

Municipal Wastewater Reuse: Is it a Competitive Alternative to Seawater Desalination?

Dafne Crutchik * and José Luis Campos

Faculty of Engineering and Sciences, Universidad Adolfo Ibáñez, Av. Diagonal Las Torres 2640, 7941169 Santiago, Chile; jluis.campos@uai.cl

* Correspondence: dafne.crutchik@uai.cl; Tel.: +56-(2)-2331-1934

Table S1. Capital costs (MUSD) to produce water from municipal wastewater by a UF-RO system (scenario 1).

Water Production Capacity (m ³ /d)	UF System Cost	RO System Cost	Yard Piping	Sitework Landscaping	Site Electrical and Controls	Total Capital Costs
100,000	18,211	36,405	5,464	2,725	10,931	73,735
90,000	16,596	33,177	4,979	2,484	9,961	67,197
80,000	14,981	29,950	4,493	2,243	8,992	60,658
70,000	13,366	26,723	4,008	2,001	8,022	54,120
60,000	11,751	23,495	3,523	1,760	7,053	47,582
50,000	10,136	20,268	3,038	1,519	6,084	41,043
45,000	9,328	18,654	2,795	1,398	5,599	37,774
40,000	8,521	17,040	2,553	1,277	5,114	34,505
35,000	7,713	15,427	2,310	1,157	4,629	31,236
30,000	6,906	13,813	2,068	1,036	4,145	27,967
25,000	6,098	12,199	1,825	915	3,660	24,698
20,000	5,291	10,586	1,582	795	3,175	21,429
15,000	4,483	8,972	1,340	674	2,691	18,160
10,000	3,676	7,358	1,097	553	2,206	14,890
7,500	3,272	6,551	976	493	1,964	13,256
5,000	2,868	5,745	855	433	1,721	11,621
4,000	2,707	5,422	806	409	1,624	10,968
3,000	2,545	5,099	758	384	1,527	10,314
2,000	2,384	4,776	709	360	1,430	9,660
1,500	2,303	4,615	685	348	1,382	9,333
1,000	2,222	4,454	660	336	1,333	9,006
500	2,141	4,292	636	324	1,285	8,679

Table S2. Capital costs (MUSD) to produce water from municipal wastewater by an activated sludge unite followed by a UF-RO system (scenario 2).

Water Production Capacity (m ³ /d)	UF System Cost	RO System Cost	Yard Piping	Sitework Landscaping	Site Electrical and Controls	Activated Sludge	Total Capital Costs
100,000	18,211	36,405	5,464	2,725	10,931	67,514	141,249
90,000	16,596	33,177	4,979	2,484	9,961	60,833	128,030
80,000	14,981	29,950	4,493	2,243	8,992	54,178	114,836
70,000	13,366	26,723	4,008	2,001	8,022	47,546	101,666
60,000	11,751	23,495	3,523	1,760	7,053	40,936	88,517
50,000	10,136	20,268	3,038	1,519	6,084	34,343	75,387
45,000	9,328	18,654	2,795	1,398	5,599	31,052	68,826
40,000	8,521	17,040	2,553	1,277	5,114	27,762	62,267
35,000	7,713	15,427	2,310	1,157	4,629	24,471	55,707
30,000	6,906	13,813	2,068	1,036	4,145	21,177	49,144
25,000	6,098	12,199	1,825	915	3,660	17,875	42,573
20,000	5,291	10,586	1,582	795	3,175	14,558	35,987
15,000	4,483	8,972	1,340	674	2,691	11,215	29,374
10,000	3,676	7,358	1,097	553	2,206	7,818	22,709
7,500	3,272	6,551	976	493	1,964	6,084	19,340
5,000	2,868	5,745	855	433	1,721	4,303	15,924
4,000	2,707	5,422	806	409	1,624	3,570	14,537
3,000	2,545	5,099	758	384	1,527	2,817	13,130
2,000	2,384	4,776	709	360	1,430	2,032	11,692
1,500	2,303	4,615	685	348	1,382	1,188	10,521
1,000	2,222	4,454	660	336	1,333	1,188	10,194
500	2,141	4,292	636	324	1,285	714	9,393

Table S3. Capital costs (MUSD) to produce water by the desalination of seawater (scenario 3).

Water Production Capacity (m³/d)	Construction and Infrastructure	Land Acquisition	Engineering	Development and Managements	Total
100,000	186,113	3,723	6,522	935	197,293
90,000	168,122	3,363	5,891	845	178,221
80,000	150,130	3,003	5,261	754	159,148
70,000	132,139	2,643	4,630	664	140,076
60,000	114,147	2,283	4,000	573	121,003
50,000	96,156	1,923	3,369	483	101,931
45,000	87,160	1,743	3,054	438	92,394
40,000	78,164	1,563	2,738	392	82,858
35,000	69,169	1,383	2,423	347	73,322
30,000	60,173	1,203	2,108	302	63,786
25,000	51,177	1,023	1,793	256	54,249
20,000	42,181	843	1,477	211	44,713
15,000	33,186	663	1,162	166	35,177
10,000	24,190	484	847	121	25,641
7,500	19,692	394	689	98	20,873
5,000	15,194	304	531	75	16,105
4,000	13,395	268	468	66	14,197
3,000	11,596	232	405	57	12,290
2,000	9,797	196	342	48	10,383
1,500	8,897	178	311	44	9,429
1,000	7,998	160	279	39	8,476
500	7,098	142	248	35	7,522

Table S4. Operating and maintenance costs (MUSD/year) to produce water from municipal wastewater by a UF-RO system (scenario 1).

