419.5	157.8	28	1		1		1894.1	0.0	2525.4	0.0
CO ₂	398.9	9.1	44	1		2		108.8	0.0	290.1	0.0
H ₂	330.4	165.2	2		2			0.0	330.4	0.0	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
H ₂ O	61.7	3.4	18		2	1		0.0	6.9	54.8	0.0
sum	5339.6	340.2						2002.9	337.3	2870.3	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	1110.1	39.6	28	1		1		475.7	0.0	634.3	0.0
CO ₂	2172.7	49.4	44	1		2		592.5	0.0	1580.1	0.0
H ₂	99.5	49.8	2		2			0.0	99.5	0.0	0.0
H ₂ O	20.5	1.1	18		2	1		0.0	2.3	18.3	0.0
DME	1749.3	38.0	46	2	6	1		912.7	228.2	608.4	0.0
MeOH	58.4	1.8	32	1	4	1		21.9	7.3	29.2	0.0
CH ₄	0.0	0.0	16	1	4			0.0	0.0	0.0	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	5339.6	184.4						2002.9	337.3	2870.4	129.1
In/Out	1.000							1.000	1.000	1.000	1.000
LO synthesis reaction from DME for TH-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	35.4	1.3	28.0	1		1		15.2	0.0	20.2	0.0
CO ₂	1598.6	36.3	44.0	1		2		436.0	0.0	1162.6	0.0
H ₂	1.0	0.5	2.0		2			0.0	1.0	0.0	0.0
H ₂ O	12.4	0.7	18.0		2	1		0.0	1.4	11.0	0.0
DME	1714.9	37.3	46.0	2	6	1		894.7	223.7	596.5	0.0
MeOH	58.4	1.8	32.0	1	4	1		21.9	7.3	29.2	0.0
CH ₄	0.0	0.0	16.0	1	4			0.0	0.0	0.0	0.0
N ₂	19404.5	693.0	28.0				2	0.0	0.0	0.0	19404.5
sum	22825.0	770.9						1367.8	233.3	1819.5	19404.4

Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	35.4	1.3	28	1		1		15.2	0.0	20.2	0.0
CO ₂	1598.6	36.33	44	1		2		436.0	0.0	1162.6	0.0
H ₂	1.0	0.5	2		2			0.0	1.0	0.0	0.0
H ₂ O	716.3	39.8	18		2	1		0.0	79.6	636.7	0.0
MeOH	0.0	0.0	32	1	4	1		0.0	0.0	0.0	0.0
N ₂	19404.4	693.0	28				2	0.0	0.0	0.0	19404.4
DME	0.0	0.0	46	2	6	1		0.0	0.0	0.0	0.0
C ₂ H ₄	38.9	1.4	28	2	4			33.4	5.6	0.0	0.0
C ₃ H ₆	432.1	10.3	42	3	6			370.4	61.7	0.0	0.0
n-C ₄ H ₈	598.4	10.7	56	4	8			512.9	85.5	0.0	0.0
n-C ₅ H ₁₀	0.0	0.0	70	5	10			0.0	0.0	0.0	0.0
sum	22825.0	793.3						1367.8	233.3	1819.5	19404.4
In/Out	1.000							1.000	1.000	1.000	1.000
Iso/Dehyd reaction for TH-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	2388.7	85.3	28				2	0.0	0.0	0.0	2388.7
O ₂	256.8	8.0	32			2		0.0	0.0	256.8	0.0
H ₂ O	588.0	32.7	18		2	1		0.0	65.3	522.7	0.0
C ₃ H ₆	3.7	0.1	42	3	6			3.2	0.5	0.0	0.0
n-C ₄ H ₈	583.1	10.4	56	4	8			499.8	83.3	0.0	0.0
sum	3820.2	136.5						503.0	149.2	779.4	2388.7
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	2388.7	85.3	28				2	0.0	0.0	0.0	2388.7
O ₂	90.2	2.8	32			2		0.0	0.0	90.2	0.0
H ₂ O	775.4	43.1	18		2	1		0.0	86.2	689.3	0.0
C ₃ H ₆	3.7	0.1	42	3	6			3.2	0.5	0.0	0.0
n-C ₄ H ₈	0.0	0.0	56	4	8			0.0	0.0	0.0	0.0
1,3-BD	562.3	10.4	54	4	6			499.8	62.5	0.0	0.0
sum	3820.2	141.7						503.0	149.2	779.4	2388.7

In/Out	1.000							1.000	1.000	1.000	1.000

Table S4 Mass balance for SC-Syn-MeOH

MeOH synthesis reaction for SC-Syn-MeOH											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	1507.5	53.8	28	1		1		646.1	0.0	861.4	0.0
CO ₂	2369.0	53.8	44	1		2		646.1	0.0	1722.9	0.0
H ₂	538.4	269.2	2		2			0.0	538.4	0.0	0.0
H ₂ O	57.5	3.2	18		2	1		0.0	6.4	51.1	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	4601.5	384.7						1292.2	544.8	2635.4	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	1139.8	40.7	28	1		1		488.5	0.0	651.3	0.0
CO ₂	1999.2	45.4	44	1		2		545.2	0.0	1454.0	0.0
H ₂	435.5	217.7	2		2			0.0	435.5	0.0	0.0
H ₂ O	208.8	11.6	18		2	1		0.0	23.2	185.6	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
MeOH	689.2	21.5	32	1	4	1		258.4	86.1	344.6	0.0
sum	4601.5	341.6						1292.2	544.8	2635.4	129.1
In/Out	1.000							1.000	1.000	1.000	1.000
LO synthesis reaction from MeOH for SC-Syn-MeOH											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO ₂	0.7	0.0	44	1		2		0.2	0.0	0.5	0.0
H ₂ O	207.6	11.5	18		2	1		0.0	23.1	184.5	0.0
MeOH	678.1	21.2	32	1	4	1		254.3	84.8	339.0	0.0
N ₂	2049.9	73.2	28				2	0.0	0.0	0.0	2049.9
sum	2936.2	105.9						254.5	107.8	524.0	2049.9
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO ₂	0.7	0.0	44	1		2		0.2	0.0	0.5	0.0
N ₂	2049.9	73.2	28				2	0.0	0.0	0.0	2049.9
C ₂ H ₄	20.8	0.7	28	2	4			17.8	3.0	0.0	0.0

