

Electronic Supplementary Material

Machine learning facilitated the modeling of plastics hydrothermal pretreatment towards constructing an on-ship marine litter-to-methanol plant

Yi Cheng^{1,2}, Qiong Pan³, Jie Li³, Nan Zhang³, Yang Yang⁴, Jiawei Wang (✉)^{1,2}, Ningbo Gao⁵

1 Department of Chemical Engineering and Applied Chemistry, Aston University, Birmingham B4 7ET, UK

2 Energy and Bioproducts Research Institute (EBRI), Aston University, Birmingham B4 7ET, UK

3 Centre for Process Integration, Department of Chemical Engineering, School of Engineering, The University of Manchester, Manchester M13 9PL, UK

4 State Key Laboratory of Coal Combustion, Huazhong University of Science and Technology, Wuhan 430074, China

5 School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an 710049, China

E-mail: j.wang23@aston.ac.uk

1. Techno-economic assessment data source

The infrastructures of the system include the central water treatment and the energy system. The water treatment coagulates the microplastics and chemicals generated to prevent ocean re-pollution. It also purifies seawater for industry and living use. To reduce energy costs and CO₂ emissions, while taking advantage of the abundant solar energy available at sea [7], the energy system implemented off-gases recovery, heating recycling, and a photoelectric device. For instance, the system could employ a gas turbine and a Heat Recovery Steam Generator (HRSG) recycle off-gases generated by methanol processes to generate steam and electricity [8], [9]. The heat integration strategy enables reactor feed streams to be heated with product streams around the synthesis units and generates 105 °C steam using the compressor and reactor effluents to recover low-quality heat [10].

- The natural gas price is 2.1681 \$/MMBtu which on a mass basis for liquefied

natural gas is 0.092 €/kg [11],

- The cost of solar-based electricity price refers to the market in solar abundance areas, such as Spain, which is 29 €/MWh [12],
- The cost of oxygen is assumed to be 3 times the leveled cost of production: 0.15 €/kg,
- CO₂ avoided emissions are worth 0.66 €/kg in CO₂ credits [13],
- Tax rate of 40% and interest rate of 12%,
- The cost of labor is equal to 19 €/h and the cost of supervision is equal to 25% total cost of labor: a total of 8 people is employed in the plant [14].
- Methanol price influenced by factors such as supply and demand dynamics, the global economic climate, and production costs [15].

Table S1: Turton's library parameters [14]

CEPCI index:	/Value: 801.3 (cepci 2022)
working hours/year:	//Default value: 4800 h/y
electricity cost:	//Default value: 0.03 \$/kWh
cooling water cost:	//Default value: 0.0000148 \$/kg
low pressure steam cost:	//Default value: 0.0277 \$/kg
medium pressure steam cost:	//Default value: 0.02831 \$/kg
high pressure steam cost:	//Default value: 0.02997 \$/kg
Cost of operators:	//Default value: 52900 \$/year/operator
Parameter for total module cost:	//Default value: C_TM: 1.18*C_BM
Parameter for grassroots cost:	//Default value: C_GR: C_TM+0.5*C_BM0
Equation for cost of manufacturing: $COMd=P1*C_GR+P2*C_OL+P3*(C_UT + C_WT + C_RM)$	
P1:	//Default value: 0.18
P2:	//Default value: 2.73
P3:	//Default value: 1.23
Equation for number of operators: $NoI=(C1+C2*P^2+C3*Neq)^{0.5}$	
C1	//Default value: 6.29
C2	//Default value: 31.7
C3	//Default value: 0.23
P (Number of processing steps involving handling of particulate solid):	//Default value: 0

Working capital	
Parameter for working capital:	//Default value: $W_CAP=0.175*C_GR$
Column sizing convergence	//Suggested values: 3 for a single column, 5 for more columns
Max number of iterations:	

Table S2 Economic results with the calculation frame [16]

Expenditure	Cost/€
Total Module Cost	14876948.78
Grass Roots Cost	19531047.77
Working Capital	2929657.16
Total Capital Investment	22460704.93

