

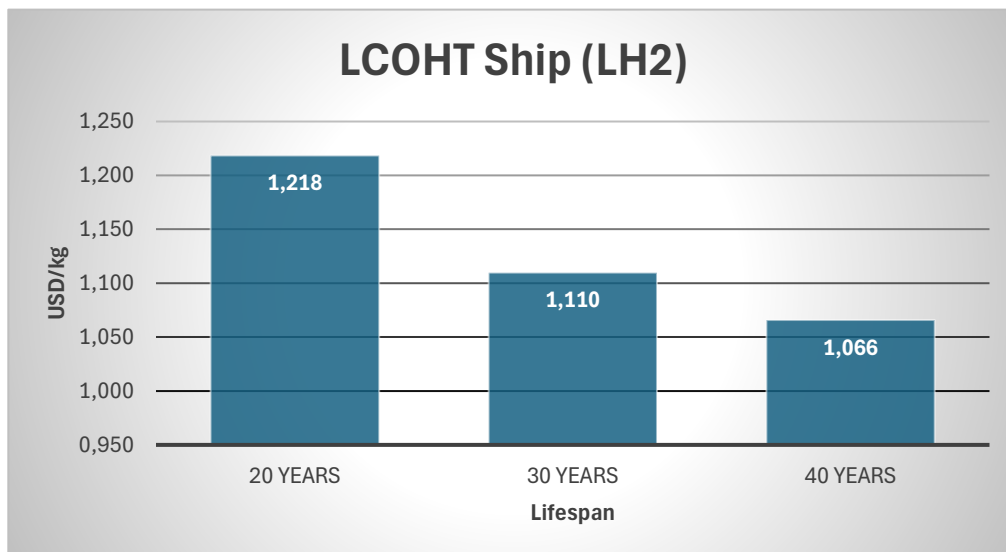
Ship LH2		
Yearly hydrogen production	78454000	kg
Liquefaction plant	142000000	USD
LH2 storage tank	37700000	USD
Cost of ship	480800000	USD
Crew cost	1460000	USD/year
Fuel cost	33062400	USD/year
Operation & maintenance	2800000	USD/year

Discount rate	0,07
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	Value	1	2
Production	78454000 kg	78454000	73321495,33
CAPEX	660500000 USD	660500000	
OPEX	37322400 USD	37322400	34880747,66

	20 years	30 years	40 years
SUM production	889322789,2	1041686641	1119140698
SUM CAPEX	660500000	660500000	660500000
SUM OPEX	423071619,9	495554662,6	532401366

	20 years	30 years	40 years
LCOHT_ship_LH2	1,218	1,110	1,066



3	4	5	6	7	8
68524761,99	64041833,63	59852180,97	55936617,73	52277212,83	48857208,25
32598829,59	30466195,88	28473080,26	26610355,39	24869491,01	23242514,97

9	10	11	12	13	14
45660942,29	42673777,84	39882035,37	37272930,25	34834514,25	32555620,79
21721976,6	20300912,71	18972815,62	17731603,38	16571591,95	15487469,11

15	16	17	18	19	20
30425813,83	28435340,03	26575084,14	24836527,23	23211707,69	21693184,76
14474270,2	13527355,32	12642388,15	11815316,03	11042351,43	10319954,61

21	22	23	24	25	26
20274004,45	18947667,71	17708100,66	16549626,79	15466940,92	14455084,97
9644817,391	9013848,029	8424157,036	7873043,959	7357985,008	6876621,503

27	28	29	30	31	32	33
13509425,2	12625631	11799655,2	11027715,1	10306275,8	9632033,47	9001900,44
6426749,07	6006307,54	5613371,53	5246141,62	4902936,09	4582183,26	4282414,27

34	35	36	37	38	39	40
8412991,06	7862608,47	7348232,21	6867506,74	6418230,6	5998346,355	5605931,17
4002256,32	3740426,47	3495725,67	3267033,34	3053302,19	2853553,445	2666872,38

Ship CGH2		
Yearly hydrogem production	78454000	kg
Compressor plant	1800000	USD
CH2 storage tank	1699200000	USD
Cost of ship	480800000	USD
Crew cost	1460000	USD/year
Fuel cost	33062400	USD/year
Operation & maintenance	2800000	USD/year

