MASTER THESIS

Designing Maritime CSR for Sustainability:

Considerations on Energy

Michiel Kamphuis

FACULTY
Behavioural, Management and Social Sciences

DOUBLE DEGREE PROGRAMME
MSc Business Administration
MSc Philosophy of Science, Technology and Society

EXAMINATION COMMITTEE
Prof. dr. P.A.E. Brey
Dr. M.L. Franco Garcia

DATE
6 January 2021

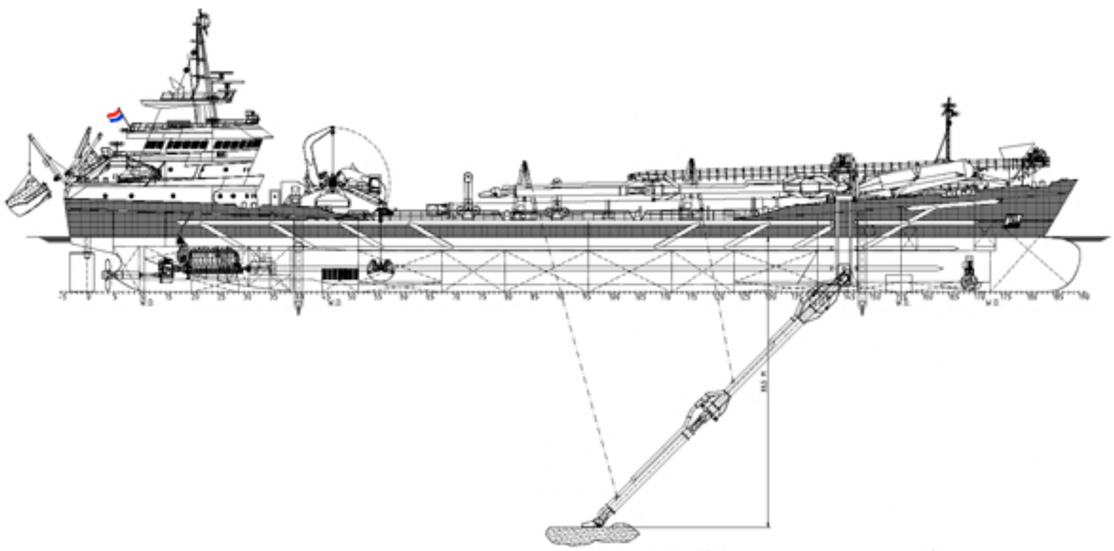
UNIVERSITY OF TWENTE.

DESIGNING MARITIME CSR FOR SUSTAINABILITY: CONSIDERATIONS ON ENERGY

BY

MICHIEL KAMPHUIS

Word count: 35884[1]



"Plants absorb energy from the sun. This energy flows through a circuit called the biota, which may be represented by a pyramid consisting of layers. […] Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals. [...] The circuit is not closed; some energy is dissipated in decay, some is added by absorption from the air, some is stored in soils, peats, and long-lived forests; but it is a sustained circuit, like a slowly augmented revolving fund of life. [...] [The] interdependence between the complex structure of the land and its smooth functioning as an energy unit is one of its basic attributes. When a change occurs in one part of the circuit, many other parts must adjust themselves to it."

Aldo Leopold - A Sand County Almanac (1949)

[1] Glossary and *Chapters 1* to *8*, excluding figures, tables and footnotes.

ACKNOWLEDGEMENTS

This thesis is the final result of an odyssey that I have enjoyed for more than two years. Being offered the possibility to combine the two studies of *Business Administration* and *Philosophy of Science, Technology and Society* was a great opportunity. I value the perspectives that were taught in the *Business Administration* programme. I am particularly grateful for the efforts that have been put in the *Philosophy of Science, Technology and Society* programme that distinguishes itself in many ways. The quality of teaching, the content of the separate courses and of the programme altogether have all been fabulous. I dealt with a frequent shortage of hours, but not a second did I wish there was less to think, read or write. It has been a true inspiration.

For the development of this thesis, I am particularly grateful for the conversations with Laura and Philip and their constructive feedback. I believe I could not have wished for a more complementary combination of supervisors that kept (or rather put) me on track, improved my writing and has been supportive at the same time along the process. Thanks go to the participants of the empirical investigation as well. The sorts and conversations have been very insightful.

Of course, the experience of studying is not the same without fellow students. First, many thanks to Laura for offering a listening ear when needed, Florian for the most welcome efforts and Wietse for the philosophising hours - I am looking forward to the sessions around the fire basket. Second, Justin, Ellemijke, Anouk and Carlo, thank you for the practice round. Lastly, I have to express my gratitude for being part of the whole 2018-2020 PSTS group. Our studying sessions together were a great experience, as well as the coffee breaks and cabin weekends. There was always someone ready to help out or have a chat with and I have undeniably missed that part after my migration to Austria to finish the study while the world was (and is) in a grip of a pandemic.

Coming to that, thank you cousin Rutger and Silvia for the laughs, the great food and withstanding my fluctuating moods over the last couple of months. To Brendan, well done what you have achieved over the last four months. Our morning walks have been particularly helpful for me as well, each day - in all weather, rain or shine - I had a head start because of those. Sophie, sadly we've not been physically close very often, but words come short to tell you what it meant to feel your presence practically all the time. You got me through some tough moments.

Then, finally, thanks to my parents and brother for all the support. Even as a returning student, mother's food and washing could not be missed. Stefan, without you it would have been many times harder or not even been possible to pursue. You're a Great Brother.

SUMMARY

Maritime energy use is a nexus of economic, social and environmental issues. Therefore, related questions of sustainability require a holistic approach. Maritime CSR is understood as the main system within a firm that should advance corporations' contributions to sustainable development. A system that can be (re-)designed for the value of energy sustainability, by employing a Value Sensitive Design (VSD) approach with conceptual, empirical and technical investigations.