[illegible]

In/Out	1.000							1.000	1.000	1.000	1.000
--------	-------	--	--	--	--	--	--	-------	-------	-------	-------

Table S5 Mass balance for TH-Syn-MeOH

MeOH synthesis reaction for TH-Syn-MeOH											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	1507.5	53.8	28	1		1		646.1	0.0	861.4	0.0
CO ₂	2369.0	53.8	44	1		2		646.1	0.0	1722.9	0.0
H ₂	538.4	269.2	2		2			0.0	538.4	0.0	0.0
H ₂ O	57.5	3.2	18		2	1		0.0	6.4	51.1	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	4601.5	384.7						1292.2	544.8	2635.5	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	813.9	29.1	28	1		1		348.8	0.0	465.1	0.0
CO ₂	2251.9	51.2	44	1		2		614.2	0.0	1637.8	0.0
H ₂	423.4	211.7	2		2			0.0	423.4	0.0	0.0
H ₂ O	105.4	5.9	18		2	1		0.0	11.7	93.7	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
MeOH	877.9	27.4	32	1	4	1		329.2	109.7	438.9	0.0
sum	4601.5	329.8						1292.2	544.8	2635.5	129.1
In/Out	1.000							1.000	1.000	1.000	1.000
LO synthesis reaction from MeOH for TH-Syn-MeOH											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO ₂	0.7	0.0	44	1		2		0.2	0.0	0.5	0.0
H ₂ O	104.1	5.8	18		2	1		0.0	11.6	92.6	0.0
MeOH	866.6	27.1	32	1	4	1		325.0	108.3	433.3	0.0
N ₂	2870.7	102.5	28				2	0.0	0.0	0.0	2870.7
sum	3842.2	135.4						325.2	119.9	526.4	2870.7
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO ₂	0.7	0.0	44	1		2		0.2	0.0	0.5	0.0
N ₂	2870.7	102.5	28				2	0.0	0.0	0.0	2870.7
C ₂ H ₄	10.3	0.4	28	2	4			8.8	1.5	0.0	0.0

C ₃ H ₆	137.9	3.3	42	3	6			118.2	19.7	0.0	0.0
n-C ₄ H ₈	231.0	4.1	56	4	8			198.0	33.0	0.0	0.0
n-C ₅ H ₁₀	0.0	0.00	70	5	10			0.0	0.0	0.0	0.0
H ₂ O	591.6	32.87	18		2	1		0.0	65.7	525.9	0.0
sum	3842.2	143.2						325.2	119.9	526.4	2870.7
In/Out	1.000							1.000	1.000	1.000	1.000
Iso/Dehyd reaction for TH-Syn-MeOH											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	820.7	29.3	28				2	0.0	0.0	0.0	820.7
O ₂	88.2	2.8	32			2		0.0	0.0	88.2	0.0
H ₂ O	202.0	11.2	18		2	1		0.0	22.4	179.6	0.0
C ₃ H ₆	0.3	0.0	42	3	6			0.3	0.0	0.0	0.0
n-C ₄ H ₈	201.6	3.6	56	4	8			172.8	28.8	0.0	0.0
sum	1312.9	46.9						173.1	51.3	267.8	820.7
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	820.7	29.3	28				2	0.0	0.0	0.0	820.7
O ₂	30.6	1.0	32			2		0.0	0.0	30.6	0.0
H ₂ O	266.8	14.8	18		2	1		0.0	29.6	237.2	0.0
C ₃ H ₆	0.3	0.0	42	3	6			0.3	0.0	0.0	0.0
n-C ₄ H ₈	0.0	0.0	56	4	8			0.0	0.0	0.0	0.0
1,3-BD	194.4	3.6	54	4	6			172.8	21.6	0.0	0.0
sum	1312.9	48.7						173.1	51.3	267.8	820.7
In/Out	1.000							1.000	1.000	1.000	1.000

Table S6 Mass balance for SC-Syn-LOs

Direct synthesis reaction of LOs from syngas for SC-Syn-LOs											
Input				C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	4419.5	157.8	28	1		1		1894.1	0.0	2525.4	0.0
CO ₂	398.9	9.1	44	1		2		108.8	0.0	290.1	0.0
H ₂	330.4	165.2	2		2			0.0	330.4	0.0	0.0
H ₂ O	102.6	5.7	18		2	1		0.0	11.4	91.2	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	5380.5	342.4	0					2002.9	341.8	2906.7	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	2209.8	78.9	28	1		1		947.0	0.0	1262.7	0.0
H ₂	226.3	113.2	2		2			0.0	226.3	0.0	0.0
CO ₂	2065.7	46.9	44	1		2		563.4	0.0	1502.3	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
CH ₄	101.0	6.3	16	1	4			75.8	25.3	0.0	0.0
C ₂ H ₄	146.4	5.2	28	2	4			125.4	20.9	0.0	0.0
C ₃ H ₆	126.9	3.0	42	3	6			108.7	18.1	0.0	0.0
n-C ₄ H ₈	84.6	1.5	56	4	8			72.5	12.1	0.0	0.0
n-C ₅ H ₁₀	52.9	0.8	70	5	10			45.4	7.6	0.0	0.0
n-C ₆ H ₁₂	31.8	0.4	84	6	12			27.2	4.5	0.0	0.0
C ₂ H ₆	32.1	1.1	30	2	6			25.7	6.4	0.0	0.0
C ₃ H ₈	7.0	0.2	44	3	8			5.7	1.3	0.0	0.0
n-C ₄ H ₁₀	4.6	0.1	58	4	10			3.8	0.8	0.0	0.0
n-C ₅ H ₁₂	2.9	0.0	72	5	12			2.4	0.5	0.0	0.0
n-C ₆ H ₁₄	1.7	0.0	86	6	14			1.4	0.3	0.0	0.0
H ₂ O	159.4	8.9	18		2	1		0.0	17.7	141.7	0.0
sum	5382.1	271.1						2004.5	341.8	2906.7	129.1
In/Out	1.000							0.999	1.000	1.000	1.000
Iso/Dehyd reaction for SC-Syn-LOs											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	477.7	17.1	28				2	0.0	0.0	0.0	477.7