2. Dataset

Table S3. Dataset source for machine learning

Time (min)	Temp. (°C)	Solid ratio	Solvent density	Slats concentration (g/L)							Initial composition (wt%)				Recovery (wt%)	Char composition ratio (wt%)		
				NaCl	MgCl ₂	MgSO ₄	K ₂ SO ₄	CaSO ₄	CaCO ₃	MgBr ₂	C	H	N	O		H/C	N/C	O/C
90	220	0.0269	0.50	18.904	0.000	0.000	0.000	0.000	0.000	0.000	0.6697	0.0612	0.0000	0.2691	0.934	0.0878	0.0000	0.4054
90	220	0.0279	0.50	20.316	0.000	0.000	0.000	0.000	0.000	0.000	0.6267	0.0496	0.0178	0.3058	0.931	0.0963	0.0376	0.4617
90	220	0.0221	0.50	17.520	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.953	0.0851	0.0000	0.5149
90	220	0.0200	0.50	0.000	0.000	5.546	4.726	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.949	0.1676	0.2341	0.1677
90	220	0.0209	0.50	0.000	0.000	5.470	3.938	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.975	0.0874	0.0000	0.5126
60	220	0.0384	0.25	23.904	0.000	1.940	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.974	0.0860	0.0000	0.5140
60	220	0.0399	0.25	23.892	0.000	1.880	0.000	0.000	0.000	0.000	0.8571	0.1429	0.0000	0.0000	0.995	0.1669	0.0000	0.0000
120	250	0.0436	0.25	34.156	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.734	0.1623	0.1840	0.2231
120	250	0.0390	0.25	28.700	0.000	0.000	0.000	0.000	0.000	0.000	0.6309	0.0687	0.0601	0.2404	0.786	0.1421	0.1647	0.2783
120	250	0.0426	0.25	0.000	0.000	31.008	0.000	0.000	0.000	0.000	0.7407	0.1188	0.0656	0.0750	0.962	0.1764	0.0984	0.0753
120	250	0.0376	0.25	0.000	0.000	28.084	0.000	0.000	0.000	0.000	0.7511	0.0966	0.0000	0.1523	0.917	0.0693	0.0000	0.2621
90	250	0.0410	0.25	0.000	0.000	0.000	34.604	0.000	0.000	0.000	0.7400	0.1186	0.0660	0.0754	0.994	0.1707	0.0978	0.0828
90	250	0.0391	0.25	0.000	0.000	0.000	30.932	0.000	0.000	0.000	0.7442	0.0936	0.0000	0.1622	0.96	0.1028	0.0000	0.2410
120	250	0.0393	0.25	0.000	31.904	0.000	0.000	0.000	0.000	0.000	0.7431	0.1193	0.0642	0.0734	0.957	0.1596	0.1245	0.0617
120	250	0.0391	0.25	0.000	31.840	0.000	0.000	0.000	0.000	0.000	0.7381	0.0910	0.0000	0.1709	0.954	0.0859	0.0000	0.2688
90	250	0.0387	0.25	0.000	14.224	0.000	0.000	0.000	0.000	0.000	0.7465	0.1200	0.0623	0.0712	0.96	0.1578	0.0675	0.1142
90	250	0.0422	0.25	0.000	14.224	0.000	0.000	0.000	0.000	0.000	0.7348	0.0895	0.0000	0.1757	0.934	0.0859	0.0000	0.2750
90	250	0.0285	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.408	0.7124	0.0970	0.0423	0.1483	0.972	0.0586	0.0874	0.2577
90	250	0.0301	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.408	0.7035	0.0949	0.0468	0.1548	0.972	0.0573	0.0759	0.2882
90	250	0.0260	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.834	0.7136	0.0983	0.0442	0.1439	0.94	0.0635	0.1103	0.2275