The dire maritime energy issue amounts to sustainability challenges at the input of the maritime energy chain (i.e., fuels and energy storage technologies), the energy throughput (relating to the firm's and ship's processes), and the output (i.e., the types of energy and the services that are provided by these processes). Maritime energy sustainability refers to the accumulation of the sustainability of each of these stages. If any of these stages of the maritime corporation's energy chain lack in sustainability, the whole chain lacks in sustainability.

As I argue, designing maritime CSR should start from a thorough investigation of energy, so as to develop a complete overview of the maritime energy chain. The conceptual investigation of energy itself first revealed that energy has a continuous function in ecological processes, also when it is not used by humans. Secondly, a holistic approach to energy acknowledges the energy needs of both society and the environment, and the energy challenges for sustainable development. Both the societal and the environmental stakeholders require a minimum access to energy and a mitigation of harms through frugal energy use.

With regard to the actual responsibility of firms to engage in energy sustainability practices, it was concluded that firms should revert to moral conditions of ability, justification and fulfilment in dealing with potential value conflicts. Furthermore, maritime corporations have a minimum responsibility to collaborate in forming agential collectives for solving global issues such as those with maritime energy sustainability.

The empirical investigation through Q-methodology research exposed a comprehensive but incoherent implementation of maritime CSR practices, in line with findings in literature. Moreover, also a value conflict with regard to energy frugality principles was confirmed by the research.

Finally, through a technical investigation the value considerations have been translated into CSR (re-)design requirements and practical examples of the social and technical changes that an integration of energy values should lead to.

TABLE OF CONTENTS

Acknowledgements **2**

Summary **3**

Table of Contents **4**

List of Figures and Tables **7**

List of Abbreviations **7**

Glossary **8**

Chapter 1: Introduction **9**

1.1: Research question and contribution 9

1.2: Background 10

1.3: Technological state of the art 10

1.4: Corporate Social Responsibility 14

1.5: Value Sensitive Design of Institutions 17

1.6: Outline and sub-questions 19

Chapter 2: Maritime CSR and Energy Management **21**

2.1: Defining Corporate Social Responsibility 22

2.2: Regulatory and Market-Based Measures 25

Regulatory measures 25

Market-based measures 28

2.3: Maritime CSR 30

2.4: Maritime Energy Management (MEM) 34

2.5: Chapter conclusion 36

Chapter 3: Research design **39**

3.1: Value Sensitive Design 39

3.2: Conceptual investigation 40

3.3: Empirical investigation 40

Q-methodology 41

Validation 42

Research ethics 42

3.4: Technical investigation 42

Chapter 4: Energy Holism **43**
4.1: An anthropocentric versus ecocentric understanding of energy 44
Definitions of energy 45
Ecocentrism versus anthropocentrism 46
Experiential gap 48
Deep ecology 48
4.2: Energy and Sustainability 50
4.2.1: How does energy use contribute to sustainable development? 51
4.2.2: Does energy use challenge sustainability? 53
4.2.3: Does sustainability limit or direct energy? 56
4.3: Energy frugality and sufficiency 60
Is-ought fallacy 61
If-then fallacy 61
The value of energy frugality 62
4.4: Chapter conclusion 63

Chapter 5: Business Ethics and collective responsibility **65**
5.1: Negative versus positive ethics and stakeholders 66
Negative and positive duties 66
Natural contract 67
5.2: Collective Responsibilities 69
Types of collectives and responsibilities 70
Ability, justification and fulfilment conditions 72
5.3: Collaborative Responsibility 74
5.4: Chapter conclusion 76

Chapter 6: Empirical Research - Q-methodology **78**
6.1: Q-sample 78
6.2: P-set 83
6.3: Findings: Q-sorts 84
Factor analysis and interpretation 84
Interpretation 85
Validation 87
Remarks on anticipated factors 88
6.4: Chapter conclusion 89

Chapter 7: Maritime CSR design requirements **90**
7.1: Input 91
7.2: Throughput 93
Measures and procedures 94
Local autonomy 95
Training and education 96
7.3: Output 97
Output of energy 97
Output of service 99
Section conclusion 101
7.4: Chapter conclusion 102

Chapter 8: Conclusion **103**
8.1: Findings 103
8.2: Contributions 105
8.3: Limitations 106
8.4: Suggestions for further research 106

Bibliography **108**

Appendices **118**
Appendix I: Information sheet - Maritime energy sustainability research 118
Appendix II: Q-sort Data 122
Appendix III: Post-sort interviews 124
Participant E, Dutch firm 1 124
Participant A, Dutch firm 2 126
Participant C, Dutch firm 3 128

LIST OF FIGURES AND TABLES

Figure 1: Research design overview 20

Figure 2: Maritime regulatory system (Stopford 2009, 657) 27

Figure 3: The Q-sort grid. Refer to Appendix I for the actually used Q-grid 79

Table 1: Summarised overview of the current state of the art of maritime energy technologies 12

Table 2: EU's MRV plan elements 29

Table 3: Conceptual CSR framework for a sustainable maritime industry 33

Table 4: Concerns of maritime CSR and MEM 38

Table 5: Compiled set of principles from the deep ecology environmental ethics 49

Table 6: The United Nations' SDGs 50

Table 7: Energy justice principles, adjusted for a corporate context 53

Table 8: Concourse sectors with belonging topics 81

Table 9a: Twelve Q-statements relating to corporate-level decision-making 82

Table 9b: Eleven Q-statements relating to ship-level decision-making 83

Table 10: Overview of values and CSR design requirements for maritime energy sustainability 91

Table 11: Energy holism input values, maritime CSR design requirements and examples 93

Table 12: Energy holism throughput values, maritime CSR design requirements and examples 94

Table 13: Energy holism output values, maritime CSR design requirements and examples 97

LIST OF ABBREVIATIONS

CSR	Corporate Social Responsibility
EEDI	Energy Efficiency Design Index
GHG	greenhouse gas
ILO	International Labour Organization
IMO	International Maritime Organization
MARPOL	International Convention for the Prevention of Pollution from Ships
MBM	market-based measure
MEM	Maritime Energy Management
MRV	Monitoring, Reporting and Verification
SDG	Sustainable Development Goal
SEEMP	Shipping Energy Efficiency Management Plan
UNCLOS	United Nations Convention on the Law of the Sea
VSD	Value Sensitive Design

GLOSSARY

Each of the following definitions will be discussed in the thesis there where it is relevant. However, it is useful to make some remarks upfront on the used termination.