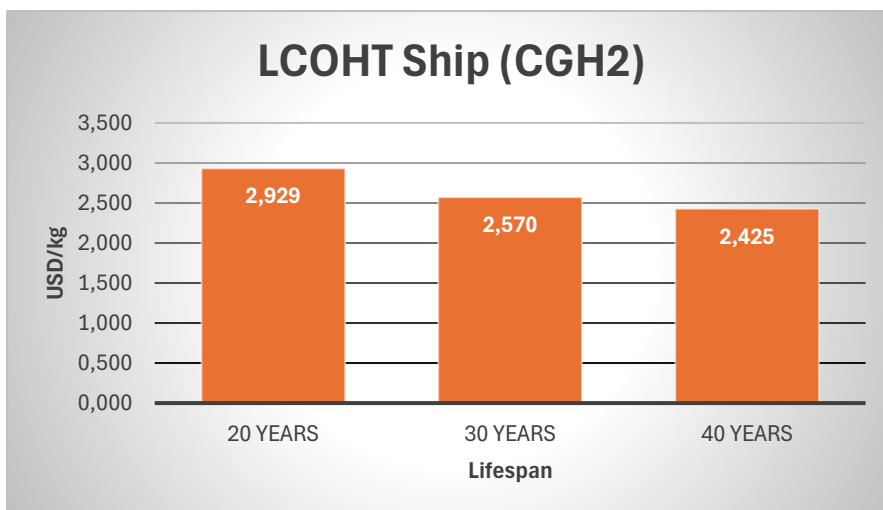
Density	0,08988
Price for tank	600
Volume	40 000
Compressed	3595,2
Liquid	2832000
Dif.	787,7169559

Discount rate	0,07
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	Value	1	2	3
Production	78454000 kg	78454000	73321495,33	68524761,99
CAPEX	2181800000 USD	2181800000		
OPEX	37322400 USD	37322400	34880747,66	32598829,59

	20 years	30 years	40 years
SUM production	889322789,2	1041686641	1119140698
SUM CAPEX	2181800000	2181800000	2181800000
SUM OPEX	423071619,9	495554663	532401366

	20 years	30 years	40 years	USD/kg
LCOHT_ship_CGH2	2,929	2,570	2,425	



kg/m³

USD/kg

m³

kg

kg

4	5	6	7	8	9	10
64041833,6	59852181	55936617,7	52277212,83	48857208,2	45660942,3	42673777,8
30466195,9	28473080,3	26610355,4	24869491,01	23242515	21721976,6	20300912,7

11	12	13	14	15	16	17
39882035,37	37272930,2	34834514,3	32555620,8	30425813,83	28435340	26575084,1
18972815,62	17731603,4	16571591,9	15487469,1	14474270,2	13527355,3	12642388,2

18	19	20	21	22	23	24
24836527,2	23211707,69	21693184,8	20274004,4	18947667,7	17708101	16549626,8
11815316	11042351,43	10319954,6	9644817,39	9013848,03	8424157	7873043,96

25	26	27	28	29	30	31
15466940,9	14455085	13509425,2	12625631	11799655,2	11027715,1	10306275,8
7357985,01	6876621,5	6426749,07	6006307,54	5613371,53	5246141,62	4902936,09

32	33	34	35	36	37	38
9632033,47	9001900,44	8412991,06	7862608,47	7348232,21	6867506,74	6418230,6
4582183,26	4282414,27	4002256,32	3740426,47	3495725,67	3267033,34	3053302,19

39	40
5998346,36	5605931,17
2853553,45	2666872,38

These values are obtained from API 5L X65 PSL2 Pipe Thickness Chart

NPS [inch]	Outside Diameter [mm]	[m]
10	232,8	0,2328
12	355,6	0,3556
14	406,4	0,4064

