

## **CRUISING INTO A NEW ENERGY FUTURE: A LOOK INTO THE ENERGY TRANSITION IN THE CRUISE SHIP INDUSTRY**

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The Cruise Ship Industry must invest further into liquefied natural gas (LNG) powered ships to become environmental stewards, to help meet future industry regulations, and to bridge the gap to a more sustainable fuel economy such as renewables. In an industry plagued with a devastating past, LNG offers hope to increase environmental awareness. Current regulations are constantly changing, forcing the cruise industry to adapt. The current environmental regulations are good but leave much to be desired. International and domestic organizations must take action to solve one of the ocean's biggest problems. LNG is not the final step in the process but one that provides more time while allowing us to cruise into a clean energy future.

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\* Juris Doctor 2019, Vermont Law School; Bachelor of Arts 2012, University of Pittsburgh. Thank you to the many professors, faculty, and staff at Vermont Law School who assisted with the note writing process and the beginning of my legal career. Special thanks to Professor Greg Johnson for his critical guidance and expert input. And thanks to my supportive friends and family for getting me through the long, cold Vermont nights spent in the computer lab.

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## INTRODUCTION

Close your eyes and picture yourself lounging on a tropical beach. The waves are slowly crashing against the shore, the sand is warm beneath your toes, and in the distance, you see a cruise ship slowly coming into port. Once the cruise ship gets closer, you can see many patrons having a wonderful time on the upper deck while waiting to embark on island excursions. After your initial amazement wears off, you begin to think about the environmental and health impacts that could be associated with cruise ships. A bit of research uncovers some unpleasant facts and statistics about the negative environmental impacts of cruise ships. For example, cruise ships have a fuel efficiency of 0.0023 miles per gallon.<sup>1</sup> Cruise ships' fuel usage affects the air

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1. See Erik Hinrichsen, *Cruise Ship Fuel Efficiency*, BRIGHT HUB ENG'G, <http://www.brighthubengineering.com/naval-architecture/100758-cruise-ship-fuel-efficiency/> (last updated Dec. 27, 2010) (discussing the fuel efficiency of Royal Caribbean's Oasis of the Seas while operating at the top speed of 26 miles per hour).

quality in all the corners of the world where the ships travel.<sup>2</sup> As the cruise ship industry rapidly grows, it becomes a larger percentage of the global use of dirty fuels; the cruise industry is responsible for an estimated three percent of all global greenhouse gas emissions.<sup>3</sup>

While this information is upsetting, the industry is beginning to change and support an environmentally sustainable approach to business. The companies, international organizations, and domestic regulators are addressing the negative environmental problems and are moving the industry in the right direction. Regulations are becoming stricter forcing the industry to adapt. Liquefied natural gas (LNG) powered cruise ships appear to be an attractive opportunity to comply with stricter emission standards and make positive change within the industry. LNG provides many benefits over the oil and gas fuels currently used in the shipping industry.<sup>4</sup> One benefit includes a reduction in “nearly all types of air pollutants and carbon dioxide . . .”<sup>5</sup> Switching to LNG- powered ships has the potential to allow the industry to comply with regulations while reducing the negative impacts of ships on the beach you are currently enjoying.

This Paper examines the environmental and human effects of the cruise ship industry around the world while calling for changes in the fuel sources being used to power the ships. Part I examines the current environmental practices in the cruise ship industry, environmental and economic impacts, and what the industry is doing to change. Part II provides an overview of the relevant international and domestic forms of governance that control the cruise ship industry. Part III examines the shift from petroleum to LNG and its effect on the environment, arguing that companies need to look to LNG to meet regulations and to become better environmental stewards.

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2. See Nicole Mölders, Scott Gende, & Michael Pierhalla, *Assessment of Cruise-Ship Activity Influences on Emissions, Air Quality, and Visibility in Glacier Bay National Park*, 4 ATMOSPHERIC POLLUTION RES. 435, 436 (2013) (noting cruise ships may produce sulfur dioxide, nitrogen-oxide, volatile organic compounds, carbon monoxide, ammonia, and particulate matter).

3. Eric V. Hull, *Missing the Boat on Protecting Human Health and The Environment: A Re-Evaluation of The EPA's Emissions Policy on Large Ocean-Going Vessels*, 81 TEMP. L. REV. 1035, 1045 (2008).

4. Mar. Highways Comm., *LNG as Ship Fuel: Effects on Ship Design, Operations and Supporting Infrastructure* (Jan 14, 2013) <http://www.lngbunkering.org/sites/default/files/2013%20HEC%20lng%20effect%20on%20ship%20design.pdf>.

5. U.S. ENERGY INFO. ADMIN., NATURAL GAS EXPLAINED: NATURAL GAS AND THE ENVIRONMENT, [https://www.eia.gov/energyexplained/index.cfm?page=natural\\_gas\\_environment](https://www.eia.gov/energyexplained/index.cfm?page=natural_gas_environment) (last updated July 12, 2017).

## I. CURRENT ENVIRONMENTAL PRACTICES IN THE CRUISE SHIP INDUSTRY

A. *Scientific Data and Background on Cruise Ships*

By nature, the cruise ship industry is linked directly to the planet's water system. Without water, there would be no cruise ships. And without cruise ships, there may be less pollution within the water. Concerns about the environmental impacts of cruise ships center around the water pollution that ships cause.<sup>6</sup> While water pollution is a major concern, the world's air quality also needs to be considered.

Cruise ships run on different types of fuel.<sup>7</sup> All of the fuels used by cruise ships generate air pollutants.<sup>8</sup> Examples of air pollutants are sulfur dioxide (SO<sub>2</sub>), nitrogen-oxides (NO<sub>x</sub>), volatile organic compounds (VOC), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), and particulate matters (PM).<sup>9</sup> Each of these pollutants affects human health and the environment in different ways. Not every cruise ship is created equal, and many factors—such as speed, weight, and fuel-type—will determine the type of and how many emissions are entering the air.<sup>10</sup> Specifically, researchers look at “cruise-voyage data (position, cruise speed, operation mode) and the ships' characteristics (engine power, size, fuel-type, maximum cruise-speed)” to estimate emissions.<sup>11</sup>

Few studies focus on the environmental impacts cruise ship emissions have on air quality. One study assessed the impacts of cruise ships in Glacier

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6. See U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-RCED-00-48, MARINE POLLUTION: PROGRESS MADE TO REDUCE MARINE POLLUTION BY CRUISE SHIPS, BUT IMPORTANT ISSUES REMAIN 4 (2000) (noting number of illegal discharges to U.S. waters caused by cruise ships) [hereinafter MARINE POLLUTION]; U.S. ENVTL. PROT. AGENCY, CRUISE SHIP WHITE PAPER (2000), [https://nmsmontereybay.blob.core.windows.net/montereybay-prod/media/resourcepro/resmanissues/pdf/white\\_paper.pdf](https://nmsmontereybay.blob.core.windows.net/montereybay-prod/media/resourcepro/resmanissues/pdf/white_paper.pdf) (discussing petition to investigate cruise ship wastewater discharges); Claudia Copeland, CRUISE SHIP POLLUTION: BACKGROUND, LAWS AND REGULATIONS, AND KEY ISSUES 1 (CRS Reports RL32450, 2008) (describing types of cruise ship waste, many of which are water pollution); Andrew Schulkin, *Safe Harbors: Crafting an International Solution to Cruise Ship Pollution*, 15 GEO. INT'L ENVTL. L. REV. 105, 106–07 (2002) (noting cruise ships discharge waste into the ocean, causing environmental concerns).

7. See Molly Harris, *How are Cruise Ships Powered?*, USA TODAY, <https://traveltips.usatoday.com/cruise-ships-powered-30089.html> (last updated May 14, 2018) (listing different cruise ship fuels).

8. See Chloe Farand, *Air quality on cruise ship deck 'worse than world's most polluted cities', investigation finds*, Independent, (July 4, 2017), <https://www.independent.co.uk/news/world/pollution-cruise-ships-po-oceana-higher-piccadilly-circus-channel-4-dispatches-a7821911.html> (reporting high cruise ship emissions, especially with heavy fuel oils).