Corporate Social Responsibility (CSR) - Although the term 'social responsibility' implies an instrumental view on environmental sustainability (for the human society), which I argue against, the term CSR can be seen as an overarching concept that serves sustainable development in each of its economic, social and environmental pillars. Throughout this thesis I used the abbreviation CSR to refer to this overarching concept.

Energy chains or systems - I have used these terms interchangeably. They usually refer to the systems that supply energy that humans can use: powerplants, cables and pipelines, fuel transports and the like. Energy systems are defined as such for this thesis, with the note that ships have two distinct roles within them. First, ships distribute energy in the form of fuels, goods or services. Second, they use energy in the form of fuels to propel the ship and to sustain life on board.

Energy consumption, transformation or use - The understanding that energy is rather transformed instead of consumed is a key notion of this thesis. Using energy refers to benefitting from such transformations. Energy consumption is such a thoroughly accepted term that it is hard not to use it at all, as many will have an idea of what is discussed. However, 'consumption' includes a notion of a final stage of something although energy itself is never destroyed or used up.

Holism - The essence of 'holism' is can be seen as recognising that the whole is more than the accumulated sum of its parts. Ethically, in the context of this thesis, this recognition entails that we have responsibilities to the whole of the eco- and the social system rather than to parts of it.

Input, throughput and output - Throughout this thesis, to support the analyses, I distinguish between the maritime corporations' energy input, throughput and output, although the boundaries are somewhat blurred. The 'input' rather refers to the part of the energy chain before actual use by the company; the 'throughput' to the firm's processes; and the 'output' then to all of the (positive and negative) consequences that ship operation leads to.

Maritime industry - Shipping is a complex industry, including governmental organisations, shipping, engineering and managing companies, training centres, ports, wharfs and much more. If not mentioned otherwise, with 'maritime industry' I refer to the shipping companies only.

CHAPTER 1: INTRODUCTION

Shipping is an important aspect of economic, social and human development (Gjølberg et al. 2017, 5), but the maritime industry has to contend with significant sustainability issues. The carbon emissions of the maritime industry amount to 3% of the global greenhouse emissions, comparing to the 6th largest CO_2 emitting country worldwide, ahead of Brazil and Germany (Balcombe et al. 2019, 181). Moreover, the environmental issues appear to be interconnected with problems of economic and societal nature. The difficulty of solving the issues make it likely that maritime energy management (MEM) will be confronted with - increasingly - morally conflicting strategic and operational choices. To improve on energy sustainability, the maritime industry needs to attain social innovation alongside the technological innovations. One candidate for such innovation for shipping firms is maritime Corporate Social Responsibility (CSR). In this thesis I argue that maritime (CSR) should be (re-)designed from a new starting point, namely from considerations of energy itself. In the assumption that values of energy sustainability can be addressed through organisational design, I investigate these by the hand of Value Sensitive Design (VSD) and subsequently make propositions for the design of maritime CSR. A holistic approach to energy is grounded in energy's circular - not ending - movement through the biophysical (and thus societal) system and recognises that energy use both establishes and challenges sustainable development.

1.1: RESEARCH QUESTION AND CONTRIBUTION

The purpose of this thesis is to explore the connections between energy use, sustainability and decision-making in the maritime industry. As such, this thesis is led by the following research question: *How could a holistic approach to energy contribute to maritime energy sustainability?*

By conducting this research, three contributions are made to existing bodies of literature. First, novel insights are provided for literature on maritime CSR as the philosophical considerations on energy reveal a bigger picture regarding the related values and value conflicts. Second, employing the VSD approach to propose design requirements of the CSR system adds to VSD literature on designing systems and institutions by providing a practical application for social innovation. Third and last, exploring "more-than-human justice considerations" of the maritime energy chain respond to a "burgeoning call" from the emerging field of Energy Justice (Jenkins et al. 2020, 8).

1.2: BACKGROUND

In the words of Isabelle Durant, deputy head of the UN trading body UNCTAD, maritime emissions are responsible for the risk of "an environmental disaster", considering that the "[g]lobal seaborne trade is expected to *double* over the next twenty years" ("UN calls for [...]", 2019; emphasis added). More than 80% of goods traded worldwide are transported over the seas (Stopford 2009; UNCTAD 2018). Ships provide livelihoods for a wide range of other businesses and many important infrastructures for global communication and energy supply rely on maritime construction. The maritime industry thus includes many different types of vessels, but all have the same issues regarding energy consumption: ships are energy intensive in operation, operate in isolated and remote places, and only have limited space to store energy.

The energy intensity of ship operation leads to interconnected problems of environmental, economic and societal nature and therefore require a holistic approach for solving them. According to Balcombe et al. (2019), a reduction of 50% of greenhouse gas emissions, an international target, would require the simultaneous application of at least five different - often yet to be developed - efficiency measures or technological improvements. Their study shows that it is most likely to achieve this goal with a combination of efficiency measures and the use of biofuels, which face significant economic, environmental and social barriers. For example, an upscaled production of biofuels may not be ecologically sustainable, endanger food security or protect the interests of the farmers and their communities in the developing world. Similar issues can be identified for the production of batteries or nuclear technologies. In other words, the dire maritime energy issue, the industry's expected growth and the proposed solutions rather illuminate the intertwined connection between the distinct pillars of sustainability instead of meaningfully improving upon each of them.

1.3: TECHNOLOGICAL STATE OF THE ART

Let me first briefly discuss the technological state of the art and present the efforts of the maritime industry to improve the environmental sustainability of ship operation. Practically, toward this goal, the industry has to deal with two most extreme factors that concentrate some general challenges that we face globally regarding energy consumption. First, as already mentioned, shipping is a very energy intensive industry and especially maritime shipping (as opposed to inland shipping) is a completely isolated enterprise with regard to access to resources; often there are no opportunities to refuel for days or weeks in succession. Second, ships are relatively small compared to the energy intensity and therefore need energy sources with a high energy density.