Distance [m]
152000

Density of carbon steel [kg/m3]
7850

Lifetime of pipe [years]
35

Cost of compressor [USD]
1800000

Yearly H2 production [kg]
78454000

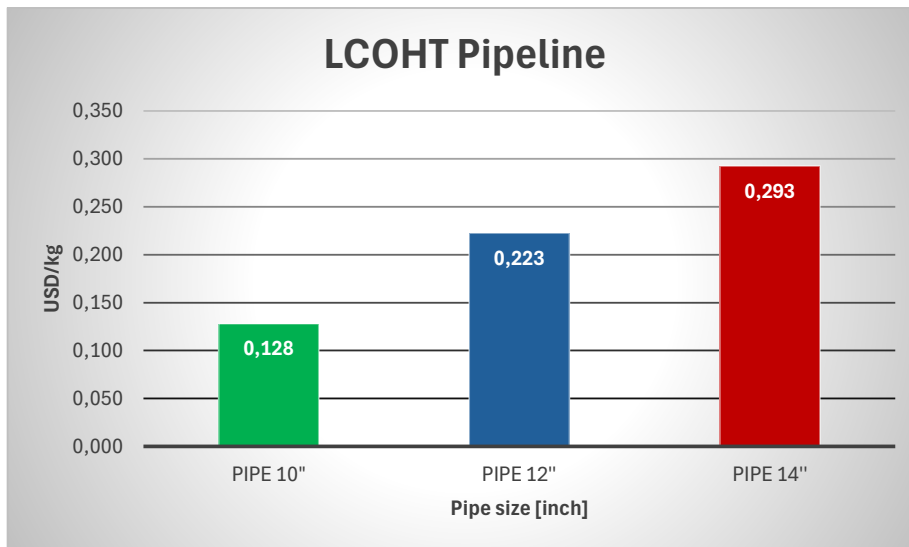
Pipe size 10"		
Discount rate	0,07	
Year	1	
Production [kg]	78454000	78454000
Total CAPEX	\$ 137 825 101,96	\$ 137 825 101,96
OPEX/year	\$ 31 502,88	\$ 31 502,88
Sum production [kg]	1079039842	
Sum CAPEX	\$ 137 825 101,96	
Sum OPEX	\$ 436 441,20	
LCOHT_pipe 10" [USD/kg]	\$ 0,128	

Pipe size 12"		
Discount rate	0,07	
Year	1	
Production [kg]	78454000	78454000
Total CAPEX	\$ 241 354 814,18	\$ 241 354 814,18
OPEX/year	\$ 55 166,81	\$ 55 166,81

Sum production [kg]		1086902450
Sum CAPEX	\$	241 354 814,18
Sum OPEX	\$	764 281,57
LCOHT_pipe 12" [USD/kg]	\$	0,22

Pipe size 14"		
Discount rate		0,07
Year		1
Production [kg]		78454000 78454000
Total CAPEX	\$	317 066 713,52
OPEX/year	\$	72 472,39 \$ 72 472,39
Sum production [kg]		1086902450
Sum CAPEX	\$	317 066 713,52
Sum OPEX	\$	1 004 033,19
LCOHT_pipe 14" [USD/kg]	\$	0,29

Pipe 10"
Pipe 12"
 LCOHT [USD/kg] 0,128 0,223



Nominal wall thickness SCH 40 [mm]	[m]	Calculated inside diameter ID [mm]	
10,31		0,01031	212,18
11,13		0,01113	333,34
12,7		0,0127	381

	2	3	4
	73321495,33	68524761,99	64041833,63
\$	29 441,94	\$ 27 515,84	\$ 25 715,73

	2	3	4
	73321495,33	68524761,99	64041833,63
\$	51 557,77	\$ 48 184,83	\$ 45 032,55

	2	3	4
	73321495,33	68524761,99	64041833,63
\$	67 731,21	\$ 63 300,19	\$ 59 159,06

Pipe 14"

0,293

[m]	Volume of pipe [m3]	Weight of steel pipe [kg]	[Ton]
0,21218	1095,374489	8598689,736	8598,689736
0,33334	1830,796317	14371751,09	14371,75109
0,381	2387,605642	18742704,29	18742,70429

5	6	7	8
59852180,97	55936617,73	52277212,83	48857208,25
\$ 24 033,40 \$	22 461,12 \$	20 991,70 \$	19 618,41

5	6	7	8
59852180,97	55936617,73	52277212,83	48857208,25
\$ 42 086,50 \$	39 333,18 \$	36 759,98 \$	34 355,12

5	6	7	8
59852180,97	55936617,73	52277212,83	48857208,25
\$ 55 288,84 \$	51 671,81 \$	48 291,41 \$	45 132,16

