2D vessels and towing a greater amount of equipment, resulting in a greater total emission output versus 2D operations. Ocean Bottom Node or Ocean Bottom Cable (OBN/OBC) surveys generate a higher quality 3D subsurface image that is similar to conventional 3D operations but are acquired with ocean bottom nodes and require a node layout vessel and seismic source vessels. Finally, multibeam and coring surveys involve relatively smaller boats than a 2D seismic operation and carry less equipment and gear, leading to less fuel consumption and lower emissions per square kilometer.

In 2020, this data will continue to be developed so that we both better understand and are transparent about the emissions used in our operations and are more informed when planning projects.

2019 Survey Emissions

	CO_2 (mt)	CH_4 (mt)	N_2O (mt)
Total Marine Seismic	212,392	1	9
Total Land Seismic	6,649	0.31	0.15
Total All Seismic	**217,137**	**2**	**10**

	CO_2 (mt/unit)	CH_4 (g/unit)	N_2O (g/unit)	SO_2 (tons/unit)	NO_x (tons/unit)
Average 2D Survey – Marine	.51	3	22	.007	.015
Average 3D Survey – Marine	2.66	16.55	118.73	.026	.074
Average Node Survey – Marine	14.93	87.76	658.17	.137	.423
Average Multibeam Survey – Marine	.03	.15	1	.39	<0.01
Average 3D Survey – Land	1.97	92.24	45	NA*	NA*

*At this time TGS is unable to calculate the SO2 and NOx for land surveys due to the varying equipment used

Emissions calculations were done based upon guidance provided by an external environmental consultant using the following:

- For GHG: EPA Simplified GHG Emission Calculator, Version 5, EPA Center for Corporate Climate Leadership, March 2018
- For NO_x: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016, European Environment Agency. NO_x emission factors from Table 3-1 (Tier 1 Emission Factors for Ships Using Bunker Fuel Oil) and Table 3-2 (Tier 1 Emission Factors for Ships using Marine Diesel Oil (MDO) and Marine Gas Oil (MGO))
- For SO_2: Marine Fuel specification: Chevron Global Marine Products (June 2012) and Total HSFO and Distillate Fuel Characteristics (2020)