The necessary strategic energy decisions illuminate the connection of the technology of shipping with society, being part of a larger socio-technical system rather than a technology on its own. From a technological standpoint it logically follows that maritime corporations only have a few options to reduce energy consumption and its environmental consequences. They could address the first factor and decrease the energy intensity of its operation or address the second factor by either deploying alternative fuels (with a similar energy density as fossil fuels) or by sacrificing larger parts of the ship for more sustainable fuels. The choices to be made affect the available space for the actual service or purpose of the ship and/or the distances or timespan between refuelling. This would mean that less people or goods could be transported at a time, or ships have to be able to refuel (bunker) more frequently by either remaining close to coastal areas or by being able to bunker in the middle of seas and oceans.

Table 1 presents an overview of the main technological developments in the industry. To unravel the distinct sustainability factors of the energy use of ship operation, I applied a process analysis that distinguishes between the inputs, throughput and outputs. I describe these as follows: (a) input(s) in the form of information, food, energy, or the like - 'what is put in a system'; (b) throughput as a mechanism of processing the input; and c) resulting in output(s), again - but altered - in the form of information, food, energy, etc.

For the technological developments this refers to the fuels and other energy resource technologies (input); the necessary technological and human processes on board (throughput); and the output as the sum of positive and negative consequences that ship operation leads to (e.g., its provided service, emitted noise, or carbon emissions and other environmental burden). To support the analyses and retain consistency, I distinguish between the energy input, throughput and output of the maritime corporations' processes throughout this thesis. This helps to illuminate the distinct direct and indirect stakeholders and how they are affected by maritime energy use.

Technological state of the art of maritime energy sustainability		
Input	*Throughput*	*Output*
Fossil fuels - from HFO to LNG$^{\Delta}$ Pros: High energy densities Cons: Environmentally polluting *Biofuels* Pros: Reduction in CO_2 emissions* Cons: Economic cost, social and environmental impact *E-fuels* Pros: Potential reduction in CO_2, NO_x and $SO_x$$^{\nabla}$ emissions* Cons: Uncertain true sustainability, high financial investments needed for technological development, infrastructure *Solar, wind and nuclear energy* Pros: No direct emissions Cons: Insufficient energy supply (solar, wind); Not durable at sea (solar); Significant negative consequences for environment and society (solar, nuclear) *Energy storing technologies* Pros: Significant energy efficiency improvement Cons: Environmental and health issues due to mining; Energy intensive production process; Inferior energy and power density to fuel technologies *Human knowledge and skills*	*Wind technologies* Pros: Significant energy efficiency improvement Cons: Immature technologies; Interdependent on ship type, speed and weather; Safety and reliability concerns *Combustion engines* Pros: Reliability; Power sufficiency Cons: Noise; Sustainability depending on fuels *Fuel cell technologies* Pros: Potentially energy efficient Cons: Energy and power insufficiency; Sustainability depending on fuel *Propulsion improvements* Pros: Reliability; Potentially energy efficient Cons: Possible for new ships mainly; Noise *Hull improvements* Pros: Potentially energy efficient Cons: Depending on many factors such as purpose and shape of ship; Energy intensive implementation of coatings that, possibly, have negative impacts on marine life *Human practices* Pros & Cons: Depending on (e.g.) the local conditions, quality of thermal insulation, and the awareness and skills of crew, other employees and contractors	*Regenerative energy systems* Pros: Connecting the output with the input; Energy efficient Cons: Not all excessively used energy can be re-obtained *Exhaust treatment technologies* Pros: Reduction of emissions* Cons: Increase of energy consumption; Energy intensity from a life cycle perspective; Negative impacts on local ecosystems expected *Service (ship's purpose)* Pros & Cons: Depending on corporate decision-making (see next chapter) Cons: Waste creation *Energy* Heat; motion; emissions; etc.

Table 1: Summarised overview of the current state of the art of maritime energy technologies, and some of their societal and environmental advantages and disadvantages. The overview has been adapted from a range of publications (IRENA 2019, DNV GL 2019, Kirstein et al. 2018, Balcombe et al. 2019, Allwright 2018, Bouman et al. 2017, Kurzweil 2015, Mutarraf et al. 2018, Goods 2015, Ventikos et al. 2018, Badino et al. 2012, Molland 2008, Demirel et al. 2018, Baldauf et al. 2018, Yoon et al. 2018, Ahlgren et al. 2018, Wen & Tien 2018, Latha et al. 2019, Lin et al. 2017). $^{\Delta}$ *HFO = Heavy Fuel Oil, LNG = Liquid Natural Gas;* $^{\nabla}$ *NO_x = nitrogen oxide, SO_x = sulphur oxide; * compared to current situation*

Through this framework, the sustainability of the (maritime) energy chain should be understood as an accumulation of the energy sustainability[2] of the input, the throughput and the output. In her book 'Energy Revolution', Mara Prentiss (2015) accurately sums up the findings of the above technological analysis divided in the distinct stages of maritime energy use: "In general, negative effects associated with energy use [...] are results of the processes [throughput] that are necessary to extract and process the primary energy source [input] and to generate and deliver the energy as well as the waste products [output] generated by using the energy" (Prentiss 2015, 256). Theoretically, we could say that a process would be 100% sustainable at best: a process that does not use any energy and which is merely beneficial to all stakeholders.

Dividing this accumulation into input, throughput and output stages, clarifies the practical impossibility of reaching 100% sustainability. It is difficult to have an input that is completely sustainable and the only way to reach such a throughput may be by not processing any resources. The problem for the maritime industry is that, currently, the energy input is harmful in multiple aspects, the energy throughput is very intense, and the output is not equally beneficial to all respective stakeholders in order to compensate. Therefore, to improve on maritime energy sustainability, the accumulation of the whole energy chain needs to be improved and not merely either the input, throughput or output stage of it.