Price of steel [USD/ton]	Total material cost [Total CAPEX [USD]	CAPEX/year
1950	\$ 18 567 444,98	\$ 137 825 101,96	\$ 3 937 860,06
2150	\$ 32 699 264,84	\$ 241 354 814,18	\$ 6 895 851,83
2200	\$ 43 033 949,43	\$ 317 066 713,52	\$ 9 059 048,96

Antar at material kost. er 1/3 av totale kostnader
 Antar 2 ganger høyere kost for offshore
 Antar OPEX er 0.8%CAPEX/y

Antar 10% kost. Differanse mellom H2 og NG rør
 Multiplication factor: 1,1

	9	10	11	12
	45660942,29	42673777,84	39882035,37	37272930,25
\$	18 334,96	\$ 17 135,48	\$ 16 014,47	\$ 14 966,79

	9	10	11	12
	45660942,29	42673777,84	39882035,37	37272930,25
\$	32 107,59	\$ 30 007,09	\$ 28 044,01	\$ 26 209,36

	9	10	11	12
	45660942,29	42673777,84	39882035,37	37272930,25
\$	42 179,59	\$ 39 420,18	\$ 36 841,29	\$ 34 431,11

OPEX/year

\$ 31 502,88

\$ 55 166,81

\$ 72 472,39

13	14	15	16	17
34834514,25	32555620,79	30425813,83	28435340,03	26575084,14
\$ 13 987,66	\$ 13 072,58	\$ 12 217,36	\$ 11 418,09	\$ 10 671,12

13	14	15	16	17
34834514,25	32555620,79	30425813,83	28435340,03	26575084,14
\$ 24 494,73	\$ 22 892,27	\$ 21 394,64	\$ 19 994,99	\$ 18 686,91

13	14	15	16	17
34834514,25	32555620,79	30425813,83	28435340,03	26575084,14
\$ 32 178,61	\$ 30 073,47	\$ 28 106,04	\$ 26 267,33	\$ 24 548,91

18	19	20	21	22	23
24836527,23	23211707,69	21693184,76	20274004,45	18947667,71	17708100,66
\$ 9 973,01	\$ 9 320,57	\$ 8 710,81	\$ 8 140,94	\$ 7 608,36	\$ 7 110,61

18	19	20	21	22	23
24836527,23	23211707,69	21693184,76	20274004,45	18947667,71	17708100,66
\$ 17 464,40	\$ 16 321,87	\$ 15 254,08	\$ 14 256,15	\$ 13 323,51	\$ 12 451,88

18	19	20	21	22	23
24836527,23	23211707,69	21693184,76	20274004,45	18947667,71	17708100,66
\$ 22 942,90	\$ 21 441,97	\$ 20 039,22	\$ 18 728,24	\$ 17 503,03	\$ 16 357,97

24	25	26	27	28	29
16549626,79	15466940,92	14455084,97	13509425,21	12625631,04	11799655,17
\$ 6 645,43	\$ 6 210,69	\$ 5 804,38	\$ 5 424,65	\$ 5 069,77	\$ 4 738,10

24	25	26	27	28	29
16549626,79	15466940,92	14455084,97	13509425,21	12625631,04	11799655,17
\$ 11 637,27	\$ 10 875,95	\$ 10 164,44	\$ 9 499,48	\$ 8 878,02	\$ 8 297,21

24	25	26	27	28	29
16549626,79	15466940,92	14455084,97	13509425,21	12625631,04	11799655,17
\$ 15 287,83	\$ 14 287,69	\$ 13 352,98	\$ 12 479,42	\$ 11 663,01	\$ 10 900,01

30	31	32	33	34	35
11027715,12	10306275,81	9632033,467	9001900,436	8412991,062	7862608,469
\$ 4 428,13	\$ 4 138,44	\$ 3 867,70	\$ 3 614,68	\$ 3 378,20	\$ 3 157,20

30	31	32	33	34	35
11027715,12	10306275,81	9632033,467	9001900,436	8412991,062	7862608,469
\$ 7 754,40	\$ 7 247,11	\$ 6 773,00	\$ 6 329,90	\$ 5 915,80	\$ 5 528,78

30	31	32	33	34	35
11027715,12	10306275,81	9632033,467	9001900,436	8412991,062	7862608,469
\$ 10 186,92	\$ 9 520,49	\$ 8 897,65	\$ 8 315,56	\$ 7 771,56	\$ 7 263,14