O ₂	51.3	1.6	32			2		0.0	0.0	51.3	0.0
H ₂ O	117.6	6.5	18		2	1		0.0	13.1	104.5	0.0
C ₃ H ₆	7.1	0.2	42	3	6			6.1	1.0	0.0	0.0
n-C ₄ H ₈	84.1	1.5	56	4	8			72.1	12.0	0.0	0.0
n-C ₅ H ₁₀	20.5	0.3	70	5	10			17.6	2.9	0.0	0.0
C ₃ H ₈	2.0	0.0	44	3	8			1.7	0.4	0.0	0.0
n-C ₄ H ₁₀	4.5	0.1	58	4	10			3.8	0.8	0.0	0.0
n-C ₅ H ₁₂	0.8	0.0	72	5	12			0.7	0.1	0.0	0.0
sum	765.7	27.3						101.8	30.3	155.9	477.7
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	477.7	17.1	28				2	0.0	0.0	0.0	477.7
O ₂	17.7	0.6	32			2		0.0	0.0	17.7	0.0
H ₂ O	144.0	8.0	18		2	1		0.0	16.0	128.0	0.0
C ₃ H ₆	7.1	0.2	42	3	6			6.1	1.0	0.0	0.0
n-C ₄ H ₈	15.1	0.3	56	4	8			12.9	2.2	0.0	0.0
n-C ₅ H ₁₀	20.5	0.3	70	5	10			17.6	2.9	0.0	0.0
C ₃ H ₈	2.0	0.0	44	3	8			1.7	0.4	0.0	0.0
n-C ₄ H ₁₀	4.5	0.1	58	4	10			3.8	0.8	0.0	0.0
n-C ₅ H ₁₂	0.8	0.0	72	5	12			0.7	0.1	0.0	0.0
1,3-BD	62.3	1.2	54	4	6			55.4	6.9	0.0	0.0
CO ₂	13.9	0.3	44	1		2		3.8	0.0	10.1	0.0
sum	765.7	28.0						101.8	30.3	155.9	477.7
In/Out	1.000							1.000	1.000	1.000	1.000

Table S7 Mass balance for Imp-Syn-LOs

Direct synthesis reaction of LOs from syngas for Imp-Syn-LOs											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	4419.5	157.8	28	1		1		1894.1	0.0	2525.4	0.0
CO ₂	398.9	9.1	44	1		2		108.8	0.0	290.1	0.0
H ₂	330.4	165.2	2		2			0.0	330.4	0.0	0.0
H ₂ O	102.6	5.7	18		2	1		0.0	11.4	91.2	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
sum	5380.5	342.4						2002.9	341.8	2906.7	129.1
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	883.9	31.6	28	1		1		378.8	0.0	505.1	0.0
H ₂	27.5	13.7	2		2			0.0	27.5	0.0	0.0
CO ₂	2065.7	46.9	44	1		2		563.4	0.0	1502.3	0.0
N ₂	129.1	4.6	28				2	0.0	0.0	0.0	129.1
CH ₄	161.6	10.1	16	1	4			121.2	40.4	0.0	0.0
C ₂ H ₄	256.7	9.2	28	2	4			220.0	36.7	0.0	0.0
C ₃ H ₆	244.8	5.8	42	3	6			209.8	35.0	0.0	0.0
n-C ₄ H ₈	179.5	3.2	56	4	8			153.9	25.6	0.0	0.0
n-C ₅ H ₁₀	123.5	1.8	70	5	10			105.8	17.6	0.0	0.0
n-C ₆ H ₁₂	81.5	1.0	84	6	12			69.9	11.6	0.0	0.0
n-C ₇ H ₁₄	52.3	0.5	98	7	14			44.8	7.5	0.0	0.0
n-C ₈ H ₁₆	32.9	0.3	112	8	16			28.2	4.7	0.0	0.0
n-C ₉ H ₁₈	20.3	0.2	126	9	18			17.4	2.9	0.0	0.0
n-C ₁₀ H ₂₀	12.5	0.1	140	10	20			10.7	1.8	0.0	0.0
C ₂ H ₆	56.3	1.9	30	2	6			45.1	11.3	0.0	0.0
C ₃ H ₈	13.5	0.3	44	3	8			11.0	2.5	0.0	0.0
n-C ₄ H ₁₀	9.9	0.2	58	4	10			8.2	1.7	0.0	0.0
n-C ₅ H ₁₂	6.7	0.1	72	5	12			5.6	1.1	0.0	0.0
n-C ₆ H ₁₄	4.4	0.1	86	6	14			3.7	0.7	0.0	0.0
n-C ₇ H ₁₆	2.8	0.0	100	7	16			2.4	0.5	0.0	0.0
n-C ₈ H ₁₈	1.8	0.0	114	8	18			1.5	0.3	0.0	0.0
n-C ₉ H ₂₀	1.1	0.0	128	9	20			0.9	0.2	0.0	0.0
n-C ₁₀ H ₂₂	0.6	0.0	142	10	22			0.5	0.1	0.0	0.0
H ₂ O	1011.7	56.2	18		2	1		0.0	112.4	899.3	0.0