If we merely take excessive CO_2 emissions into account and close our eyes for other maritime energy externalities, the International Energy Agency (IEA) has estimated a best-case-scenario. A mix of measures will lead to a maximum of 78% carbon emission reduction (Balcombe et al. 2019, 82-83). According to Ölçer and Ballini (2018), "there is no technology that can entirely remove GHGs [greenhouse gases] resulting from the operations of the maritime industry. Medium to large-scale ships will indisputably continue to burn fossil fuels, including 'cleaner' ones (like LNG [Liquid Natural Gas]) in the foreseeable future" (Ölçer & Ballini 2018, 2).

Currently, no technological innovation seems to be able to stand in for all environmental threats and most of them come with significant issues of different environmental, social and economic kinds. Especially when these technologies (e.g., biofuels or E-fuels) will be upscaled. Moreover, it is important to know what is actually referred to in discussions on energy efficiency

[2] In the representation here, a fully sustainable energy chain is understood in the following way: 100% input sustainability + 100% throughput sustainability + 100% output sustainability; with the input being merely beneficial; the throughput not requiring any energy use, and also the output being merely beneficial.

or fuel savings. For example, it is common to say that the use of sails on ships only contributes to energy efficiency to a certain degree on a modern containership, although it may be clear that the traditional sailing ship would use no (fossil) fuel at all. This exposes different types of questions.

According to the Rathenau Institute, energy issues lead to "painful choices and expenses" and each option is a nexus of questions of affordability, reliability, cleanness and spatial feasibility (Ganzevles & Van Est 2013, 7). In a critical report the authors showed that the believe in the technological solubility of energy issues is a myth that is kept alive by proposals of an alternative energy mix or a mix of energy technologies, and by the arrival of new technological promises before previous ones have been proven. Although these authors implicitly refer to such questions as land-based social themes, they are as much - if not more - applicable to maritime energy use.

Although the industry needs to keep improving on energy efficient ship operation, it is necessary to look beyond these technological achievements. The energy issue appears to be much bigger than what happens at sea and in fact needs more specific deliberation ashore. Technological and operational advancements are important but appear to be only one aspect in the whole of the economic, environmental and societal system. Therefore, to conclude this discussion on technologies, it is necessary to approach the issue of maritime energy use more holistically - taking into account all three (economic, social and environmental) pillars of sustainability.

1.4: CORPORATE SOCIAL RESPONSIBILITY

CSR can be understood as an institution (or a system) within a business organisation that should advance a certain degree of sustainability thinking. Due to the (inherently) global nature of the maritime industry, there are points of discussion about where maritime governance[3] ends and CSR begins. Due to public attention to the corporate avoidance of regulation in search for profit, related negative (societal and environmental) consequences, business circles have emphasised the importance of practicing CSR (Sampson 2016, 102-103). According to Lisa Loloma Froholdt (2018), maritime CSR is gaining more ground due to the increasing public awareness on ethical issues and because governments cannot control the present global reach of companies (Froholdt 2018, 5). Fasoulis and Kurt (2019) found that raising companies' understanding of sustainable development is the best means to achieve sustainable maritime development. Therefore, it is

[3] Maritime governance: a method to regulate all sea traffic and sea traffic standards with regard to the (marine) environment and life and work at sea, see *Section 2.2*.

argued that maritime CSR should be implemented in management systems and business operations (Fasoulis & Kurt 2019, 11).

There are multiple (possibly conflicting) values that CSR can be designed for. For its application in the maritime industry, one could - for example - design for the well-being of the crew members, the value of safety on board (e.g., Manuel 2018), gender equality and equity in shipping (e.g., Kitada & Tansey 2018), or design for the value of (energy) sustainability which is the topic of this thesis. A socially responsible organisation would implement each of these values in their CSR system, so as to attend to conflicting circumstances. Think of a situation in which a maritime firm maximises its contribution to sustainable development, but its crew members live miserable lives on board and their work environment appears to be extremely dangerous.

To improve on sustainability, corresponding values ought to be integrated in the decision-making processes of maritime corporations. Maritime corporations are part of a socio-technical energy system for which long-term as well as short-term, value-laden energy decisions are made. For example, the shape of a ship involves decisions on its hydrodynamics and stability, and thus its safety, energy frugality and the types of projects the ship can fulfil. The ship's size may affect the distances that can be covered or decide which harbours can and cannot be accessed.

There is a particular importance of focusing on energy (instead of the ship) when designing for sustainability into the decision-making structures of maritime corporations. A key aspect of an energy system is the energy infrastructure in which ships have two distinct roles. First, ships distribute energy in the form of fuels, goods or services. Second, they use energy in the form of fuels to propel the ship and to sustain life on board. As STS[4] scholar Langdon Winner (1980) has noted, with the building of infrastructures, "choices become strongly fixed in material equipment, economic investment, and social habit" and "the original flexibility vanishes for all practical purposes once the initial commitments are made" (Winner 1980, 128). Many of such choices are similarly being made in the shipbuilding process and thus have an impact for a very long time. However, energy decisions are not only made with the technological (re-)building of a ship. Due to the reiterative processes of (energy intensive) ship operation and optional modifications, energy decisions are made on a frequent, daily basis. CSR, as an internal force of maritime corporations

[4] Abbreviation for Science and Technology Studies (or Science, Technology and Society studies).

towards contributing to sustainable development, is an important institution to be designed so that it actually imports these considerations on energy values.

Two main issues for CSR are (1) whether avoiding harm is sufficient or if efforts are demanded to actively do good, and (2) who the stakeholders are and to what degree. At the heart of these points of discussion lies the question regarding the nature of the firm. According to Grewal (2018), a corporation is inanimate because, in itself, it is "unable to take a decision or undertake any action. It is run by its managers who make decisions on its behalf, based on their own values and needs" (Grewal 2018, 26). I doubt if this is a sound argument. Of course, decisions are made by people, but the reference 'on the firm's behalf' already gives away that these people do not necessarily make decisions on their own behalf. Therefore, it is doubtful that they base them mainly on their own values and needs. If a firm is inanimate, why would decisions be made on the firm's behalf? And if not on the manager's and not on the firm's behalf, on whose behalf are decisions made then? I would argue that decisions are indeed made on the firm's behalf, exactly because corporations are not inanimate.