9. See Mölders et al., *supra* note 2, 436 (2013) (measuring emission rates of air pollutants); see also Christina Nunez, *Air Pollution, Explained*, NAT'L GEOGRAPHIC, <https://www.nationalgeographic.com/environment/global-warming/pollution/> (last visited Feb. 14, 2019) (noting carbon dioxide as an air pollutant associated with burning fossil fuels).

10. Mölders et al., *supra* note 2, at 435.

11. *Id.*

Bay National Park in Alaska.<sup>12</sup> Researchers chose Glacier Bay National Park for this case study because it is easier to pinpoint air pollution problems from the ships in areas where they are the only anthropogenic emission source, accounting for greater than 95% of all visitors.<sup>13</sup> The cruise ships that visit the park are the major source of air pollution, in a geographical area that generally has little to no other pollution sources.<sup>14</sup> After all, cruise ships often showcase exciting, new locations. Unfortunately, the ships have disproportionately larger effects on these areas due to the lack of development or other pollution sources.<sup>15</sup>

The study, *Assessment of Cruise-ship Activity Influences on Emissions, Air Quality, and Visibility in Glacier Bay National Park*, developed a model and performed emissions simulations to understand how management actions can modify the emissions impact.<sup>16</sup> The study used a complex model that creates activity-based ship-emission inventories to determine the hourly emission rates for air pollutants, including sulfur dioxide.<sup>17</sup> The cruise ships in the study used marine gas oil (sulfur content <1.5%) and intermediate fuel oil (sulfur content <4.5%) for the main engines.<sup>18</sup> Once researchers determined the rates, they assigned the rates to the cruise ship's path using a calculated mean speed.<sup>19</sup> It is important to note that cruise ships still need to run while docked at ports-of-call.<sup>20</sup> Thus, they are still creating emissions while at port, but at a different variable rate.<sup>21</sup>

After running the model and simulations, the study ended by determining the emissions for the 2008 cruise-ship season to serve as reference emissions.<sup>22</sup> The study used the reference emissions to model how management of cruise ship factors affect air pollution.<sup>23</sup> The two management actions, a prescribed speed in the area and implementation of an Emission Control Area (ECA), drastically affect the emissions and air quality within Alaska.<sup>24</sup> On average, cruise ships emitted approximately 2.5  $\mu\text{g}/\text{m}^2/\text{s}$  PM in Glacier Bay.<sup>25</sup> Implementing a 6.69 m/s speed decreased PM-emissions by 32%.<sup>26</sup> The International Maritime Organization (IMO)

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12. *Id.* at 436.

13. *Id.* at 435.

14. *See id.* (noting cruise ship emissions are major concern in area where there is no road).

15. *See id.* (noting no roads go into Glacier Bay National Park).

16. *Id.* at 436.

17. *Id.*

18. *Id.*

19. *Id.*

20. *Id.*

21. *See id.* (noting use of different emissions factors during berthing).

22. *Id.* at 444.

23. *Id.* at 435–445.

24. *Id.* at 438.

25. *Id.* at 435.

26. *Id.*

established the ECA in Alaska to reduce fuel sulfur content to 0.1% 1,000 ppm, and NOx emissions by 80% by 2016.<sup>27</sup> Using ECA standards reduced PM-emissions by 74%.<sup>28</sup>

Emission rates vary depending on what the cruise ships are doing and how fast they are going.<sup>29</sup> “Emissions were highest close to ports and in front of glaciers . . . demonstrating that operating for longer periods in an area (berthing, maneuvering) at low loads can more than offset the increased emission rates when cruising through an area.”<sup>30</sup> Speed is another key factor that determines the emissions in an area.<sup>31</sup> “Lifting speed limits means the engines are less frequently at low propulsion loads, at which emission rates increase with decreasing load for all species but SO<sub>2</sub> and NH<sub>3</sub>, for which emission just increases with speed . . . .”<sup>32</sup> These assertions help illustrate some of the factors that influence air pollution from cruise ships while giving scientifically-tested theories on how to mitigate the environmental problems associated with the cruise ship industry.

#### *B. Environmental and Economic Impacts of the Cruise Ship Industry*

The environmental impacts of cruise ships go beyond air pollution. Specifically, cruise ships also cause water pollution, several types of waste, and other human health concerns.<sup>33</sup> This Note will mainly focus on the emission and air pollution concerns. Before looking at the environmental impacts, it is important to understand the economics behind the cruise ship industry and what drives the \$117 billion dollar industry.<sup>34</sup> Cruise Lines International Association (CLIA) estimates there are more than 950,000 jobs globally in the cruise industry.<sup>35</sup> In 2016, more than 24 million passengers experienced a cruise—double the 11.5 million passengers in 2005.<sup>36</sup> CLIA estimates that 25.3 million passengers will sail in 2017.<sup>37</sup> As the number of passengers grow, so does the size of each company’s fleet, as well as the size of new ships.<sup>38</sup> The average ship size has been increasing by roughly 90 feet

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27. *Id.* at 437.

28. *Id.* at 435.

29. *Id.* at 438.

30. *Id.*

31. *See id.* (noting changing cruise speed altered emission distribution).

32. *Id.*

33. *See* Schulkin, *supra* note 6, at 109–12, 118 (noting human health effects of cruise ship waste and how cruise ships contribute to water pollution).

34. CRUISE LINES INT’L ASS’N, 2016 ANNUAL REPORT (2016) [hereinafter ANNUAL REPORT].

35. *Id.*

36. *Id.*; Copeland, *supra* note 6, at 1.

37. ANNUAL REPORT, *supra* note 34, at 31.

38. Copeland, *supra* note 6, at 1.

every five years.<sup>39</sup> Currently the three biggest ships belong to Royal Caribbean Cruise Lines.<sup>40</sup> The largest is the *Harmony of the Seas*, measuring at 1,188 feet long and possessing the capacity to hold 6,687 passengers.<sup>41</sup> Not only are the ships massive, the cruise ship industry also has a titanic effect on the global economy.

The size of the cruise ship industry helps put the pollution issues into perspective. However, the cruise industry has roughly 300 ocean-going vehicles—only a small percent of the 50,000 international commercial maritime ships.<sup>42</sup> While relatively small in number, cruise ships still contribute a big share of pollution.<sup>43</sup> Cruise ships have historically used large diesel engines that burn large amounts of fuel; that fuel contains sizeable amounts of sulfur and other particulate matter (PM).<sup>44</sup> Because the large engines burn such dirty fuels, cruise ships are a significant source of pollution globally.<sup>45</sup>

In 2000, the U.S. Environmental Protection Agency (EPA) estimated “large marine diesel engines accounted for about 1.6% of mobile source nitrogen oxide emissions and 2.8% of mobile source particulate emission in the United States . . . .”<sup>46</sup> Due to the disproportionate effects on certain areas, this number can significantly increase, as in Glacier Bay National Park.<sup>47</sup> This effect has also been seen in areas like Santa Barbara, where large marine engines contributed about 37% of total nitrogen oxide emissions.<sup>48</sup>

Emissions, specifically diesel fuel emissions, have a history of negative human and global health effects.<sup>49</sup> Many of the pollutants, particularly particulate matter, can irritate and advance dangerous health problems such as asthma.<sup>50</sup> “Particulate matter is a mixture of extremely small particles and liquid droplets consisting of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.”<sup>51</sup> Sulfur levels of fuels used by ships have a direct correlation to

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39. *Id.*

40. Miquel Ros, *15 Biggest Cruise Ships in the World*, CNN (Dec. 3, 2018), <https://www.cnn.com/travel/article/worlds-biggest-cruise-ships/index.html>.

41. *Harmony of the Seas: Fast Facts*, ROYAL CARIBBEAN INTERNATIONAL, <https://www.royalcaribbeanpresscenter.com/fact-sheet/29/harmony-of-the-seas/> (last visited Mar. 12, 2019).