sum	5380.6	187.7						2002.8	342.0	2906.7	129.1
In/Out	1.000							1.000	0.999	1.000	1.000
Iso/Dehyd reaction for Imp-Syn-LOs											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	955.3	34.1	28				2	0.0	0.0	0.0	955.3
O ₂	102.7	3.2	32			2		0.0	0.0	102.7	0.0
H ₂ O	235.2	13.1	18		2	1		0.0	26.1	209.0	0.0
C ₃ H ₆	1.5	0.0	42	3	6			1.3	0.2	0.0	0.0
n-C ₄ H ₈	175.9	3.1	56	4	8			150.7	25.1	0.0	0.0
n-C ₅ H ₁₀	54.0	0.8	70	5	10			46.3	7.7	0.0	0.0
n-C ₆ H ₁₂	3.4	0.0	84	6	12			2.9	0.5	0.0	0.0
C ₃ H ₈	0.7	0.0	44	3	8			0.6	0.1	0.0	0.0
n-C ₄ H ₁₀	9.3	0.2	58	4	10			7.7	1.6	0.0	0.0
n-C ₅ H ₁₂	2.5	0.0	72	5	12			2.1	0.4	0.0	0.0
sum	1540.4	54.6						211.6	61.8	311.7	955.3
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	955.3	34.1	28				2	0.0	0.0	0.0	955.3
O ₂	52.4	1.6	32			2		0.0	0.0	52.4	0.0
H ₂ O	291.7	16.2	18		2	1		0.0	32.4	259.3	0.0
C ₃ H ₆	1.5	0.0	42	3	6			1.3	0.2	0.0	0.0
n-C ₄ H ₈	0.0	0.0	56	4	8			0.0	0.0	0.0	0.0
n-C ₅ H ₁₀	54.0	0.8	70	5	10			46.3	7.7	0.0	0.0
n-C ₆ H ₁₂	3.4	0.0	84	6	12			2.9	0.5	0.0	0.0
C ₃ H ₈	0.7	0.0	44	3	8			0.6	0.1	0.0	0.0
n-C ₄ H ₁₀	9.3	0.2	58	4	10			7.7	1.6	0.0	0.0
n-C ₅ H ₁₂	2.5	0.0	72	5	12			2.1	0.4	0.0	0.0
1,3-BD	169.6	3.1	54	4	6			150.7	18.8	0.0	0.0
sum	1540.4	56.2						211.6	61.8	311.7	955.3
In/Out	1.000							1.000	1.000	1.000	1.000

Table S8 Electric power and heat properties for SC-Syn-DME

1. Gasification					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Air separation				3487	969
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock drying	Cold	25.0	1200.0	41932	11648
Ash (Na ₂ O) heating	Cold	25.0	1132.0	33	9
Ash (K ₂ O) heating	Cold	25.0	350.0	6	2
Reaction heat recovery	Hot	1200.2	1200.0	45246	12568
Product mixture cooling	Hot	1200.0	25.0	38704	10751
Ash (Na ₂ O) cooling	Hot	1132.0	25.0	33	9
Ash (K ₂ O) cooling	Hot	350.0	25.0	6	2
2. DME synthesis					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				6928	1925
Feed gas compression				4620	1283
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Cooling by 1st HX	Hot	283.4	65.0	2435	676
Cooling by 2nd HX	Hot	205.7	65.0	1761	489
Feed gas heating	Cold	98.3	280.0	1867	519
Reaction heat recovery	Hot	280.2	280.0	7183	1995
Product cooling 1	Hot	280.0	50.0	2779	772
Product cooling 2	Hot	50.0	-50.0	1618	449
Exhaust heating	Cold	-154.8	800.0	22974	6382
Combustion heat recovery	Hot	800.2	800.0	42370	11769
Exhaust cooling	Hot	800.0	25.0	21666	6018

3. LO synthesis from DME					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Air separation				549	152
Product compression				243	68
Regeneration of absorption tower				780	217
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	-67.9	400.0	2327	646
Additional N ₂ heating	Cold	25.0	400.0	5728	1591
Reaction heat recovery	Hot	400.2	400.0	1464	407
Product cooling	Hot	400.0	-150.0	12108	3363
Exhaust heating	Cold	-150.0	25.0	2651	736
Product heating	Cold	-150.0	0.0	787	218
Compressed product cooling	Hot	153.2	-30.0	750	208
Distillation tower 1 distillate condensation	Hot	16.2	16.0	255	71
Distillation tower 1 bottom reboiling	Cold	130.8	131.0	715	199
Distillation tower 2 distillate condensation	Hot	117.2	117.0	74	21
Distillation tower 2 bottom reboiling	Cold	181.2	181.4	160	44
Distillation tower 2 distillate cooling	Hot	117.0	25.0	141	39
Product heating	Cold	-2.5	25.0	95	26
Exhaust heating	Cold	54.5	800.0	4053	1126
Combustion heat recovery	Hot	800.2	800.0	7795	2165
Exhaust cooling	Hot	800.0	25.0	4336	1204
C ₃ H ₆ heating	Cold	-64.5	25.0	127	35
4. Iso/Dehyd					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Air separation				177	49
Product compression				413	115

Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	1192	331
Reaction heat recovery	Hot	335.2	335.0	772	215
Product cooling	Hot	335.0	-40.0	1566	435
Compressed product cooling	Hot	235.1	-80.0	589	164
Exhaust heating	Cold	-187.1	25.0	239	66
Distillation tower 1 distillate condensation	Hot	16.4	16.2	8	2
Distillation tower 1 bottom reboiling	Cold	114.5	114.7	118	33
Distillation tower 2 distillate condensation	Hot	112.0	111.8	48	13
Distillation tower 2 bottom reboiling	Cold	141.8	142.0	96	27
Distillation tower 2 distillate heating	Cold	0.7	25.0	7	2
Distillation tower 1 distillate heating	Cold	-75.9	25.0	2	1
Exhaust heating	Cold	22.1	800.0	869	241
Combustion heat recovery	Hot	800.2	800.0	1676	466
Exhaust cooling	Hot	800.0	25.0	929	258

Table S9 Electric power and heat properties for TH-Syn-DME

1. Gasification					
Referred in Table S8					
2. DME synthesis					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				6928	1925
Feed gas compression				4620	1283
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Cooling by 1st HX	Hot	283.4	65.0	2435	676
Cooling by 2nd HX	Hot	205.7	65.0	1761	489
Feed gas heating	Cold	98.3	280.0	1867	519
Reaction heat recovery	Hot	280.2	280.0	10160	2822
Product cooling 1	Hot	280.0	50.0	2008	558
Product cooling 2	Hot	50.0	-50.0	2124	590
Exhaust heating	Cold	-137.2	800.0	14061	3906
Combustion heat recovery	Hot	800.2	800.0	25391	7053
Exhaust cooling	Hot	800.0	25.0	13690	3803
3. LO synthesis from DME					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Air separation				1942	539
Product compression				575	160
Regeneration of absorption tower				2639	733
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	-76.8	280.0	3068	852
Reaction heat recovery	Hot	280.2	280.0	1890	525
Product cooling	Hot	280.0	-150.0	13903	3862

Exhaust heating	Cold	-150.0	25.0	3569	991
Product heating	Cold	-150.0	0.0	1524	423
Compressed product cooling	Hot	184.3	-30.0	1548	430
Distillation tower 1 distillate condensation	Hot	-0.9	-1.1	633	176
Distillation tower 1 bottom reboiling	Cold	106.9	107.1	1476	410
Distillation tower 2 distillate condensation	Hot	107.6	107.4	137	38
Distillation tower 2 bottom reboiling	Cold	107.5	107.7	274	76
Distillation tower 2 distillate cooling	Hot	107.4	25.0	270	75
Distillation tower 2 distillate heating	Cold	-6.5	25.0	224	62
Distillation tower 2 bottom heating	Cold	-6.0	25.0	3	1
C ₃ H ₆ heating	Cold	-81.4	25.0	331	92
4. Iso/Dehyd					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Air separation				432	120
Product compression				1005	279
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	2886	802
Reaction heat recovery	Hot	335.2	335.0	1336	371
Product cooling	Hot	335.0	-40.0	3927	1091
Compressed product cooling	Hot	240.8	-80.0	1429	397
Distillation tower distillate condensation	Hot	41.6	41.4	11	3
Distillation tower bottom reboiling	Cold	109.1	109.3	259	72
Distillation tower distillate heating	Cold	-44.9	25.0	3	1
Distillation tower bottom heating	Cold	-4.2	25.0	122	34
Exhaust heating	Cold	25.0	800.0	220	61
Combustion heat recovery	Hot	800.2	800.0	421	117
Exhaust cooling	Hot	800.0	25.0	233	65

Table S10 Electric power and heat properties for SC-Syn-MeOH

1. Gasification					
Referred in Table S8					
2. MeOH synthesis					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				11958	3322
Feed gas compression				6012	1670
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	25.0	300.0	8566	2379
Reaction heat recovery	Hot	300.2	300.0	4047	1124
Product gas cooling	Hot	300.0	25.0	4090	1136
Cooling by 1st HX	Hot	247.1	65.0	2255	626
Cooling by 2nd HX	Hot	274.3	65.0	3054	848
Feed gas heating	Cold	117.8	270.0	1865	518
Reaction heat recovery	Hot	270.2	270.0	1819	505
Product cooling	Hot	270.0	0.0	4483	1245
Exhaust 1 heating	Cold	-163.8	25.0	2005	557
Exhaust 1 heating	Cold	25.0	800.0	22697	6305
Combustion heat 1 recovery	Hot	800.2	800.0	65725	18257
Exhaust 1 cooling	Hot	800.0	25.0	30084	8357
Exhaust 2 heating	Cold	25.0	800.0	31	9
Combustion heat 2 recovery	Hot	800.2	800.0	53	15
Exhaust 2 cooling	Hot	800.0	25.0	38	10
Product heating	Cold	-1.6	25.0	94	26
3. LO synthesis from MeOH					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				58	16
Regeneration of absorption tower				1	0

Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	25.0	400.0	2129	591
Reaction heat recovery	Hot	400.2	400.0	790	220
Product cooling	Hot	400.0	-150.0	3957	1099
Product heating	Cold	-150.0	25.0	214	59
Exhaust 1 heating	Cold	-150.0	25.0	376	104
Compressed product cooling	Hot	154.1	25.0	168	47
Distillation tower 1 distillate condensation	Hot	43.9	43.7	46	13
Distillation tower 1 bottom reboiling	Cold	130.3	130.5	137	38
Distillation tower 2 distillate condensation	Hot	113.3	113.1	22	6
Distillation tower 2 bottom reboiling	Cold	200.5	200.7	50	14
Distillation tower 2 distillate cooling	Hot	113.1	25.0	45	13
Product heating	Cold	-3.5	25.0	36	10
Exhaust 2 cooling	Hot	66.6	25.0	21	6
Exhaust 2 heating	Cold	25.0	800.0	790	219
Combustion heat 2 recovery	Hot	800.2	800.0	2368	658
Exhaust 2 cooling	Hot	800.0	25.0	877	244
C ₃ H ₆ heating	Cold	-49.9	25.0	23	6
4. Iso/Dehyd					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				160	44
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	461	128
Reaction heat recovery	Hot	335.2	335.0	289	80
Product cooling	Hot	335.0	-40.0	609	169
Compressed product cooling	Hot	235.1	-80.0	228	63
Distillation tower distillate condensation	Hot	-37.8	-38.0	3	1
Distillation tower bottom reboiling	Cold	110.8	111.0	45	13