In terms of energy decisions, the view that firms are animate recognises a clear connection of maritime corporations with the larger social and natural system. Firms represent an own collective culture that changes over time and is not in full control by the firm's directors and managers. Organisational cultures tend to be mostly tacit and autonomous, and rooted in shared practices (Ravasi & Schultz 2006, 437). This is also in line with theories of Corporate Citizenship (CC) in which companies are seen as rightful members of society with particular rights and duties that are interlinked with those of other citizens (Roszkowska-Menkes 2017, 73). It should not be confused, however, with the thought that corporations have the *same* rights as human citizens. A clear example would be the *unconditional* right to life of humans, versus the *conditionally* granted legal privileges of firms. However, an important aspect of citizenship is 'being alive', and this would either mean that corporations cannot be seen as citizens and - therefore - refute CC theories, or it means that corporations are animate indeed. This latter case is the position I hold in this thesis, meaning that companies can be seen as organic parts of the whole of society. As such, firms are connected with the social and natural system by matters of where their used energy comes from, how it is processed and how it contributes to sustainable development of that system.

There are two important notions in this statement for companies' responsibilities and attitudes. First, corporations should be seen as parts of a larger system and not as being isolated and detached from that. Second, to be able to function as something organic there is a certain base level of energy use necessary and there is always some kind of waste creation as well. Here, it should be noted that the modern maritime corporation has a high base level of energy use.

1.5: VALUE SENSITIVE DESIGN OF INSTITUTIONS

To study the design of the maritime CSR system for values of energy sustainability, I employed VSD. According to its founders, VSD is a "theoretically grounded approach [...] that accounts for human values in a principled and comprehensive manner throughout the design process" (Friedman et al. 2013, 56). Value is broadly defined as that "what a person or group of people consider important in life" (ibid., 57). VSD is built on the assumption that moral and societal values can be designed for by explicit efforts to address them in technologies or systems that do not only produce externalities but also positively add value. The approach is shared with literatures that similarly call for designing for values such as 'Design for Values', "characterized by a diversity of approaches, theoretical backgrounds, values for which is designed, and application domains" (Van den Hoven et al. 2015b, 5). Theoretical contributions to this field concern a wide range of applications[5]. For example, for designing for the values *of* 'Inclusiveness', 'Responsibility', or 'Sustainability', or for designing for values *in* 'Engineering', 'Institutions', or 'Water Management'.

Seumas Miller (2015) has used VSD to examine the relationship between the design of institutions[6] and moral or ethical values. Institutions constantly evolve, either consciously or unconsciously, and from the ground up or rather piecemeal by changing parts of a system or organisation. According to Miller, institutions have three dimensions that can be considered for designing values into them: certain functions (or purposes), and various possible types of structures and cultures. The dimension of function should give direction to the dimensions of structure and culture; on their turn, structure and culture facilitate the function of the institution (Miller 2015, 780). Miller further distinguishes between different, possibly overlapping levels of institutions: the macro-level (e.g., an industry as a whole), the meso-level (e.g., a single maritime corporation), and the micro-level (sub-organisational units, e.g., CSR policies). From an institutional design perspective, these levels are cross-cutting. As such, within a firm CSR might affect the

---

[5] See Van den Hoven et al. 2015a for an extensive collection of example studies related to designing for values.
[6] Miller defined the institutions he discussed as "organizations and/or systems of organizations" (Miller 2015, 771).

organisation as a whole or merely a certain part of it (e.g., the technical department). Less likely but imaginable, CSR of one corporation could also affect an entire industry.

As the most central aspect of a maritime CSR system that is (re-)designed for energy sustainability, I focus on energy itself. In designing for values, Friedman et al. (2006) suggest starting with the value, technology or context of use that is the most central aspect for the system that is designed (Friedman et al. 2006, 363). Commonly, the design of maritime CSR starts from the (essential) shipping or fuel technologies - isolated from the socio-technical system - or from a firm's contribution to sustainable development. Instead, I argue that the design should start from a conceptualisation of energy. Taking a holistic approach, and seeing energy as a socio-technical construct, acknowledges the maritime energy system as a coherent and "co-evolving mix of technologies, supply chains, infrastructures, markets, regulations, user practices, and cultural meanings" (Geels et al. 2017, 464). As such, an energy holism improves attending to the interconnected environmental and social issues of maritime energy sustainability.

The VSD approach involves conceptual, empirical and technical investigations (Friedman et al. 2006, 360). For this thesis, the conceptual investigation of the phenomenon of energy sharpens the focus on the direct and indirect stakeholders of maritime energy use and on how they are affected. Before values can be integrated, it is necessary to understand CSR's purpose(s). An agreed purpose of CSR is the corporate contribution to sustainable development (see *Chapter 2*). In this study, maritime CSR is empirically investigated with the cooperation of maritime sustainability managers, revealing potential value conflicts that could occur in a CSR design. Lastly, a technical investigation serves to depict a possible implementation of the value considerations into the design of a maritime CSR system.

Informed by Miller's examination, this work can be seen as a normative thesis, specifying how the (micro-level) institution of maritime CSR ought to be designed differently[7] in order to evolve towards the value of maritime energy sustainability by affecting the (meso-level) maritime corporation and - possibly - affecting the industry as a whole (macro-level).

---

[7] A normative theory of institutions would imply to specify what the function of an institution ought to be, instead of defining what it is, and designing values into an institution depends on the context of this institutional function.