42. CRUISE LINES INT’L ASS’N, ENVIRONMENT SUSTAINABILITY REPORT 3 (2016) [hereinafter SUSTAINABILITY REPORT].

43. Copeland, *supra* note 6, at 7.

44. Hull, *supra* note 3, at 1045.

45. *Id.* at 1037.

46. Copeland, *supra* note 6, at 6.

47. See Mölders et al., *supra* note 2, at 435 (noting an increased number of cruise ships in Glacier Bay National Park).

48. Copeland, *supra* note 6, at 7.

49. Schulkin, *supra* note 6, at 112.

50. *Id.* at 113.

51. Hull, *supra* note 3, at 1040.

the volume of PM emissions.<sup>52</sup> PM emissions have also been linked to ocean acidification because they enter the water supply and alter the normal pH balance necessary to maintain a suitable environment for the organisms living there.<sup>53</sup>

Arguably, one of the biggest impacts from cruise ship emissions is the contribution to climate change. Anthropogenic greenhouse gases, such as CO<sub>2</sub>, CH<sub>4</sub>, and SO<sub>2</sub>, contribute to global climate change.<sup>54</sup> Greenhouse gases “act to absorb terrestrial radiation reflected from the Earth’s surface that, in turn, causes global temperatures to rise.”<sup>55</sup> Sources emitting greenhouse gases, including cruise ships, are changing the global climate. As of 2008, the shipping industry emitted 5 to 6 percent of all greenhouse gas emissions and twenty percent of all SO<sub>2</sub> emissions.<sup>56</sup> All of these emissions mean that the relatively small shipping industry accounts for a significant portion of the total greenhouse gas emissions and, ultimately, contribute to anthropogenic climate change.

### *C. What the Cruise Ship Industry is Doing to Change Its Environmental Practices*

While cruise ships may have a murky history of environmental stewardship,<sup>57</sup> the industry is taking great strides to preserve the environment and human health. Environmental conservation campaigns, commitments for the future, and technological advancements allow the cruise ship industry to reduce its impact on the environment.<sup>58</sup> Transitioning an entire industry overnight is not a viable option. But taking small steps toward environmental goals will help meet regulations and standards.

Cruise Lines International Association (CLIA) “is the world’s largest cruise industry trade association, providing a unified voice and leading authority of the global cruise community.”<sup>59</sup> Along with unifying the

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52. *Id.*

53. Elizabeth Kolbert, *The Darkening Sea*, NEW YORKER, Nov. 20, 2006,

54. CHRIS WOLD ET AL., CLIMATE CHANGE AND THE LAW 6-7 (LexisNexis eds., 2nd ed. 2013).

55. Hull, *supra* note 3, at 1041.

56. Rachel Oliver, *Shipping’s Impact on the Air*, CNN, <http://edition.cnn.com/2008/WORLD/asiapcf/01/20/eco.about.ships/> (last visited Mar. 12, 2019).

57. See e.g., MARINE POLLUTION, *supra* note 6, at 40–52 (reporting incidents of illegal discharges of pollution, alleged pollution incidents, and violations involving pollution incidents from cruise ships from 1993-98).

58. *Royal Caribbean and the Environment*, ROYAL CARIBBEAN CRUISES LTD., <http://www.rclcorporate.com/environment/> (last visited Mar. 12, 2019); see *Sustainability*, CARNIVAL CORP. AND PLC, <http://phx.corporate-ir.net/phoenix.zhtml?c=140690&p=irol-sustainability> (last visited Mar. 12, 2019) (listing Carnival’s sustainability initiatives); *Sail & Sustain Environmental Program*, NORWEGIAN CRUISE LINE, <https://www.ncl.com/about/environmental-commitment> (last visited Mar. 12, 2019).

59. SUSTAINABILITY REPORT, *supra* note 42, at 4.

industry, CLIA actively promotes environmental sustainability for a safe and healthy experience for everyone.<sup>60</sup> Each year CLIA publishes several reports, including the Environmental Sustainability Report that highlights ongoing environmental practices in the industry.<sup>61</sup> Examples of the environmental practices adopted by cruise corporations include prohibiting discharge of untreated sewage anywhere in the world, developing technologies to allow ships to “plug in” at port to reduce air emissions, and pledging \$2.5 million in support the Nature Conservancy’s work on global marine protection priorities.<sup>62</sup> CLIA members invested over \$1 billion in advanced emission systems and alternative fuels, like liquefied natural gas.<sup>63</sup>

Individual companies are changing the status quo by partnering with environmental conservation groups, developing environmental management plans, and increasing energy efficiency through the use of LED lights and solar panels.<sup>64</sup> Royal Caribbean Cruises LTD. (Royal Caribbean), one of the largest cruise corporations, emphasizes its positive relationship with the environment.<sup>65</sup> “Save the Waves” is Royal Caribbean’s environmental stewardship program focusing on four key principles: (1) reduce, reuse, recycle; (2) practice pollution prevention; (3) Go Above and Beyond Compliance program; and (4) continuous improvement.<sup>66</sup> Royal Caribbean partnered with the World Wildlife Fund and the University of Miami’s Rosenstiel School of Marine and Atmospheric Science to collaboratively research and “ensure the long-term health of the world’s oceans.”<sup>67</sup> Royal Caribbean’s sustainable practices include a \$100 million wastewater treatment system upgrade, engineering new hull and propulsion designs to maximize performance, and housing two laboratories on the Explorer of the Seas to study water pollution and climate change.<sup>68</sup> While impressive, Royal Caribbean’s partnerships and practices represent only a fraction of what the cruise industry is doing to promote environmental sustainability and stewardship.

Carnival Corporation & PLC (Carnival) publishes a yearly sustainability report to highlight current practices and promote their future goals.<sup>69</sup> Cruise

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60. *Id.*

61. *Id.* at 3.

62. *Id.* at 5–6.

63. *See id.* at 6 (noting that investments in advanced emission systems and alternative fuels have been occurring over the past decade).

64. ROYAL CARIBBEAN CRUISES LTD., *supra* note 58.

65. *Id.*

66. *Id.*

67. *Community: World Wildlife Fund*, Royal Caribbean Cruises Ltd., <http://www.rclcorporate.com/community/#world-wildlife-fund> (last visited Mar. 23, 2019).

68. Kristin Underwood, *7 Ocean-Friendly Eco Cruises Hitting the High Seas*, TREEHUGGER (June 3, 2009), <https://www.treehugger.com/natural-sciences/7-ocean-friendly-eco-cruises-hitting-the-high-seas.html>.

69. CARNIVAL CORP. & PLC, SUSTAINABILITY FROM SHIP TO SHORE 8 (2017).

companies establish these goals and practices to remain in compliance with environmental regulations, but also to preserve the health and safety of the environment and patrons on board. One of Carnival's biggest commitments is to pioneer the use of LNG, specifically partnering with Shell Western LNG B.V. to supply the fuel.<sup>70</sup> Some of the benefits Carnival estimates include: zero sulfur dioxide emissions; 85% reduction in nitrogen oxides emissions; 25% reduction in carbon emissions; and 95%–100% reduction in particulate matter.<sup>71</sup> Carnival is ahead of its scheduled reduction of carbon emissions and continues to reduce waste onboard ships.<sup>72</sup> Carnival's sustainability report highlights and apologizes for violations of company policy and environmental laws that led to a plea agreement with the United States Department of Justice.<sup>73</sup>

Moreover, Norwegian Cruise Line's mission is "to continually improve our sustainability culture through fresh innovation, progressive education and open collaboration."<sup>74</sup> Norwegian Cruise Line receives awards and accolades for their environmental commitment.<sup>75</sup> For example, the Maritime Award of Americas and the United States Coast Guard William M. Benkert Award for Environmental Excellence.<sup>76</sup> The State of Washington only allows Norwegian Cruise Line to operate in the "pristine" waters of Puget Sound because Norwegian Cruise Line led the industry by installing an eco-ballast system.<sup>77</sup> Additionally, Norwegian Cruise Line is retrofitting many of its ships with an exhaust gas cleaning system to "scrub away" sulfur dioxide and particulate matter.<sup>78</sup>

The examples above describe technological advancements, commitments to the environment, and partnerships with environmental groups. This supports the proposition that the cruise ship industry is taking major strides to preserve the natural world we inhabit.