90	250	0.0268	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7120	0.0974	0.0438	0.1469	0.965	0.0613	0.0817	0.2615
40	205	0.0207	0.51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8571	0.1429	0.0000	0.0000	1	0.1699	0.0000	0.0000
40	205	0.0210	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	1	0.1676	0.2080	0.1938
40	205	0.0207	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	1	0.0957	0.0000	0.5043
90	260	0.0325	0.50	27.124	4.172	2.124	1.499	0.898	0.000	0.013	0.7108	0.0958	0.0411	0.1522	0.92	0.1607	0.1232	0.1229
60	260	0.0322	0.50	30.454	4.172	2.124	1.499	0.898	0.000	0.013	0.7159	0.0967	0.0379	0.1495	0.891	0.1502	0.0596	0.1871
120	270	0.0328	0.30	40.523	0.000	0.000	0.000	0.000	0.000	0.000	0.7103	0.0967	0.0439	0.1492	0.705	0.1684	0.1145	0.1250
90	270	0.0224	0.50	24.404	0.000	0.000	0.000	0.000	0.000	0.000	0.7152	0.0989	0.0441	0.1418	0.849	0.1415	0.1518	0.1049
120	250	0.0203	0.35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.936	0.0610	0.0000	0.5390
120	250	0.0203	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.903	0.1150	0.2235	0.2309
60	220	0.0394	0.50	27.364	0.000	1.852	0.996	0.000	0.000	0.000	0.6311	0.0694	0.0616	0.2380	0.906	0.1715	0.1522	0.2610
90	220	0.0361	0.25	0.000	0.000	18.784	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.983	0.1398	0.0978	0.3318
60	220	0.0397	0.50	26.442	0.000	1.622	1.104	0.000	0.000	0.000	0.7474	0.1202	0.0618	0.0706	0.939	0.1630	0.1280	0.0469
60	220	0.0401	0.51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7399	0.0917	0.0000	0.1684	1	0.0954	0.0000	0.2562
60	220	0.0398	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6307	0.0679	0.0585	0.2429	1	0.0860	0.0957	0.4038
60	220	0.0400	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7344	0.1175	0.0691	0.0790	1	0.1645	0.1287	0.0684
90	220	0.0407	0.25	0.000	0.000	27.072	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.969	0.1606	0.2026	0.2063
90	220	0.0360	0.25	0.000	0.000	8.600	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.962	0.1667	0.2091	0.1936
60	280	0.0432	0.30	31.140	0.000	0.000	0.000	0.000	0.000	0.000	0.7157	0.0992	0.0444	0.1407	0.904	0.1008	0.0045	0.2919
90	280	0.0250	0.50	29.158	0.000	0.000	0.000	0.000	0.000	0.000	0.7155	0.0988	0.0435	0.1422	0.836	0.1598	0.1258	0.1120
60	220	0.0409	0.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.944	0.1696	0.2045	0.1953
60	220	0.0402	0.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8571	0.1429	0.0000	0.0000	0.988	0.1669	0.0000	0.0000
60	220	0.0385	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7458	0.1198	0.0627	0.0717	0.987	0.1628	0.0558	0.1223
90	220	0.0390	0.25	0.000	6.436	0.000	15.192	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.967	0.1669	0.2190	0.1836
90	220	0.0378	0.25	0.000	8.628	0.000	10.652	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.967	0.1574	0.2175	0.1945

90	220	0.0394	0.25	0.000	12.004	0.000	4.656	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.966	0.1455	0.2201	0.2038
60	220	0.0368	0.25	0.000	0.000	35.752	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.971	0.1673	0.1938	0.2084
60	220	0.0333	0.25	0.000	0.000	29.804	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.97	0.1649	0.2115	0.1930
90	270	0.0226	0.30	36.203	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.709	0.1634	0.2231	0.1830
90	270	0.0145	0.40	31.550	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.8	0.0833	0.0000	0.5167
60	220	0.0410	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6310	0.0693	0.0615	0.2382	0.984	0.0862	0.0175	0.4810
60	220	0.0411	0.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.7423	0.0928	0.0000	0.1649	0.98	0.0866	0.0000	0.2605
60	220	0.0408	0.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.972	0.1056	0.0000	0.4944
90	220	0.0392	0.25	0.000	0.000	0.000	38.812	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.974	0.1615	0.2220	0.1859
90	220	0.0372	0.25	0.000	0.000	0.000	21.448	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.942	0.1615	0.2177	0.1903
90	220	0.0413	0.25	0.000	0.000	0.000	9.308	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.94	0.1615	0.2203	0.1876
90	240	0.0409	0.25	40.264	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.669	0.1667	0.2116	0.1911
90	240	0.0396	0.25	26.552	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.733	0.1633	0.2152	0.1909
90	240	0.0362	0.25	0.000	0.000	23.376	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.971	0.1446	0.1938	0.2311
90	240	0.0407	0.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.932	0.1418	0.2131	0.2145
60	220	0.0410	0.25	0.000	0.000	0.000	0.820	0.000	0.000	0.000	0.8571	0.1429	0.0000	0.0000	0.989	0.1788	0.0000	0.0000
60	220	0.0415	0.25	0.000	0.000	0.000	0.820	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0.987	0.1695	0.1998	0.2001
60	220	0.0411	0.25	0.000	0.000	0.000	0.704	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.958	0.0869	0.0000	0.5131
60	220	0.0391	0.50	0.000	4.026	2.118	0.000	0.000	0.000	0.000	0.7430	0.0931	0.0000	0.1639	0.984	0.0884	0.0000	0.2576
60	220	0.0396	0.50	0.000	3.596	19.990	0.000	0.000	0.000	0.000	0.6311	0.0695	0.0619	0.2375	0.975	0.1155	0.0883	0.3809
60	220	0.0411	0.50	0.000	3.862	1.886	0.000	0.000	0.000	0.000	0.7434	0.1193	0.0641	0.0732	0.991	0.1609	0.1665	0.0179
60	220	0.0415	0.50	0.000	0.000	2.222	0.994	0.000	0.000	0.000	0.7458	0.1198	0.0627	0.0717	0.984	0.1713	0.1583	0.0114
60	220	0.0424	0.50	0.000	0.000	1.628	0.996	0.000	0.000	0.000	0.7392	0.0914	0.0000	0.1694	0.974	0.0985	0.0000	0.2544
60	220	0.0410	0.50	0.000	0.000	1.966	0.954	0.000	0.000	0.000	0.6313	0.0705	0.0641	0.2341	0.971	0.1327	0.1194	0.3320
120	220	0.0331	0.50	26.484	3.904	1.864	1.276	1.090	0.000	0.000	0.7076	0.0932	0.0383	0.1610	0.917	0.1246	0.0464	0.2423