Exhaust 1 heating	Cold	-188.5	25.0	92	25
Exhaust 2 heating	Cold	-98.7	25.0	1	0

Table S11 Electric power and heat properties for TH-Syn-MeOH

1. Gasification					
Referred in Table S8					
2. MeOH synthesis					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				11958	3322
Feed gas compression				6012	1670
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	25.0	300.0	8566	2379
Reaction heat recovery	Hot	300.2	300.0	4047	1124
Product gas cooling	Hot	300.0	25.0	4090	1136
Cooling by 1st HX	Hot	247.1	65.0	2255	626
Cooling by 2nd HX	Hot	274.3	65.0	3054	848
Feed gas heating	Cold	117.8	270.0	1865	518
Reaction heat recovery	Hot	270.2	270.0	2636	732
Product cooling	Hot	270.0	0.0	4431	1231
Exhaust 1 heating	Cold	-161.7	25.0	1939	539
Exhaust 1 heating	Cold	25.0	800.0	21469	5964
Combustion heat 1 recovery	Hot	800.2	800.0	60930	16925
Exhaust 1 cooling	Hot	800.0	25.0	28677	7966
Exhaust 2 heating	Cold	25.0	800.0	37	10
Combustion heat 2 recovery	Hot	800.2	800.0	62	17
Exhaust 2 cooling	Hot	800.0	25.0	45	12
Product heating	Cold	-1.8	25.0	102	28
3. LO synthesis from MeOH					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				60	17
Regeneration of absorption tower				1	0

Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	25.0	280.0	1640	455
Reaction heat recovery	Hot	280.2	280.0	734	204
Product cooling	Hot	280.0	-150.0	3458	961
Exhaust heating	Cold	-150.0	25.0	375	104
Product heating	Cold	-150.0	25.0	218	61
Compressed product cooling	Hot	155.1	25.0	170	47
Distillation tower 1 distillate condensation	Hot	55.3	55.1	55	15
Distillation tower 1 bottom reboiling	Cold	107.5	107.7	165	46
Distillation tower 2 distillate condensation	Hot	107.8	107.6	47	13
Distillation tower 2 distillate cooling	Hot	107.6	25.0	93	26
Product heating	Cold	-5.9	25.0	77	21
Exhaust 2 heating	Cold	-5.8	25.0	1	0
Exhaust 2 heating	Cold	25.0	800.0	81	23
Combustion heat 2 recovery	Hot	800.2	800.0	255	71
Exhaust 2 cooling	Hot	800.0	25.0	94	26
C ₃ H ₆ heating	Cold	-41.0	25.0	24	7
4. Iso/Dehyd					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				345	96
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	992	276
Reaction heat recovery	Hot	335.2	335.0	459	128
Product cooling	Hot	335.0	-40.0	1362	378
Compressed product cooling	Hot	240.7	-80.0	491	136
Distillation tower distillate condensation	Hot	34.5	34.3	6	2
Distillation tower bottom reboiling	Cold	108.3	108.5	92	26
Distillation tower bottoms heating	Cold	-3.7	25.0	43	12

Exhaust 1 heating	Cold	-193.3	25.0	194	54
Exhaust 2 heating	Cold	-50.3	25.0	1	0
Exhaust 2 heating	Cold	25.0	800.0	44	12
Combustion heat 2 recovery	Hot	800.2	800.0	133	37
Exhaust 2 cooling	Hot	800.0	25.0	49	14

Table S12 Electric power and heat properties for SC-Syn-LOs

1. Gasification					
Referred in Table S8					
2. Direct synthesis of LOs from syngas					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				9922	2756
Feed gas compression				4085	1135
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Cooling by 1st HX	Hot	205.4	65.0	1470	408
Cooling by 2nd HX	Hot	205.0	65.0	1801	500
Feed gas heating	Cold	126.3	340.0	2216	616
Reaction heat recovery	Hot	340.2	340.0	7503	2084
Product cooling	Hot	340.0	-100.0	5390	1497
Exhaust 1 heating	Cold	-192.0	25.0	1460	405
Product heating	Cold	-100.1	-30.0	341	95
Exhaust 2 heating	Cold	-96.5	25.0	32	9
Distillation tower 1 distillate condensation	Hot	-21.2	-21.4	427	119
Distillation tower 1 bottom reboiling	Cold	-6.8	-6.6	882	245
Exhaust 3 heating	Cold	-90.6	25.0	256	71
Distillation tower 2 distillate condensation	Hot	0.5	0.3	162	45
Distillation tower 2 bottom reboiling	Cold	123.3	123.5	360	100
Distillation tower 2 distillate heating	Cold	-80.2	25.0	84	23
Distillation tower 3 distillate condensation	Hot	114.2	114.0	30	8
Distillation tower 3 distillate heating	Cold	6.9	25.0	3	1
Distillation tower 3 bottom reboiling	Cold	177.0	177.2	66	18
Exhaust 3 cooling	Hot	49.7	25.0	24	7
Exhaust 1 heating	Cold	25.0	800.0	30091	8359
Combustion heat 1 recovery	Hot	800.2	800.0	60614	16837
Exhaust 1 cooling	Hot	800.0	25.0	31547	8763
Exhaust 2 heating	Cold	25.0	800.0	729	203
Combustion heat 2 recovery	Hot	800.2	800.0	1124	312