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70. *Id.* at 9.

71. *Id.*

72. *Id.* at 11.

73. *See id.* at 9 (apologizing for the conduct of some employees who violated environmental laws); *see also* Gene Sloan, *Princess Cruises to Plead Guilty to Polluting Ocean*, USA TODAY (Dec. 2, 2016, 4:13 PM), <https://www.usatoday.com/story/news/nation/2016/12/01/princess-cruises-felony-plea-pollution/94726786/> (noting Princess Cruise ship discharged oily water into the ocean).

74. *Norwegian Cruise Line Environmental Commitment*, NORWEGIAN CRUISE LINE, <https://www.ncl.com/about/environmental-commitment> (last visited Mar. 12, 2019).

75. *Id.*

76. *Id.*

77. *See* Underwood, *supra* note 68 (describing an eco-ballast system that ensures "water leaving the ship does not send out toxin or other invasive species").

78. NORWEGIAN CRUISE LINE, *supra* note 74.

## II. CURRENT ENVIRONMENTAL REGULATIONS THE CRUISE SHIP INDUSTRY MUST MEET

### A. International Regulations

Many industries around the world follow regulations on an international and domestic scale. The cruise ship industry is no exception. Several international entities, such as the International Maritime Organization (IMO)<sup>79</sup> and the United Nations Convention on the Law of the Seas (UNCLOS)<sup>80</sup> currently exist to regulate the world's seas and waterways. While both fall under the purview of the United Nations, the distinction between the two entities before looking at what and how they regulate is imperative.

#### 1. International Maritime Organization

The United Nations decided it would be more effective to improve maritime safety and pollution prevention on an international scale instead of on a country-by-country basis.<sup>81</sup> In 1984, the United Nations adopted a convention establishing the International Maritime Organization (IMO).<sup>82</sup> Currently, the IMO has 170 Member States, including the United States, and three Associate Members.<sup>83</sup> “Safe, secure and efficient shipping on clean oceans” is the official IMO slogan.<sup>84</sup> The IMO's technical organization contains committees and subcommittees, such as the Marine Environment Protection Committee (MEPC) and the Sub-Committee on Pollution Prevention and Response (PPR), which are responsible for carrying out many assigned duties.<sup>85</sup> These duties include “co-ordinating [sic] the Organization's activities in the prevention and control of pollution of the environment from ships.”<sup>86</sup>

Among other responsibilities, the IMO establishes regulations preventing and dealing with pollution through the use of conventions and amendments.<sup>87</sup> The most significant and comprehensive plan to deal with

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79. INT'L MARITIME ORG., <http://www.imo.org/EN/Pages/Default.aspx#1> (last visited Mar. 19, 2019).

80. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397.

81. INT'L MARITIME ORG., IMO – WHAT IT IS, at 1, Oct. 20, 2013, [http://www.imo.org/en/About/Documents/What%20it%20is%20Oct%202013\\_Web.pdf](http://www.imo.org/en/About/Documents/What%20it%20is%20Oct%202013_Web.pdf) [hereinafter IMO – WHAT IT IS].

82. *Id.* at 2.

83. *Id.*

84. *Id.*

85. *Id.*

86. *Id.*

87. *Id.*

pollution from ships came in 1973 when the IMO adopted the “first ever comprehensive anti-pollution convention,” the International Convention for the Prevention of Pollution from Ships (MARPOL).<sup>88</sup> In 1978, the Conference on Tanker Safety and Pollution Prevention expanded MARPOL to include operation and construction requirements.<sup>89</sup> This expansion is important because it allows MARPOL to address the sources of pollution, like cruise ships, not just the pollution itself.

MARPOL regulates most forms of pollution from ships, including oil, sewage, and air pollution.<sup>90</sup> The Convention is broken up into six Annexes that address several types of pollution and determine international objectives:<sup>91</sup>

- Annex I deals with regulations preventing pollution by oil.
- Annex II details the discharge criteria and measures for controlling pollution by noxious liquid substances carried in bulk.
- Annex III contains general requirements for issuing standards on packing, marking, labeling, and notifications for preventing pollution by harmful substances.
- Annex IV contains requirements for controlling pollution of the sea by sewage.
- Annex V deals with different types of garbage, including plastics, and specifies the distances from land and the manner in which they may be disposed of.
- Annex VI sets limits on sulfur oxide, nitrogen oxide, and other emissions from marine vessel operations and prohibits deliberate emissions of ozone-depleting substances.<sup>92</sup>

The standard Annex ratification process is unique because they must be “ratified by a total number of member countries whose combined gross tonnage represents 50% of the world’s gross tonnage.”<sup>93</sup> Essentially, the bigger the polluter, the more influence they have on ratifying the proposed Annexes.

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88. *Id.* at 10–11.

89. *Id.* at 11.

90. WOLDE ET AL., *supra* note 55, at 506.

91. Copeland, *supra* note 6, at 7.

92. *Id.*

93. *Id.* at 8.

Annex VI, adopted in 1997, sets the international air pollution limits on nitrogen oxides (NOx).<sup>94</sup> It prohibits deliberate emissions of ozone-depleting substances from marine vessel operations.<sup>95</sup> Also, Annex VI sets limits on the sulfur content of marine fuels used by ships.<sup>96</sup> Under Annex VI, the ship's registered country (flag state) must verify a ship's compliance with MARPOL's standards.<sup>97</sup> In North America, these requirements apply to ships within the Emission Control Area (ECA).<sup>98</sup> The North American ECA, where emission impacts are most felt, extends 200 nautical miles off the coast.<sup>99</sup> Cruise ships are not an exception to this rule and must follow the applicable standards when moving between the regulated areas.<sup>100</sup>

A 2011 amendment to Annex VI implemented two energy efficiency standards for ocean-going ships: the Energy Efficient Design Index (EDDI) and the Ship Energy Efficiency Management Plan (SEEMP).<sup>101</sup> EDDI requires ships to meet a minimum energy efficiency standard by choosing from different technologies and designs.<sup>102</sup> Energy efficiency standards are "measured in CO2 emissions, per capacity mile (e.g. tonne mile) for different ship types (e.g., tankers, container ships)."<sup>103</sup> The SEEMP requires that ship operators implement an environmental management system that will monitor ship performance and increase energy efficiency.<sup>104</sup> Technology upgrades and review of operational practices are two ways for the cruise industry to meet SEEMP requirements.<sup>105</sup> The IMO estimates these programs will reduce CO2 emissions by 151.5 tons annually by 2020, which will translate into fuel savings of \$50 billion in 2020.<sup>106</sup> While these numbers are estimates for the entire shipping industry, cruise ships will see proportional reductions.<sup>107</sup> Liquefied natural gas (LNG) offers one way that these ships can increase energy efficiency while reducing emissions.<sup>108</sup>

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94. IMO – WHAT IT IS, *supra* note 81, at 11; *MARPOL Annex VI*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/enforcement/marpol-annex-vi> (last visited Mar. 13, 2019) [hereinafter *MARPOL Annex VI*].

95. Copeland, *supra* note 6, at 8.

96. *MARPOL Annex VI*, *supra* note 94.

97. Copeland, *supra* note 6, at 8.

98. *MARPOL Annex VI*, *supra* note 94.

99. *Id.*; WOLD ET AL., *supra* note 54, at 507.