30	220	0.0324	0.50	26.422	4.498	1.612	0.802	1.024	0.000	0.000	0.7041	0.0914	0.0376	0.1669	0.994	0.1230	0.0419	0.2554
90	220	0.0381	0.50	26.308	4.474	1.656	1.272	1.030	0.000	0.000	0.6951	0.0877	0.0382	0.1790	0.976	0.1097	0.0401	0.2889
90	220	0.0198	0.51	12.637	0.000	0.000	0.000	0.955	0.000	0.000	0.7203	0.0832	0.0000	0.1965	0.994	0.0938	0.0000	0.2945
90	220	0.0263	0.50	12.930	0.000	0.000	0.000	0.876	0.000	0.000	0.6312	0.0699	0.0627	0.2363	0.957	0.1339	0.1216	0.3289
90	220	0.0199	0.50	13.290	0.000	0.000	0.000	0.738	0.000	0.000	0.7378	0.1182	0.0672	0.0768	0.949	0.1604	0.1776	0.0172
180	200	0.1000	0.50	27.200	3.800	1.700	0.900	1.200	0.100	0.100	0.7740	0.1260	0.0299	0.0701	0.4686	0.1506	0.0124	0.1289
180	250	0.1000	0.50	27.200	3.800	1.700	0.900	1.200	0.100	0.100	0.7740	0.1260	0.0299	0.0701	0.29	0.1573	0.0000	0.1347
180	300	0.1000	0.50	27.200	3.800	1.700	0.900	1.200	0.100	0.100	0.7740	0.1260	0.0299	0.0701	0.2526	0.1607	0.0000	0.1313
60	250	0.0333	0.30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8395	0.1382	0.0000	0.0223	0.9	0.1646	0.0000	0.0265
60	300	0.0333	0.30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8395	0.1382	0.0000	0.0223	0.88	0.1633	0.0000	0.0278
60	350	0.0333	0.30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.8395	0.1382	0.0000	0.0223	0.75	0.1571	0.0000	0.0341
60	250	0.0333	0.30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.4167	0.0647	0.0797	NaN	0.988	0.1250	0.0946	NaN
60	300	0.0333	0.30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.4167	0.0647	0.0797	NaN	0.123	0.1060	0.0440	NaN
10	300	0.0267	0.75	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0	0.0051	0.0005	0.5638
10	330	0.0289	0.69	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0	0.0043	0.0005	0.5646
5	360	0.0365	0.55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6372	0.0973	0.1239	0.1416	0	0.0038	0.0005	0.5650
15	400	0.1000	0.42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.6250	0.0417	0.0000	0.3333	0.685	0.0401	0.0000	0.5599