Water Production Capacity (m ³ /d)	UF-RO system							Total
	Labor	Reagents UF	Membrane Replacement UF	Energy UF	Reagents RO	Membrane Replacement RO	Energy RO	
100,000	1,043	2,684	1,069	473	2,710	1,052	4,722	13,753
90,000	939	2,418	963	426	2,441	948	4,247	12,381
80,000	834	2,152	856	378	2,171	844	3,772	11,008
70,000	730	1,887	750	330	1,902	739	3,298	9,636
60,000	626	1,621	643	282	1,633	635	2,823	8,263
50,000	521	1,355	537	234	1,364	531	2,348	6,891
45,000	469	1,222	483	211	1,229	479	2,111	6,205
40,000	417	1,089	430	187	1,095	427	1,874	5,518
35,000	365	956	377	163	960	375	1,636	4,832
30,000	313	823	324	139	826	323	1,399	4,146
25,000	261	690	270	115	691	270	1,161	3,459
20,000	209	558	217	91	557	218	924	2,773
15,000	156	425	164	67	422	166	687	2,087
10,000	104	292	110	43	287	114	449	1,401
7,500	78	225	84	31	220	88	331	1,058
5,000	52	159	57	19	153	62	212	714
4,000	42	132	46	15	126	52	165	577
3,000	31	106	36	10	99	41	117	440
2,000	21	79	25	5	72	31	70	303
1,500	16	66	20	3	59	26	46	234
1,000	10	52	14	3	45	20	35	180
500	5	39	9	1	32	15	17	119

Table S5. Operating and maintenance costs (MUSD/year) to produce water from municipal wastewater by an activated sludge unite followed by a UF-RO system (scenario 2).

Water Production Capacity (m ³ /d)	UF-RO System							Activated Sludge System					Total
	Labor	Reagents UF	Membrane Replacement UF	Energy UF	Reagents RO	Membrane Replacement RO	Energy RO	Energy	Labor	Reagents	Waste Management	Maintenance	
100,000	1,043	2,684	1,069	473	2,710	1,052	4,722	1,728	3,139	1,327	1,508	1,997	23,452
90,000	939	2,418	963	426	2,441	948	4,247	1,555	2,825	1,194	1,357	1,797	21,110
80,000	834	2,152	856	378	2,171	844	3,772	1,383	2,511	1,062	1,206	1,598	18,767
70,000	730	1,887	750	330	1,902	739	3,298	1,210	2,197	929	1,055	1,398	16,425
60,000	626	1,621	643	282	1,633	635	2,823	1,037	1,883	796	905	1,198	14,083
50,000	521	1,355	537	234	1,364	531	2,348	864	1,569	663	754	999	11,740
45,000	469	1,222	483	211	1,229	479	2,111	778	1,413	597	678	899	10,569
40,000	417	1,089	430	187	1,095	427	1,874	691	1,256	531	603	799	9,398
35,000	365	956	377	163	960	375	1,636	605	1,099	464	528	699	8,227
30,000	313	823	324	139	826	323	1,399	518	942	398	452	599	7,055
25,000	261	690	270	115	691	270	1,161	432	785	332	377	499	5,884
20,000	209	558	217	91	557	218	924	346	628	265	302	399	4,713
15,000	156	425	164	67	422	166	687	259	471	199	226	300	3,542
10,000	104	292	110	43	287	114	449	173	314	133	151	200	2,371
7,500	78	225	84	31	220	88	331	130	235	100	113	150	1,785
5,000	52	159	57	19	153	62	212	86	157	66	75	100	1,199
4,000	42	132	46	15	126	52	165	69	126	53	60	80	965
3,000	31	106	36	10	99	41	117	52	94	40	45	60	731
2,000	21	79	25	5	72	31	70	35	63	27	30	40	497
1,500	16	66	20	3	59	26	46	26	47	20	23	30	379
1,000	10	52	14	3	45	20	35	17	31	13	15	20	277
500	5	39	9	1	32	15	17	9	16	7	8	10	168

Table S6. Operating and maintenance costs (MUSD/year) to produce water by the desalination of seawater (scenario 3).

Water Production Capacity (m ³ /d)	Energy Consumption	Membrane Replacement	Maintenance	Reagents	Labour	Other Costs	Total
100,000	22,740	5,840	2.0	2,920	1,460	1.3	32,963
90,000	20,466	5,256	2.6	2,628	1,314	1.7	29,668
80,000	18,192	4,672	3.2	2,336	1,168	2.1	26,373
70,000	15,918	4,088	3.8	2,044	1,022	2.5	23,078
60,000	13,644	3,504	4.3	1,752	876	2.9	19,783
50,000	11,370	2,920	4.9	1,460	730	3.3	16,488
45,000	10,233	2,628	5.2	1,314	657	3.5	14,840
40,000	9,096	2,336	5.5	1,168	584	3.7	13,193
35,000	7,959	2,044	5.8	1,022	511	3.9	11,546
30,000	6,822	1,752	6.1	876	438	4.1	9,898
25,000	5,685	1,460	6.4	730	365	4.3	8,251
20,000	4,548	1,168	6.7	584	292	4.5	6,603
15,000	3,411	876	7.0	438	219	4.7	4,956
10,000	2,274	584	7.3	292	146	4.9	3,308
7,500	1,705	438	7.4	219	110	5.0	2,484
5,000	1,137	292	7.6	146	73	5.1	1,661
4,000	910	234	7.6	117	58	5.1	1,331
3,000	682	175	7.7	88	44	5.1	1,002
2,000	455	117	7.8	58	29	5.2	672
1,500	341	88	7.8	44	22	5.2	507
1,000	227	58	7.8	29	15	5.2	343
500	114	29	7.9	15	7	5.2	178