100. WOLD ET AL., *supra* note 54, at 507.

101. *Id.*

102. *Id.*

103. *Id.*

104. *Id.*

105. *Id.*

106. *Id.*

107. *Id.*

108. SUSTAINABILITY REPORT, *supra* note 42, at 15.

## 2. United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea (UNCLOS) is a comprehensive agreement that establishes “the basic legal and institutional framework for ocean governance.”<sup>109</sup> In 1973, in the third UNCLOS, the General Assembly of the United Nations met in New York to form an international agreement that set guidelines for jurisdiction of the seas and marine resources.<sup>110</sup> The agreement specifically mentions conservation of the living resources and the preservation of the marine environment.<sup>111</sup> As of November 6, 2017, UNCLOS has been ratified by 168 nations.<sup>112</sup> The United States refuses to ratify the Convention due to limits on seabed mining and exploration.<sup>113</sup>

A major function of UNCLOS is to resolve jurisdictional issues over marine areas.<sup>114</sup> UNCLOS created a series of coastal zones: internal waters, territorial seas, contiguous zones, exclusive economic zones (EEZ), and high seas.<sup>115</sup> Within these zones, environmental protections and conservation obligations exist to create rights and responsibilities for each member state, such as patrolling waters to deter polluters.<sup>116</sup> Addressing pollution within each zone is crucial for cruise ships because each zone calls for different standards, forcing different types of procedures and strategies to come into effect during a voyage. Although UNCLOS sets the international standards, it fails to create effective enforcement measures, essentially leaving it to the states to “to prevent, reduce and control pollution of the marine environment.”<sup>117</sup> Coastal states are only able to enforce pollution violations in their territorial seas and EEZs because many cruise ships register with foreign states.<sup>118</sup>

The international nature of the cruise ship industry makes it a challenging industry to govern. UNCLOS requires registration of ships in a flag state that

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109. WOLD ET AL., *supra* note 54, at 525.

110. *Third United Nations Conference on the Law of the Sea*, UNITED NATIONS [http://legal.un.org/diplomaticconferences/1973\\_los/](http://legal.un.org/diplomaticconferences/1973_los/) (last visited Mar. 13, 2019).

111. UNITED NATIONS, FINAL ACT OF THE THIRD UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA 25 (1973) [http://www.un.org/depts/los/convention\\_agreements/texts/final\\_act\\_eng.pdf](http://www.un.org/depts/los/convention_agreements/texts/final_act_eng.pdf).

112. *Chronological Lists of Ratifications of, Accessions and Successions to the Convention and the Related Agreements*, UNITED NATIONS, [http://www.un.org/depts/los/reference\\_files/chronological\\_lists\\_of\\_ratifications.htm](http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications.htm) (last visited Mar. 13, 2019).

113. Schulkin, *supra* note 6, at 119.

114. WOLD ET AL., *supra* note 54, at 525.

115. *Id.*

116. *Id.*

117. *See, e.g.*, Convention on the Law of the Sea (UNCLOS), art. 194, Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS] (discussing measures to take to “prevent, reduce and control pollution of the marine environment from any source”); *see also* UNCLOS, art. 204 (monitoring the risks or effects of pollution on the marine environment); Schulkin, *supra* note 6, at 120.

118. Schulkin, *supra* note 6, at 120.

is responsible for regulating pollution and enforcing violations.<sup>119</sup> However, the requirements for registration are weak, requiring only a “genuine link” between the ship and flag state without elaborating on what this “genuine link” is.<sup>120</sup> Such relaxed standards lead to the practice of cruise ship registration in states where the pollution laws and regulations are weak or non-existent.<sup>121</sup> This does not mean that cruise ship operators are free to do what they want; they must follow the rules and regulations of any state’s water in which they enter, and they must follow their flag state’s laws when they are in international waters.<sup>122</sup> Strengthening the registration requirements is one way that the international community can help alleviate pollution from ships skirting environmental duties by registering in places with the least restrictive regulations.<sup>123</sup>

### 3. Relationship Between the IMO and UNCLOS

The Law of the Sea Convention “is acknowledged to be an ‘umbrella convention’ because most of its provisions, being of general nature, can be implemented only through specific operative regulations” in other international treaties.<sup>124</sup> UNCLOS establishes general obligations for governance that reference the IMO standards.<sup>125</sup> UNCLOS contains no standard specifications of its own.<sup>126</sup> Several IMO convention provisions give notice that their text “does not prejudice the codification and development of the law of the sea by UNCLOS or any present or future claims and legal views of any State concerning the law of the sea and the nature and extent of coastal and flag State jurisdiction.”<sup>127</sup>

Many of the UNCLOS provisions reference the “competent international organization,” which has been widely accepted to mean the IMO.<sup>128</sup> One provision, Article 2, refers to the IMO as a legitimate state-utilized international forum for setting international standards.<sup>129</sup> Due to the

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119. *Id.* at 119.

120. *Id.*

121. *Id.*

122. *Passenger Cruise Ship Information*, U.S. DEP’T. OF TRANSP <https://www.transportation.gov/mission/safety/passenger-cruise-ship-information> (last visited Mar. 19, 2019).

123. *See generally* Copeland *supra* note 6, at 7–8 (noting that many countries have ratified all MARPOL annexes, including Liberia and Panama, where a majority of cruise ships are flagged).

124. BARBARA KWIATKOWSKA ET AL., *INTERNATIONAL ORGANIZATIONS AND THE LAW OF THE SEA DOCUMENTARY YEARBOOK* (Martinus Nijhoff Publishers 1997).

125. ANNA MIHNEVA-NATOVA, *THE RELATIONSHIP BETWEEN UNITED NATIONS CONVENTION ON THE LAW OF THE SEA AND THE IMO CONVENTION 14* (2005).

126. *Id.*

127. *Id.* at 7.

128. *Id.*

129. UNCLOS, art. 2; MIHNEVA-NATOVA, *supra* note 125, at 7.

specialized nature of the IMO, UNCLOS drafters saw the “efficiency of potentially higher standards adopted within IMO.”<sup>130</sup> As a result, UNCLOS drafters assume the IMO standards are the primary regulatory source for determining the shipping industry’s international obligations.<sup>131</sup>

Despite rarely being recognized as environmental leaders, the IMO and UNCLOS are the leading mechanisms for protecting the marine environment.<sup>132</sup> The IMO primarily uses MARPOL to regulate maritime pollution.<sup>133</sup> Article 192 of UNCLOS establishes the general obligation “to protect and preserve the marine environment,” and Article 211 deals with pollution from vessels.<sup>134</sup> Article 212 addresses pollution from and through the atmosphere.<sup>135</sup> With the inclusion of the “competent international organization” clause, UNCLOS does not create new technical or pollution rules; rather it suggests the IMO standards are the ruling authority.<sup>136</sup>

UNCLOS and the IMO actively protect the maritime environment but differ in their approach. UNCLOS emphasizes prevention and penalizes ocean discharges without specifying enforcement mechanisms, leaving this up to the coastal states.<sup>137</sup> The IMO, through MARPOL, addresses non-compliance with preventative measures whether or not non-compliance results in illegal discharges.<sup>138</sup> The shipping industry, specifically cruise ships, needs to be aware of the relevant environmental rules and regulations when hitting the open ocean.

The United States, like most countries, is concerned with protecting its coastal and marine environments. In regard to the IMO and MARPOL, the United States has ratified all the Annexes except for Annex IV; which requires sewage discharge controls.<sup>139</sup> The United States is the only industrialized nation that has not ratified UNCLOS due to concerns over the provisions limiting seabed mining and exploration.<sup>140</sup> While the United States is not a signatory to the Convention, many of the principal ideals can be found throughout domestic environmental regulation.

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130. MIHNEVA-NATOVA, *supra* note 125, at 8.

131. Copeland, *supra* note 6, at 22.

132. MIHNEVA-NATOVA, *supra* note 125, at 15.

133. MARPOL Annex VI, *supra* note 94.

134. UNCLOS, art. 192; UNCLOS, art. 211.

135. UNCLOS, art. 212.

136. MIHNEVA-NATOVA, *supra* note 125, at 7.

137. *Id.* at 16, 18.

138. *Id.* at 16.