Exhaust 2 cooling	Hot	800.0	25.0	747	207
Exhaust 3 heating	Cold	25.0	800.0	1648	458
Combustion heat 3 recovery	Hot	800.2	800.0	3120	867
Exhaust 3 cooling	Hot	800.0	25.0	1740	483
3. Iso/Dehyd					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				188	52
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	579	161
Reaction heat recovery	Hot	335.2	335.0	349	97
Product cooling	Hot	335.0	-40.0	755	210
Compressed product cooling	Hot	237.5	-100.0	305	85
Distillation tower 1 distillate condensation	Hot	18.2	18.0	6	2
Distillation tower 1 bottom reboiling	Cold	115.8	116.0	65	18
Distillation tower 2 distillate condensation	Hot	113.5	113.3	22	6
Distillation tower 2 bottom reboiling	Cold	158.0	158.2	45	13
Distillation tower 2 distillate heating	Cold	1.8	25.0	3	1
Distillation tower 1 distillate heating	Cold	-64.7	25.0	3	1
Exhaust 1 heating	Cold	25.0	800.0	220	61
Combustion heat recovery	Hot	800.2	800.0	407	113
Exhaust 1 cooling	Hot	800.0	25.0	236	65
Exhaust 1 heating	Hot	30.4	25.0	4	1
Exhaust 2 heating	Cold	25.0	800.0	337	94
Combustion heat recovery	Hot	800.2	800.0	641	178
Exhaust 2 cooling	Hot	800.0	25.0	357	99

Table S13 Electric power and heat properties for Imp-Syn-LOs

1. Gasification					
Referred in Table S8					
2. Direct synthesis of LOs from syngas					
Power loads					
Stream data				Power load	Power load
				MJ/h	kW
Regeneration of absorption tower				9552	2653
Feed gas compression				4085	1135
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Cooling by 1st HX	Hot	205.4	65.0	1470	408
Cooling by 2nd HX	Hot	205.0	65.0	1801	500
Feed gas heating	Cold	126.3	340.0	2216	616
Reaction heat recovery	Hot	340.2	340.0	14397	3999
Product cooling	Hot	340.0	-100.0	7390	2053
Exhaust 1 heating	Cold	-183.5	25.0	388	108
Product heating	Cold	-100.3	-30.0	617	171
Exhaust 2 heating	Cold	-98.6	25.0	152	42
Distillation tower 1 distillate condensation	Hot	-24.7	-24.9	415	115
Distillation tower 1 bottom reboiling	Cold	5.2	5.4	880	244
Exhaust 3 heating	Cold	-93.4	25.0	259	72
Distillation tower 2 distillate condensation	Hot	13.6	13.4	201	56
Distillation tower 2 bottom reboiling	Cold	145.6	145.8	562	156
Distillation tower 2 distillate heating	Cold	-69.4	25.0	102	28
Distillation tower 3 distillate condensation	Hot	121.9	121.7	61	17
Distillation tower 3 distillate heating	Cold	17.3	25.0	3	1
Distillation tower 3 bottom reboiling	Cold	204.5	204.7	151	42
Exhaust 3 cooling	Hot	88.5	25.0	118	33
Exhaust 1 heating	Cold	25.0	800.0	9404	2612
Combustion heat 1 recovery	Hot	800.2	800.0	17894	4971
Exhaust 1 cooling	Hot	800.0	25.0	9476	2632
Exhaust 2 heating	Cold	25.0	800.0	4830	1342
Combustion heat 2 recovery	Hot	800.2	800.0	8046	2235

Exhaust 2 cooling	Hot	800.0	25.0	5023	1395
Exhaust 3 heating	Cold	25.0	800.0	6857	1905
Combustion heat 3 recovery	Hot	800.2	800.0	12919	3589
Exhaust 3 cooling	Hot	800.0	25.0	7211	2003
3. Iso/Dehyd					
Power loads					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				398	110
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	1164	323
Reaction heat recovery	Hot	335.2	335.0	403	112
Product cooling	Hot	335.0	-40.0	1536	427
Compressed product cooling	Hot	226.3	-80.0	568	158
Distillation tower 1 distillate condensation	Hot	25.6	25.4	4	1
Distillation tower 1 bottom reboiling	Cold	117.9	118.1	115	32
Distillation tower 1 distillate heating	Cold	-59.8	25.0	1	0
Distillation tower 2 distillate condensation	Hot	114.3	114.1	49	14
Distillation tower 2 bottom reboiling	Cold	160.5	160.7	100	28
Distillation tower distillate heating	Cold	2.1	25.0	6	2
Distillation tower bottom heating	Cold	33.6	25.0	13	4
Exhaust 1 heating	Cold	25.0	800.0	76	21
Combustion heat recovery	Hot	800.2	800.0	144	40
Exhaust 1 cooling	Hot	800.0	25.0	81	23
Exhaust 2 heating	Cold	25.0	800.0	1032	287
Combustion heat recovery	Hot	800.2	800.0	1956	543
Exhaust 2 cooling	Hot	800.0	25.0	1087	302