Reference:

- [1] A. A. Papa, A. Di Carlo, E. Bocci, L. Taglieri, L. Del Zotto, and A. Gallifuoco, "Energy Analysis of an Integrated Plant : Fluidized Bed Steam Gasification of Hydrothermally Treated Biomass Coupled to Solid Oxide Fuel Cells," 2021.
- [2] M. Gatti, E. Martelli, F. Marechal, and S. Consonni, "Review, modeling, Heat Integration, and improved schemes of Rectisol ®-based processes for CO₂ capture," *Appl. Therm. Eng.*, vol. 70, no. 2, pp. 1123–1140, 2014, doi: 10.1016/j.applthermaleng.2014.05.001.
- [3] C. N. Hamelinck and A. P. C. Faaij, "Future prospects for production of methanol and hydrogen from biomass," *J. Power Sources*, vol. 111, no. 1, pp. 1–22, 2002, doi: 10.1016/S0378-7753(02)00220-3.
- [4] L. C. Grabow and M. Mavrikakis, "Mechanism of methanol synthesis on cu through CO₂ and CO hydrogenation," *ACS Catal.*, vol. 1, no. 4, pp. 365–384, 2011, doi: 10.1021/cs200055d.
- [5] S. D. Phillips, J. K. Tarud, M. J. Bidy, and A. Dutta, "Gasoline from woody biomass via thermochemical gasification, methanol synthesis, and methanol-to-gasoline technologies: A technoeconomic analysis," *Ind. Eng. Chem. Res.*, vol. 50, no. 20, pp. 11734–11745, 2011, doi: 10.1021/ie2024992.
- [6] A. P. Douglas and A. F. A. Hoadley, "A process integration approach to the design of the two- and three-column methanol distillation schemes," *Appl. Therm. Eng.*, vol. 26, no. 4, pp. 338–349, 2006, doi: 10.1016/j.applthermaleng.2005.07.001.
- [7] H. Weldekidan, V. Strezov, and G. Town, "Review of solar energy for biofuel extraction," *Renew. Sustain. Energy Rev.*, vol. 88, no. March, pp. 184–192, 2018, doi: 10.1016/j.rser.2018.02.027.
- [8] A. M. Petersen, S. Farzad, and J. F. Görgens, "Techno-economic assessment of integrating methanol or Fischer-Tropsch synthesis in a South African sugar mill," *Bioresour. Technol.*, vol. 183, pp. 141–152, 2015, doi: 10.1016/j.biortech.2015.02.007.
- [9] A. M. Petersen, M. C. Aneke, and J. F. Görgens, "Techno-economic comparison of ethanol and electricity coproduction schemes from sugarcane residues at existing sugar mills

in Southern Africa,” *Biotechnol. Biofuels*, vol. 7, no. 1, pp. 1–19, 2014, doi: 10.1186/1754-6834-7-105.

[10] N. H. Leibbrandt, A. O. Aboyade, J. H. Knoetze, and J. F. Görgens, “Process efficiency of biofuel production via gasification and Fischer-Tropsch synthesis,” *Fuel*, vol. 109, pp. 484–492, 2013, doi: 10.1016/j.fuel.2013.03.013.

[11] “Commodities - Live Quote Price Trading Data.”

[12] “Solar PV power price EU-28 by select country 2019 _ Statista.”

[13] carboncredits.com, “Live Carbon Prices Today, Carbon Price Charts • Carbon Credits.” [Online]. Available: <https://carboncredits.com/carbon-prices-today/>

[14] R. A. . Turton, J. Shaeiwitz, D. Bhattacharyya, and W. Whiting, *Analysis; Synthesis and Design of Chemical Processes*; 5th ed. 2018.

[15] “Methanol - 2023 Data - 2014-2022 Historical - 2024 Forecast - Price - Quote - Chart.” 2022. [Online]. Available: <https://tradingeconomics.com/commodity/methanol>

[16] K. Prifti, A. Galeazzi, M. Barbieri, and F. Manenti, “A Capex Opex Simultaneous Robust Optimizer: Process Simulation-based Generalized Framework for Reliable Economic Estimations,” *Comput. Aided Process Eng.*, vol. 51, pp. 1321–1326, 2022, doi: <https://doi.org/10.1016/B978-0-323-95879-0.50221-6>.