139. Copeland, *supra* note 6, at 8, 11.

140. Schulkin, *supra* note 6, at 119.

*B. Domestic Regulations*

Cruise ships are a fascinating topic from an environmental regulatory point of view, especially in the United States, due to the international and diverse nature of the industry. Many agencies, including the U.S. Coast Guard and the State Department, collaborate to regulate and enforce environmental practices within the cruise ship industry.<sup>141</sup> While several agencies participate in the regulations and negotiations, the EPA is the main environmental regulatory and standard-setting body.<sup>142</sup> United States environmental law is a vast, complex machine that works to preserve the environment while regulating industry in economically and environmentally sustainable ways. While this Paper deals with the environmental laws that regulate emissions from cruise ships, it should be acknowledged that cruise ship operators need to look at many sources of law to deal with the many types of environmental matters that arise.

The Clean Air Act (CAA) is one of the most complex federal laws that regulates emissions and air quality.<sup>143</sup> The CAA defines “air pollutant” as “any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance or matter which is emitted into or otherwise enters the atmosphere.”<sup>144</sup> The CAA regulates air pollutants from stationary and mobile sources.<sup>145</sup> More specifically, in 2007, the Supreme Court in *Massachusetts v. EPA* gave the EPA the authority to regulate greenhouse gas emissions under the CAA.<sup>146</sup> This decision eventually allowed the EPA to regulate emissions from mobile sources on land and at sea.<sup>147</sup>

In 2003, the EPA promulgated regulations for cruise ships.<sup>148</sup> Since then, the EPA has set standards to regulate emissions from Category 3 marine diesel engines on large vessels flagged in the United States.<sup>149</sup> The EPA continually reviews issues and technologies related to emissions in an effort

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141. Copeland, *supra* note 6, at 9.

142. *Id.*; see, e.g. *Domestic Regulations for Emissions from Marine Compression-ignition (Diesel) Engines*, U.S. ENVTL. PROT. AGENCY, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/domestic-regulations-emissions-marine-compression> (last visited Mar. 12, 2019) (listing EPA’s regulation concerning emissions from marine diesel engines).

143. 42 U.S.C. §§ 7401–7671(q) (2018); Copeland, *supra* note 6, at 9; WOLD ET AL., *supra* note 54, at 629.

144. § 7602(g); WOLD ET AL., *supra* note 54, at 629.

145. WOLD ET AL., *supra* note 54, at 629.

146. *Massachusetts v. Env’tl. Prot. Agency*, 549 U.S. 497, 497 (2007); WOLD ET AL., *supra* note 54, at 629.

147. See § 7521 (regulating emission standards from new motor vehicles or new motor vehicle engines); § 7547 (regulating emission from non-road engines and non-road vehicles).

148. Copeland, *supra* note 6, at 16.

149. § 7547, Copeland, *supra* note 6, at 16 (classifying Category 3 marine engines include container ships, tankers, bulk carriers, and cruise ships flagged or registered in the United States).

to set the standards for non-road engines and vehicles.<sup>150</sup> In 2004, Bluewater Network lost a challenge to the EPA's emissions standards for ocean-going vessels.<sup>151</sup> The D.C. Circuit Court determined that the emissions standards were set to the same level as Annex VI of MARPOL and thus satisfied international standards and the CAA.<sup>152</sup>

To further the goal of limiting emissions from ocean-going vessels, Congress enacted the Act to Prevent Pollution from Ships (APPS).<sup>153</sup> APPS is the United States legislation that implements provisions of MARPOL, specifically Annex VI regarding air pollution.<sup>154</sup> Not only does APPS apply to these standards to U.S.-flagged ships, the Act also applies to foreign-flagged vessels operating within the navigable waters of the United States.<sup>155</sup> The Coast Guard is working with the EPA to oversee and enforce violations of APPS, which may result in criminal or civil liability in the United States.<sup>156</sup> APPS creates a zone of enforcement called the North American Emission Control Area (ECA) in which ships must meet the most advanced standards for NOx emissions and use fuel with lower sulfur content.<sup>157</sup> Because the ECA extends 200 miles off the coast of the United States, the Coast Guard needs to stay vigilant in order to enforce APPS and protect the maritime environment.<sup>158</sup>

### III. HOW THE SHIFT FROM PETROLEUM TO LNG WILL AFFECT THE ENVIRONMENT

Many refer to natural gas as the “bridge fuel to the future” when looking at its economic and environmental impacts.<sup>159</sup> A shift to natural gas, specifically liquefied natural gas (LNG), will allow the shipping industry to meet its emission goals while greatly reducing its environmental impacts. The IMO implemented a global sulfur limit of 0.5% m/m (mass/mass) by 2020, representing a great reduction from the current 3.5% m/m global

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150. Copeland, *supra* note 6, at 16.

151. Bluewater Network v. Env'tl. Prot. Agency, 372 F.3d 404, 405 (D.C. Cir. 2004).

152. *Id.* at 407.

153. *See generally* 33 U.S.C. §§ 1901–1915 (regulating marine pollution from ships in the United States); Copeland, *supra* note 6, at 8.

154. Copeland, *supra* note 6, at 8.

155. CRUISE SHIP WHITE PAPER, *supra* note 6.

156. MARPOL Annex VI, *supra* note 94.

157. *Id.*

158. *Id.*

159. JOSEPH P. TOMAIN & RICHARD D. CUDAHY, ENERGY LAW IN A NUTSHELL 317 (3d ed. 2017); Richard J. Pierce, Jr., *Natural Gas: A Long Bridge to a Promising Destination*, 32 UTAH ENVTL. L. REV. 245, 245 (2012).

limit.<sup>160</sup> Also, the IMO, working in tandem with the Cruise Line's International Association, set a mandatory 30% reduction in carbon emissions by 2025 for new ships.<sup>161</sup> One way the cruise ship industry is attempting to meet these goals is switching from heavy fuel oil (HFO) to LNG powered ships.<sup>162</sup> In doing so, the cruise ship industry is working to comply with international standards while improving their environmental stewardship and commitment to public health.<sup>163</sup> The cruise ship industry, along with the shipping industry at large, should look to LNG as a powerful driver of regulatory, health, and environmental revolution.

#### A. Evaluating the Environmental and Economic Impacts of LNG

In 2000, the EPA estimated that "large marine diesel engines accounted for about 1.6% of mobile source nitrogen oxide emissions and 2.8% of mobile source particulate emissions in the United States . . . ."<sup>164</sup> These percentages drastically change in certain areas of the country, such as Baton Rouge and Santa Barbara, where cruise ships are more prevalent.<sup>165</sup> One way to reduce these numbers and meet the mandatory goals is to change fuel sources to LNG. Several cruise lines, including Royal Caribbean and Carnival, have a total of eight ships powered by LNG on order.<sup>166</sup> These ships, scheduled to be ready for 2019, will demonstrate the potential environmental and health benefits of LNG fuel sources.<sup>167</sup> Notably, the cost to build Royal Caribbean's Allure of the Seas and Oasis of the Seas cruise ships ranges from roughly \$150 million to just over \$1.4 billion.<sup>168</sup> Hopefully, as the benefits of LNG-powered cruise ships become apparent, more cruise liners will place more orders. This shift is important because of the potential environmental and economic benefits that come from utilizing LNG as a fuel source compared to HFO.<sup>169</sup>

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160. IMO Sets 2020 Date for Ships to Comply with Low Sulphur Fuel Oil Requirement, IMO (Oct. 28, 2016), <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/MEPC-70-2020sulphur.aspx?platform=hootsuite>.

161. SUSTAINABILITY REPORT, *supra* note 42, at 3.

162. Joe Baker, *How are Cruise Operators Preparing for the IMO Sulphur Cap?*, SHIP TECHNOLOGY (May 21, 2018), <https://www.ship-technology.com/features/cruise-operators-preparing-imo-sulphur-cap/>.

163. SUSTAINABILITY REPORT, *supra* note 42, at 3.

164. Copeland, *supra* note 6, at 6.

165. *Id.*

166. SUSTAINABILITY REPORT, *supra* note 42, at 15.

167. *Id.*

168. *How Much Does a Cruise Ship Cost to Build*, OZCRUSING, <https://www.ozcruising.com.au/blog/how-much-does-a-cruise-ship-cost-to-build> (Mar. 3, 2015).