2019 Marine and Land Seismic Projects	Study Size	CO_2 (mt/unit)	CH_4 (g/unit)	N_2O (g/unit)	SO_2 (tons/unit)	NO_x (tons/unit)
1 AMENDMENT 3D PH I	2,750.57 km²	7.90	46.41	348.09	0.12	0.24
2 CANTON 3D	1,404 km²	0.41	17.76	9.28	NA*	NA*
3 GLOSS MOUNTAIN 3D	901 km²	2.03	97.55	47.45	NA*	NA*
4 JEANNE D' ARC 3D	4,709.49 km²	3.63	21.31	159.82	0.03	0.10
5 NORTH TABLELANDS 3D	4,608.26 km²	2.29	19.24	110.51	0.03	0.04
6 NORTHEAST NEWFOUNDLAND 2D	575.68 km	0.68	4.00	30.00	0.01	0.02
7 RAILGUN 3D	715 km²	2.52	123.43	56.22	NA*	NA*
8 SOUTH GLOSS 3D	606 km²	2.82	126.12	61.66	NA*	NA*
9 SOUTH HACKBERRY 3D	352 km²	2.05	96.37	48.44	NA*	NA*
10 SOUTHEAST GRAND BANKS 2D	10,518.66 km	0.42	2.47	18.53	0.01	0.01
11 TORNGAT 3D	3,698.88 km²	3.44	20.23	151.73	0.02	0.10
12 VOYAGER 2D TEST	5.6 km	0.53	8.39	2.50	NA*	NA*
13 ARGENTINA BASIN 2D	2395.3 km	0.41	2.41	18.09	0.01	0.01
14 CAMPOS 3D	11,840.69 km²	2.62	15.41	115.60	0.04	0.08
15 CAMPOS 2019 MULTIBEAM	31,502 km²	0.03	0.20	1.52	<0.01	<0.01
16 MALVINAS 3D	1,854.77 km²	3.24	19.01	142.59	0.02	0.09
17 PARA MARANHAO 2D	5,638.95 km²	0.53	3.13	23.51	<0.01	0.01
18 SANTOS 3D	4,268.37 km²	2.72	15.97	119.79	0.04	0.08
19 SANTOS 3D PH III	4,794.8 km²	3.08	18.09	135.68	0.05	0.09
20 ATLANTIC MARGINS 19 3D	6,059.83 km²	2.28	20.76	112.67	0.04	0.07
21 GREATER CASTBERG 19 3D	5,168.46 km²	4.23	25.55	187.75	0.03	0.12
22 UTSIRA OBN	815 km²	21.97	129.10	968.26	0.15	0.61
23 JAAN 4B5B18 3D	4,682.84 km²	0.31	1.81	13.59	<0.01	0.01
24 JAAN 6B19 3D	2,152.28 km²	2.36	13.89	104.15	0.02	0.07
25 JAAN AGCP19 3D	877.73 km²	2.55	14.97	112.28	0.02	0.07
26 JAAN AGCS19 3D	970.88 km²	3.16	18.57	139.30	0.02	0.09
27 JAAN SO19 3D	2,671.35 km²	2.17	12.73	95.50	0.02	0.06
28 MSGBC 2019 MULTIBEAM	11,4698 km²	0.02	0.10	0.73	<0.01	<0.01
29 SENEGAL ULTRA-DEEP OFFSHORE 3D	2,151.05 km²	1.81	10.66	79.93	0.01	0.05
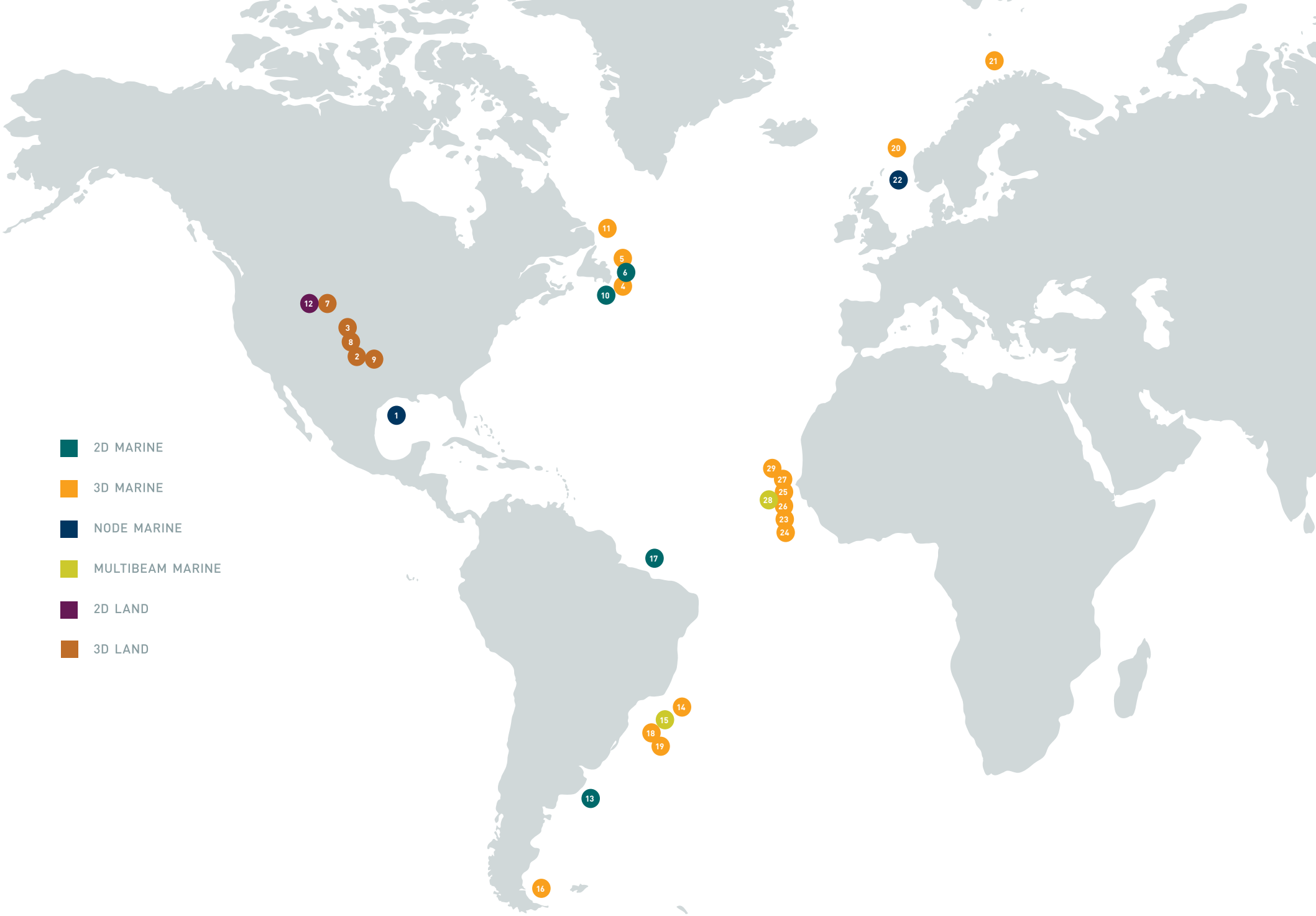
2D MARINE

3D MARINE

NODE MARINE

MULTIBEAM MARINE

2D LAND

3D LAND