Table S14 Mass balance for Imp TH-Syn-DME

LO synthesis reaction from DME for Imp TH-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	35.4	1.3	28.0	1		1		15.2	0.0	20.2	0.0
CO ₂	1598.6	36.3	44.0	1		2		436.0	0.0	1162.6	0.0
H ₂	1.0	0.5	2.0		2			0.0	1.0	0.0	0.0
H ₂ O	12.4	0.7	18.0		2	1		0.0	1.4	11.0	0.0
DME	1714.9	37.3	46.0	2	6	1		894.7	223.7	596.5	0.0
MeOH	58.4	1.8	32.0	1	4	1		21.9	7.3	29.2	0.0
N ₂	10361.3	370.0	28.0				2	0.0	0.0	0.0	10361.3
	13781.8	447.9						1367.8	233.3	1819.5	10361.2
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
CO	35.4	1.3	28.0	1		1		15.2	0.0	20.2	0.0
CO ₂	1598.6	36.3	44.0	1		2		436.0	0.0	1162.6	0.0
H ₂	1.0	0.5	2.0		2			0.0	1.0	0.0	0.0
H ₂ O	716.3	39.8	18.0		2	1		0.0	79.6	636.7	0.0
MeOH	0.0	0.0	32.0	1	4	1		0.0	0.0	0.0	0.0
N ₂	10361.2	370.0	28.0				2	0.0	0.0	0.0	10361.2
DME	0.0	0.0	46.0	2	6	1		0.0	0.0	0.0	0.0
C ₂ H ₄	31.0	1.1	28.0	2	4			26.6	4.4	0.0	0.0
C ₃ H ₆	398.6	9.5	42.0	3	6			341.6	56.9	0.0	0.0
n-C ₄ H ₈	639.8	11.4	56.0	4	8			548.4	91.4	0.0	0.0
n-C ₅ H ₁₀	0.0	0.0	70.0	5	10			0.0	0.0	0.0	0.0
sum	13781.9	469.9						1367.8	233.3	1819.5	10361.2
In/Out	1.000							1.000	1.000	1.000	1.000
Iso/Dehyd reaction for Imp TH-Syn-DME											
Input			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	2502.4	89.4	28				2	0.0	0.0	0.0	2502.4
O ₂	269.0	8.4	32			2		0.0	0.0	269.0	0.0
H ₂ O	616.0	34.2	18		2	1		0.0	68.4	547.6	0.0
C ₃ H ₆	2.4	0.1	42	3	6			2.0	0.3	0.0	0.0

n-C ₄ H ₈	612.8	10.9	56	4	8			525.3	87.5	0.0	0.0
sum	4002.6	143.0						527.3	156.3	816.5	2502.4
Output			MW	C	H	O	N	C	H	O	N
	kg/h	kmol/h	kg/kmol					kg/h	kg/h	kg/h	kg/h
N ₂	2502.4	89.4	28				2	0.0	0.0	0.0	2502.4
O ₂	93.9	2.9	32			2		0.0	0.0	93.9	0.0
H ₂ O	813.0	45.2	18		2	1		0.0	90.3	722.6	0.0
C ₃ H ₆	2.4	0.1	42	3	6			2.0	0.3	0.0	0.0
n-C ₄ H ₈	0.0	0.0	56	4	8			0.0	0.0	0.0	0.0
1,3-BD	590.9	10.9	54	4	6			525.3	65.7	0.0	0.0
sum	4002.6	148.5						527.3	156.3	816.5	2502.4
In/Out	1.000							1.000	1.000	1.000	1.000

Table S15 Electric power and heat properties for Imp TH-Syn-DME

1. Gasification					
Referred in Table S8					
2. DME synthesis					
Referred in Table S9					
3. LO synthesis from DME					
Electric power					
Stream data				Power load	Power load
				MJ/h	kW
Product compression				582	162
Regeneration of absorption tower				2703	751
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feed gas heating	Cold	-76.8	280.0	3068	852
N ₂ heating	Cold	25.0	280.0	2773	770
Reaction heat recovery	Hot	280.2	280.0	1919	533
Product cooling	Hot	280.0	-150.0	9846	2735
Exhaust heating	Cold	-150.0	25.0	1909	530
Product heating	Cold	-150.0	0.0	1548	430
Compressed product cooling	Hot	184.1	-30.0	1571	436
Distillation tower 1 distillate condensation	Hot	-2.4	-2.6	630	175
Distillation tower 1 bottom reboiling	Cold	107.2	107.4	1481	411
Distillation tower 2 distillate condensation	Hot	107.7	107.5	143	40
Distillation tower 2 bottom reboiling	Cold	107.5	107.7	287	80
Distillation tower 2 distillate cooling	Hot	107.5	25.0	284	79
Product heating	Cold	-6.3	25.0	235	65
Exhaust heating	Cold	-6.0	25.0	5	2
Exhaust heating	Cold	25.0	800.0	642	178
Combustion heat recovery	Hot	800.2	800.0	1249	347
Exhaust cooling	Hot	800.0	25.0	692	192
C ₃ H ₆ heating	Cold	-82.6	25.0	332	92
4. Iso/Dehyd					
Electric power					

Stream data				Power load	Power load
				MJ/h	kW
Product compression				1053	292
Heat properties					
Stream data	Type	T _s	T _t	Heat load	Heat load
		°C	°C	MJ/h	kW
Feedstock heating	Cold	25.0	335.0	3024	840
Reaction heat recovery	Hot	335.2	335.0	1405	390
Product cooling	Hot	335.0	-40.0	4116	1143
Compressed product cooling	Hot	240.7	-80.0	1497	416
Distillation tower distillate condensation	Hot	6.1	5.9	10	3
Distillation tower bottom reboiling	Cold	109.1	109.3	269	75
Distillation tower distillate heating	Cold	-83.1	25.0	3	1
Distillation tower bottom heating	Cold	-4.2	25.0	130	36
Exhaust heating	Cold	25.0	800.0	92	25
Combustion heat recovery	Hot	800.2	800.0	164	46
Exhaust cooling	Hot	800.0	25.0	96	27