Submarine power cable		
Yearly production	4,75	TWh
Operational time	4754	h
Distance	152000	meters
€/ \$ conversion rate	1,08	\$/€
Energy installed	999,2	MW
CAPEX	2	€/MW/m
OPEX	0,0067	CAPEX/year

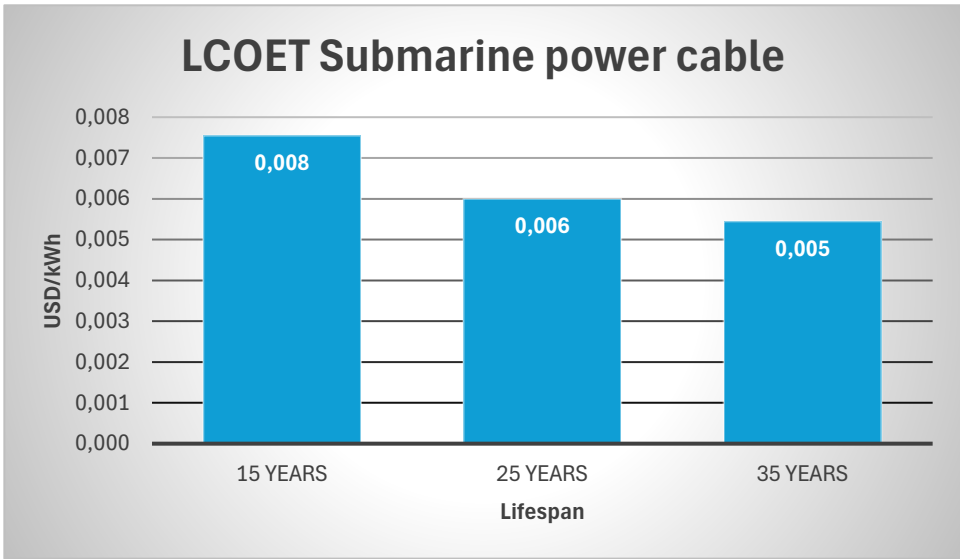
06.05.2024

Discount rate 0,07

	Value	1	2	3
Production	4750000000 kWh	4750000000	4439252336	4148833959
Total CAPEX	328043752,6 USD	328043752,6		
OPEX/year	2197893,143 USD	2197893,143	2054105,741	1919724,991

	15 years	25 years	35 years
SUM production	46290972931	59229336503	65806544467
SUM CAPEX	328043752,6	328043752,6	328043752,6
SUM OPEX	21419497,26	27406263,69	30449632,17

	15 years	25 years	35 years	
LCOET	0,008	0,006	0,005	Oxfordenergy.org USD/kWh



4	5	6	7	8	9	10
3877414915	3623752257	3386684353	3165125563	2958061274	2764543247	2583685277
1794135,506	1676762,155	1567067,435	1464549,004	1368737,387	1279193,82	1195508,243

11	12	13	14	15	16
2414659138	2256690783	2109056806	1971081127	1842131895	1721618593
1117297,423	1044203,199	975890,8405	912047,5144	852380,8546	796617,6211

17	18	19	20	21	22	23
1608989340	1503728355	1405353603	1313414582	1227490263	1147187162	1072137535
744502,4497	695796,6819	650277,2728	607735,769	567977,3542	530819,9572	496093,4179

24	25	26	27	28	29
1001997696	936446444,8	875183593,2	817928591,8	764419244,7	714410509
463638,7084	433307,2041	404960,0038	378467,2933	353707,7507	330567,9913

30	31	32	33	34	35
667673372,9	623993806,5	583171781,8	545020356,8	509364819,4	476041887,3
308942,048	288730,886	269841,9495	252188,7378	235690,4092	220271,4105

Density of hydrogen 33,3 kWh/kg

	LCOHT	
Ship LH2	1,110	USD/kg
Ship CGH2	2,570	USD/kg
Pipeline 10"	0,128	USD/kg
Submarine power cable	0,200	USD/kg

	LCOET	
Ship LH2	0,033	USD/kWh
Ship CGH2	0,077	USD/kWh
Pipeline 10"	0,004	USD/kWh
Submarine power cable	0,006	USD/kWh