1.6: OUTLINE AND SUB-QUESTIONS

Friedman et al. presented a set of practical suggestions for the employment of the VSD approach and the conceptual, empirical and technical investigations (Friedman et al. 2006, 363-365): 1) start with the most central aspect - a value, technology, or context of use; 2) identify direct and indirect stakeholder; 3) identify benefits and harms for each stakeholder group; 4) map benefits and harms onto corresponding values; 5) conduct a conceptual investigation of key values; 6) identify potential value conflicts; 7) integrate value considerations into one's organisational structure. To answer the research question, this thesis is structured according to these steps (also see *Figure 1*).

A literature review in *Chapter 2* serves to introduce the purpose, structure and culture of maritime CSR. I also identify the stakeholders and key values if shipping technologies or a firm's contribution to sustainable development are taken as a starting point for CSR design.

In *Chapter 3* I present the research design for this project.

The focus in *Chapter 4* is on the sub-question what a holistic approach to energy (an energy holism) entails and how it relates to sustainable development. I present some important and underexposed characteristics of energy by the hand of literature from the field of the Energy Humanities. This is a conceptual investigation that serves to sharpen focus on the direct and indirect stakeholders and how they are affected by energy use.

Chapter 5 is guided by the sub-question of what the actual responsibility of corporations is to engage with sustainable energy use. I present a conceptual investigation to demarcate the key value of responsibility and explore what we actually might expect of a maritime firm in terms of its contribution to sustainable development. I identified potential value conflicts with the help of literature from the field of Business Ethics and the philosophy of collective responsibility.

The empirical investigation is presented in *Chapter 6*, using Q-methodology. Led by the sub-question how maritime CSR and MEM is perceived in practice, I further explored potential value conflicts through the eyes of direct stakeholders: sustainability managers of maritime firms.

Through a technical investigation in *Chapter 7*, I explore the sub-question how an energy holism contributes to the (re-)design of maritime CSR. I integrated the energy sustainability value considerations of the previous chapters by discussing CSR design requirements and examples.

VSD method	VSD steps	Chapters
Introductory		CHAPTER 1: INTRODUCTION CHAPTER 2: MARITIME CSR AND ENERGY MANAGEMENT CHAPTER 3: RESEARCH DESIGN
Conceptual investigation	Direct/indirect stakeholders, benefits, harms, values	CHAPTER 4: ENERGY HOLISM
	Key value (responsibility) and value conflicts	CHAPTER 5: BUSINESS ETHICS AND COLLECTIVE RESPONSIBILITY
Empirical investigation	Value considerations and value conflicts	CHAPTER 6: EMPIRICAL RESEARCH - Q-METHODOLOGY
Technical investigation	Integration of value considerations	CHAPTER 7: MARITIME CSR DESIGN REQUIREMENTS
Conclusion		CHAPTER 8: CONCLUSION

Figure 1: Research design overview

To facilitate an understanding of the design of maritime CSR in relation to energy sustainability, in this chapter I discuss different aspects of the CSR system in maritime organisations, based on existing literature. I examine CSR's definition, its purpose, structure and culture, and the sources of motivation[8] that play a role in the commencement of CSR practices. Furthermore, I sketch the stakeholders and their interests that are commonly identified through maritime CSR.

A maritime CSR system can be designed for particular values and seems to be a prominent candidate to improve on the energy sustainability of the industry[9]. To reiterate from the introductive chapter, the energy issue of the maritime industry appears to be much bigger than what happens at sea. This suggests the need for a holistic approach to improve on each of the (economic, social and environmental) sustainability pillars without, overall, suppressing the interests of any of them. One could distinguish between several external (e.g., governmental and market-based) and internal (e.g., CSR) forces that could drive sustainability. As discussed in the following sections, the maritime industry is an inherently global undertaking, interconnected with global issues without sufficiently empowered regulatory bodies[10]. This explicitly calls for CSR initiatives and it - evidently - requires a framing that goes further than what happens between the bow and stern of a ship. CSR - as an institution - may evolve rather unconsciously in some corporations, but often has organisational components that have been consciously designed.

While CSR can be seen as an internal system of the company, there are also external motivations that could affect the company's view and policy on energy sustainability such as regulatory or market-based measures. In this chapter I also analyse these forces, since CSR cannot be seen disconnected from them. In the end, values that should be incorporated into CSR partially depend on society's opinions. The market as well as regulatory institutions voice these opinions. Moreover, it cannot be denied that more responsible behaviour is likely to affect the economic profitability of a firm. Therefore - in order to protect a level playing field - it is necessary that

[8] Seumas Miller (2015) identified six sources of motivation that can be accommodated for the (re-)design of institutions for values: formal sanctions, economic incentives, desire for status and reputation, desire for control over one's own destiny, moral motivations, and an assemblage of various psychosocial factors (Miller 2015, 769).

[9] According to Miller (2015), the function (or purpose), structure and culture are the three dimensions that can be considered in institutional design for values.

[10] Stopford (2009) refers to six principal participants that are involved in the maritime regulatory process, which I discuss in *Section 2.2*: classification societies, the United Nations, flag states, coastal states, the IMO and the ILO (Stopford 2009, 657-658).

regulations are in place that encourage rather than impede companies' responsible behaviour. Due to the connection between these internal and external forces towards energy sustainability, it may be necessary as well to embed CSR into regulations and the market, and vice versa. As such, CSR is shaping and is being shaped by those external forces.

In the subsequent sections of this chapter, I discuss CSR definitions, the related regulatory and market-based measures in the maritime industry, outline the industry's perception of CSR and its integration in energy management. This serves to outline the common understanding of maritime CSR practices, its identified stakeholders and the potential benefits and harms for them.

2.1: DEFINING CORPORATE SOCIAL RESPONSIBILITY

CSR and overlapping concepts, such as business ethics, corporate citizenship or corporate social performance, all contain themes that relate business to morals, the community and accountability. According to Carroll and Shabana, CSR has a focus on corporate self-regulation with regard to ethical issues, human rights, health and safety, environmental protection, social and environmental reporting, and voluntary initiatives involving support for community projects and philanthropy (Okpara & Idowu 2013, 3-4). This idea is based on Carroll's definition of CSR (also referred to as *Carroll's dimensions*) encompassing corporations moving from the bottom the higher layers "the economic, legal, ethical, and discretionary expectations that society has of organisations at a given point in time" (Carroll 1979, 500).