169. See Baker, *supra* note 162 (stating that using LNG is expected to reduce sulphur emissions by 99% and carbon dioxide emissions by up to 85% when compared to conventional HFOs).

According to the U.S. Energy Information Administration, “burning natural gas for energy results in fewer emissions of nearly all types of air pollutants and carbon dioxide (CO<sub>2</sub>) than burning coal or petroleum products to produce an equal amount of energy.”<sup>170</sup> In the United States, building natural gas plants instead of coal-fired plants would reduce new greenhouse gas emissions by half.<sup>171</sup> Some estimates state that LNG can greatly reduce air emissions from sources, specifically “nitrogen oxides by up to 80 percent and particulate matter by approximately 80 percent.”<sup>172</sup> Ship engines running on LNG are clean-burning, meaning that levels of SO<sub>x</sub>, particulate, and NO<sub>x</sub> emissions are low.<sup>173</sup> LNG offers a cleaner source of energy than what cruise liners currently use to power cruise ships, thus making it a desirable move by the industry.

One of the best attributes LNG brings to the cruise ship industry is a dramatic reduction of sulfur content.<sup>174</sup> Reducing sulfur emissions will significantly help the shipping industry meet the 2020 IMO goals.<sup>175</sup> Aside from meeting the required emissions limits, reducing sulfur will drastically decrease cruise ships’ negative effects on human and environmental health. Sulfur emissions are harmful to human health because the airborne particles intrude on the human pulmonary system, leading to “respiratory illness, irritation of the eyes, nose, and throat, and premature mortality.”<sup>176</sup> These impacts are most prevalent near ports where concentrations of SO<sub>2</sub> and SO<sub>x</sub> are highest.<sup>177</sup> Cruise ships reducing sulfur emissions at ports or on the sea would reduce the negative health impacts associated with such emissions.<sup>178</sup> Transitioning to LNG-powered cruise ships would greatly improve the overall public health.

A transition to LNG engines demonstrates the industry’s commitment to the environment. Reducing greenhouse gas emissions, including sulfur oxides, can reduce the amount of emissions contributing to climate change.<sup>179</sup>

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170. U.S. ENERGY INFO. ADMIN., *supra* note 5.

171. WOLD ET AL., *supra* note 54, at 820.

172. SUSTAINABILITY REPORT, *supra* note 42, at 15.

173. MAR. HIGHWAYS COMM, *supra* note 4.

174. SUSTAINABILITY REPORT, *supra* note 42, at 15; FREDERICK ADAMCHAK & AMOKEYE ADEDE, POTEN & PARTNERS, LNG AS MARINE FUEL 10 (Apr. 17, 2013) <https://www.gti.energy/wp-content/uploads/2018/12/Transport-11-Fred-Adamchak-LNG17-Presentation.pdf>.

175. See *IMO Sets 2020 Date for Ships to Comply with Low Sulphur Fuel Oil Requirement*, *supra* note 160 (noting IMO’s goal of global sulfur limit of 0.50% m/m by 2020).

176. Hull, *supra* note 3, at 1038.

177. *Id.*

178. *IMO Sets 2020 Date for Ships to Comply with Low Sulphur Fuel Oil Requirement*, *supra* note 160.

179. See *Environmental Impacts of Natural Gas*, UNION OF CONCERNED SCIENTISTS, <http://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas#.WgIJFbaZN-U> (last visited Feb. 14, 2019) (noting that releasing less sulfur dioxide meant the release of less heat-trapping gases).

When these gases accumulate in the atmosphere, they absorb radiation reflected from the earth causing global temperatures to rise.<sup>180</sup> Sulfur oxides are volatile compounds that can react with other molecules forming strong acids.<sup>181</sup> Acids devastate ecological landscapes by changing water chemistry, increasing disease rates in plants and animals, and even eroding infrastructures of communities in the area.<sup>182</sup> Therefore, industry-wide shifts to LNG will reduce the negative impacts of fossil fuel emissions on the ecological environment.

Acting as a “bridge fuel,” natural gas could displace coal and oil, thereby reducing greenhouse gas emissions.<sup>183</sup> While reducing greenhouse gasses through the transition to natural gas, the world should also invest and research renewable alternatives. Natural gas is not the last step in our energy transition. However, natural gas has the potential to reduce our environmental footprint while we work towards a carbon-free energy system. Every industry, including the cruise ship industry, should look to implement this “bridge” to move towards a more sustainable system of energy while the energy sector innovates. New technologies, such as LNG engines and scrubbers, are drastically decreasing the negative environmental and health effects of cruise ships.<sup>184</sup> These technologies will allow the industry to meet the current mandatory IMO standards and give engineers time to explore new technologies to reduce the industry’s carbon footprint.

Every solution will have its drawbacks as we look towards improving technologies and bettering our world; LNG is no exception. Widely noted for its environmental benefits over coal, LNG can have a significant negative impact on the environment if not properly utilized.<sup>185</sup> Natural gas is mostly methane, a greenhouse gas with strong global warming potential.<sup>186</sup> Methane has the global warming potential of 25 to 34 times more than carbon dioxide over a 100-year period.<sup>187</sup> One problem with natural gas and methane is the leakage from wells, storage, pipelines, and plants.<sup>188</sup> “These leaks were the cause of about 32% of total U.S. methane emissions and about 4% of total U.S. greenhouse gas emissions in 2015.”<sup>189</sup> Reducing leaks is crucial when

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180. Hull, *supra* note 3, at 1041.

181. *Id.* at 1038.

182. *Id.*

183. Pierce, Jr., *supra* note 159, at 245, 249.

184. NED MOLLOY, S&P GLOBAL PLATTS, THE IMO’S 2020 GLOBAL SULFUR CAP (Oct. 2016) <https://www.platts.com/IM.Platts.Content/InsightAnalysis/IndustrySolutionPapers/SR-IMO-2020-Global-sulfur-cap-102016.pdf>; *see also Environmental Impacts of Natural Gas*, *supra* note 179 (noting burning natural gas releases very little sulfur).

185. U.S. ENERGY INFO. ADMIN., *supra* note 5.

186. *Id.*

187. WOLD ET AL., *supra* note 54, at 823; *Environmental Impacts of Natural Gas*, *supra* note 179.

188. U.S. ENERGY INFO. ADMIN., *supra* note 5.

189. *Id.*

looking to LNG as a viable fuel source for cruise ships. Technologies exist to limit these leaks from engines, but they are not infallible.<sup>190</sup>

Infrastructure complications are another hurdle that the cruise ship industry must overcome to properly utilize LNG. The cruise ship industry is confident that LNG will be available for use in their new ships, but is uncertain where this fuel will be located due to the specialized nature of LNG refueling stations.<sup>191</sup> Currently, experts believe that the U.S. natural gas reserve will meet U.S. needs for the next century.<sup>192</sup> However, natural gas pipelines are not as widespread as other resources, making it difficult to fuel ships at the necessary ports.<sup>193</sup> This creates a complicated problem for the cruise ship industry as well as the LNG developers who want secure, profitable investments. Fuel infrastructure industries will not build the port infrastructure without confidence that the shipping industry will use it.<sup>194</sup> Meanwhile, the shipping industry won't build LNG-powered ships unless they are sure the infrastructure will be there.<sup>195</sup> Cruise ship CEOs, specifically Royal Caribbean Cruises, Ltd. chairman and chief executive officer, Richard Fain, have voiced commitments to LNG ships that makes it easier for suppliers to commit to infrastructure development.<sup>196</sup> A commitment by the industry could open up the LNG market, thereby moving the energy industry away from coal and aiding the environment.

Another argument that refutes the use of LNG as a “bridge fuel” is one of complacency.<sup>197</sup> Building the infrastructure to ports for LNG is expensive and time-consuming. Development and investment in LNG are a long-term commitment. Some argue that we will continue to use natural gas as a substitute for coal instead of using it as a short-term transitional energy.<sup>198</sup> Investing in LNG may restrain the cruise ship industry from doing more research or looking to new energy sources without new regulations persuading them to do so.

