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**Legal Issues with Novel Uses and Emerging
Technologies in the Maritime Sector**

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Introduction

It is generally accepted that the next decade will present more innovation in the maritime industry than the last century, including through decarbonization efforts, digitalization and advanced autonomy, and novel uses of the marine environment. Innovation is developing in several aspects of the marine sector, including with design and engineering as a means to reduce production time, but also as a means to mitigate risks and capitalize on vessel data to reduce operational costs and manage the complexity of a ship's lifecycle from design to operations. However, in many cases, emerging technologies and concepts have outpaced regulations and may not fit squarely in current legal frameworks, and are requiring innovative solutions, in particular as shipping moves to decarbonize and technology further permeates the industry.

Maritime stakeholders can thus expect to face challenges in fitting innovative and novel solutions in existing legal frameworks, and should expect complex and challenging regulatory proposals to continue to emerge. For the historically conservative U.S. maritime industry, this could be particularly problematic and could lead stakeholders to review how costs and risks of complying with current regulations or new measures should be approached. The first step, though, is understanding what are the rapidly-developing areas of innovation impacting the industry, some of which are addressed in this paper.

To this end, this paper first discusses the regulatory landscape related to innovative and emerging alternative and zero-emission fuels being developed to meet IMO targets of 50% CO₂ reduction by 2050, and identifies the legal challenges with implementing alternative fuels for maritime and ports applications, and address current approaches to achieving compliance through alternative designs, safety equivalences, and risk-based approaches. This paper next explores the ongoing development of other novel uses in the maritime sector, including wave energy generation and autonomy, and the regulatory frameworks in which they fall.

I. Alternative Fuels

While the impact of COVID-19 on seafarers and port congestion have grabbed headlines over the past year, no single issue has dominated the maritime industry press more than decarbonization as climate change represents the greatest challenge this century. Maritime transportation industry stakeholders sit at a tipping point as governments, the general public, consumers, and financial institutions are demanding more action and exerting increasing pressure to reduce their greenhouse gas (GHG) footprint. In fact, transportation is considered one of the largest contributors to air emissions as the shipping industry accounts for around 2.9 percent of global carbon dioxide (CO₂) emissions.

In response, some shipping companies and shipowners are aiming for carbon-neutral fleets well before 2050 with a focus on alternate fuels such as LNG, hydrogen, fuel cells, methanol, and ammonia. Ports are also seeking means by which to reduce emissions and health risks while remaining competitive and financially sustainable. However, there is no one-size-fits-all solution. Stakeholders pursuing opportunities related to alternative propulsion and energy sources in shipping must navigate the still-developing international and domestic regulatory framework for application and infrastructure of these alternative fuels.

In fact, decarbonization is rapidly moving from goals aspirational to real impact on the corporate bottom line as consumer pressure is now being exerted on some of the U.S. largest maritime importers, including Amazon, Target, IKEA, and Walmart, as environmental advocacy groups are calling on them to transition to 100% zero-emissions cargo shipping vessels by 2030. At least part of the U.S.-based decarbonization movement challenging shipping practices has been bolstered by a recently released NGO report titled *Shady Ships: Retail Giants Pollute Communities and Climate with Fossil-Fueled Ocean Shipping* that purports to expose "the untold

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