In tandem with environmental impacts, LNG is helping the United States economy become less dependent on foreign fuel sources.<sup>199</sup> LNG prices have dropped since 2014, creating a bigger market for the increasingly

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190. MAR. HIGHWAYS COMM, *supra* note 4.

191. Anna Shiryayevskay & Rakteem Katakey, *Oil Tankers to Cruise Ships Fueled by LNG Offer Hope on Glut*, BLOOMBERG L.P. (April 26, 2017, 11:23 AM), <https://www.bloomberg.com/news/articles/2017-04-25/oil-tankers-to-cruise-ships-fueled-by-lng-offer-hope-on-gas-glut>.

192. Pierce, Jr., *supra* note 159, at 246.

193. ADAMCHAK & ADEDE, *supra* note 174, at 6.

194. *Id.* at 9.

195. *Id.*

196. *Liquid Natural Gas is Clean, Cold, and New to Cruising*, ROYAL CARIBBEAN CRUISES LTD. (Oct 10, 2016), <https://www.rclcorporate.com/liquid-natural-gas-is-clean-cold-and-new-to-cruising>.

197. WOLD ET AL., *supra* note 54, at 820.

198. *Id.*

199. Pierce, Jr., *supra* note 159, at 249–50.

environmentally friendly fuel.<sup>200</sup> While prices are becoming more competitive with coal and oil, the U.S. has increased its natural gas reserves at a rate of almost 48% per year since 2006.<sup>201</sup> Demand for LNG is expected “to rise to 364 million tons in 2025, from 260 million tons.”<sup>202</sup> Cruise ships will not have a major impact on the market but can assist in furthering the demand and usefulness of LNG. If these trends continue and the demand for natural gas increases, the fossil fuel industry will start to see a decrease in productivity and demand.

### *B. Why Cruise Ship Companies Should Adopt LNG-Powered Ships*

Several prominent cruise lines have begun placing orders for LNG-powered ships, with plans to set sail in 2019.<sup>203</sup> Adopting LNG-powered ships into cruise line fleets offers the industry an advanced way to push the environmental envelope by not only meeting regulations, but by exceeding them.<sup>204</sup> The 2020 International Maritime Organization standards that set a 0.50% m/m cap on sulfur emissions should prompt the industry to look at innovative ways to meet the standards.<sup>205</sup> While current cruise ships meet, or should be meeting, the current international standards, these standards are subject to change. These standards could create a legal obligation for cruise liners to adapt their fleets to cleaner models, such as LNG-powered engines. LNG will assist cruise companies to meet further obligations if the IMO and CLIA succeed in setting a mandatory carbon emission reduction for new ships.<sup>206</sup>

If the cruise ship company decides the environmental impacts are not a concern, the economic consequences of not shifting to LNG could be damaging. Non-compliance with SOx regulations, in countries with ECAs, could cost companies \$25,000 per day in the United States or up to €6,000,000 in Belgium.<sup>207</sup> Companies need to consider customer perception, on top of economic penalties for failure to meet regulations.

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200. Shiryayevskay & Katakey, *supra* note 191.

201. Pierce, Jr., *supra* note 159, at 246.

202. Shiryayevskay & Katakey, *supra* note 191.

203. SUSTAINABILITY REPORT, *supra* note 42, at 15 (noting that just three companies have announced that they will build up to eight total ships powered by LNG).

204. *Maritime Regulation*, CLIA, <https://cruising.org/maritime-regulation> (last visited Feb. 14, 2019) (“[CLIA] leads efforts to develop and update industry-level policies which go above and beyond international regulatory requirements to ensure . . . environmental stewardship.”).

205. See *IMO Sets 2020 Date for Ships to Comply with Low Sulphur Fuel Oil Requirement*, *supra* note 160 (noting ships will have to use fuel with a low sulfur content).

206. SUSTAINABILITY REPORT, *supra* note 42, at 3.

207. MOLLOY, *supra* note 184, at 9.

In an industry where customers have choices, companies must consider their reputation when making decisions.<sup>208</sup> People can voice their opinions and express dissatisfaction with a company, leading to potential loss of profits or business. Environmental stewardship and threat of sanctions may not be enough for stubborn companies to change their business practices. However, people voicing their disapproval towards a certain practice by buying their cruise tickets elsewhere gets attention. Once cruise lines begin the shift to LNG-powered engines, customers can actively decide between companies that utilize LNG and companies that do not. Companies not adapting will be left behind as the push for more environmental business practices come to the forefront.<sup>209</sup>

Regulatory frameworks are constantly evolving to match industry standards and ever-changing technologies. CLIA works with the IMO to develop, implement, and apply standards that support the cruise ship industry.<sup>210</sup> However, current industry regulations leave much to be desired due to gaps in coverage between the different regulatory frameworks, specifically in oversight and enforcement.<sup>211</sup> To kick-start a clean energy transition in the cruise industry, stricter regulations should and will be implemented, by IMO and UNCLOS, in the future with a focus on enforcement and oversight. These regulations will work similarly to the increasing Corporate Average Fuel Economy (“CAFE”) standards promulgated by the EPA. These regulations reduce greenhouse gas emissions and improve fuel economy for light-duty vehicles, effectively pressuring the car manufacturing industry to implement new technologies and find ways to come into compliance.<sup>212</sup> Similar standards for the cruise industry could promote LNG and the development of even cleaner fuel sources, such as wind and solar.

Regulations and standards should not be the only reasons that cruise ship companies look to LNG. The eight LNG-powered ships already on order represent the cruise ship company’s commitment to improving the environment through using innovative solutions.<sup>213</sup> Those companies who do not follow suit and fail to take progressive steps will be left in the wake trying to catch up to the competition. Companies are developing innovative

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208. Robert G. Eccles, et al., *Reputation and Its Risks*, HARV. BUS. REV. (Feb. 2007), <https://hbr.org/2007/02/reputation-and-its-risks>.

209. *Id.*

210. SUSTAINABILITY REPORT, *supra* note 42, at 3.

211. See Copeland, *supra* note 6, at 23–26 (discussing inadequacy of enforcement measures, inability to properly verify records, and lack of U.S. Coast Guard resources).

212. *Final Rule for Model Year 2017 and Later Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards*, U.S. ENVTL. PROT. AGENCY, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-model-year-2017-and-later-light-duty-vehicle> (last visited Feb. 14, 2019).

213. SUSTAINABILITY REPORT, *supra* note 42, at 15.

technologies daily and more plans are ever-present. Some ships have implemented small scale solar panels to power lights, while others are looking to utilize the power of the wind to move cruise ships around the globe.<sup>214</sup> Massive cruise ships powered by wind and solar are years away, but we currently have a reliable fuel source in LNG that can slash emissions, help meet future regulations, and reduce the negative impact of the cruise industry.

#### CONCLUSION

Thirty years have gone by and you find yourself back on that same tropical beach where you first became curious about the environmental effects of the cruise ship industry. You look to the horizon and see a similar scene with the cruise ship coming into port. Except this ship is vastly different than the first one you saw. Giant sails ripple in the wind, solar panels glisten on the sides of the ship, and there are no longer giant smokestacks spewing emissions due to the LNG-powered engine. The cruise ship industry could reach this drastic change through a variety of reasons including a commitment to the environment, a strengthened regulatory framework, and the advancement of liquefied natural gas-powered cruise ships.

Global emissions from the cruise ship industry are a problem for our health and our environment. There needs to be a push towards a more sustainable and clean future that will allow the advancement of technologies and environmental stewardship to advance in an industry with a harmful past. Liquefied natural gas offers hope that the industry can learn from its mistakes and guide not only the cruise ship industry, but the entire shipping industry, in the right direction. While LNG may not be the final solution, it is a substantial step that will allow cruise ships to sail into a new energy future.

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214. Sarah Fecht, *Is This The Cruise Ship of The Future?*, POPULAR SCIENCE (Dec. 29, 2014), <https://www.popsci.com/cruise-ship-future#page-3> (highlighting Celebrity's *Solstice* using 216 solar panels to generate as much as 52 kilowatts of power and STX Europe's concept cruise that runs mainly on wind and solar).