This and other definitions, up to more recently emerged ones, move along a continuum concerning the nature of the firm and its role in society. Should a corporation indeed be seen as inanimate on which' behalf decisions are being made? In relation to social responsibility this could result in two perspectives. To some, profit maximisation is the only legitimate goal of management while others argue that corporations are administrating societal property that should be managed for the public good (Okpara & Idowu 2013, 4). It could also offer the viewpoint that "CSR must be considered to be an investment of time and resources which must provide tangible benefits" (Grewal 2018, 40). The other option, when a firm is considered animate, is that they are rather (organically) interlocked with society and the environment.

Within Carroll's four dimensions different points of discussion are identified. For example, regarding the *economic* dimension distinct views hold that long-term shareholder wealth should be maximised in the long run. However, opinions differ whether short-term considerations may ignore the maximising principle, so as to prevent its possible long-term negative effects (Okpara & Idowu 2013, 5-6). One could imagine such negative effects to become visible only when business and its consequences develop toward a larger scale. Discussions in the *legal* dimension of CSR rather focus on proposals for a market or a more regulatory approach to the concept. Proponents of the first approach argue that CSR activities that are not supported by the market are not valued and therefore not supported by individuals. Supporters of more regulatory approaches, however, question the market's ability to reward CSR activities sufficiently. (Okpara & Idowu 2013, 6-7). The business ethical movement has established the *ethical* responsibility of firms as a next, legitimate dimension of CSR (Okpara & Idowu 2013, 7). This represents a question on the scope of CSR activities, i.e., the stakeholders that corporations have obligations to and to what degree (Frederiksen & Nielsen 2013, 28). Around Carroll's fourth CSR dimension of *discretionary* responsibility, it is being discussed to what degree firms should actively engage in doing good with programs that promote human welfare or goodwill. It is seen as a more voluntary dimension than the ethical one, although society does seem to expect business to provide in philanthropy (Okpara & Idowu 2013, 7-8).

While Carroll based his typology of CSR with these four dimensions on research done in the prior decades, similarly, Alexander Dahlsrud (2008) managed to formulate a congruent definition of CSR, despite the extremely diverse range of literature on the topic. Through an extensive literature review, Dahlsrud found that publications - since 1980 but mainly after 1998 - on CSR allowed to identify five basic dimensions. These overlap with Carroll's typology; however, Dahlsrud categorised the dimensions slightly different and - moreover - his review elucidated a significant new dimension of discussion: the *environmental aspect* of CSR. Altogether, the five dimensions that Dahlsrud identified are (Dahlsrud 2008, 4):

1. Environmental - "the natural environment"
2. Social - "the business-society relationship"
3. Economic - "socio-economic or financial aspects and business operations"
4. Stakeholder - "the relationship with stakeholders or stakeholder groups"
5. Voluntariness - "the extent to which the above dimensions are prescribed by law"

The moral source of motivation appears to be an important factor for the commencement of CSR practices. Relating to Carroll's definition, more than a quarter of the analysed sources referred to the ethical dimension underlying firms' responsibilities. In 9 of the 37 definitions there is an explicit reference to ethical values or behaviour. On top of that, two of the sources that did not include 'ethic' in their definition were 'Ethical Performance' and 'Ethics in Action'[11]. Instead, this first source refers to "society's values", and the second source - more weakly - talks of "balancing the needs of the stakeholders with [the corporation's] need to make profit". Interestingly, these two sources are also among the few that explicitly refer to a holistic notion of the scope of impacts by phrasing this as "the totality" and "the full scope" of impacts. One more source similarly used words like "all the positive and negative [...] effects"[12], and two others refer to "the overall relationship [...] with all of its stakeholders"[13] and "the effects of any of their actions"[14].

It is noteworthy that the first three of the presented dimensions show a direct link to the concept of sustainable development and its goals as formulated in the United Nations' 2030 Agenda for Sustainable Development (United Nations General Assembly, 2015). According to Fasoulis and Kurt (2019), CSR should be seen as a vehicle to deal with sustainable development requirements and fulfil stakeholders' demands (Fasoulis & Kurt 2019, 15). As such, it could be argued that the key value of CSR is understood as a business' contribution to sustainable development[15] (Dahlsrud 2008, 11). Therefore, CSR interlocks the corporations' obligations and responsibilities with those of other collectives and individuals (Werhane 2008, 286). According to Schmidpeter (2013), through sustainable entrepreneurship, businesses could be able to help providing solutions for present global challenges. A reorientation as "responsible corporate citizens" would be "the actual and fundamental contribution of business to a sustainable development of our society" (Schmidpeter 2013, 171). In this regard, not the lack of one universally accepted definition of CSR but rather the insufficient guidance on managing the related issues is seen as problematic (Roszkowska-Menkes 2017, 75). Crowther and Jatana (2005) also concluded that CSR includes the key values of assuring responsibility and sustainability and has the task of providing accountability and transparency (Aluchna 2017, 12).

Nonetheless, in relation to the stakeholder dimension of CSR literature, the notion of an environmental dimension is of significant importance. Now, the environment is identified as a

---

[11] Dahlsrud 2008, pages 9 and 8 respectively.
[12] In the definition of Marsden (2001), as referred to in Dahlsrud 2008, 9.
[13] In the definition of Khoury et al. (1999), as referred to in Dahlsrud 2008, 7.
[14] In the definition of Frederick et al. (1992), as referred to in Dahlsrud 2008, 11.
[15] In relation to maritime CSR this can be seen, for example, by the acknowledged importance of (maritime) transport, as freight volumes by mode of transport are used as a measure of progress towards achieving target 9.1.2 of the Sustainable Development Goals (United Nations General Assembly 2017, 9).

stakeholder in itself (Desjardins 2018, 376). Human beings, and their corporations, depend on the natural environment to survive and for that reason there appears to be an overwhelming consensus to protect the natural environment. However, there remains a controversy about the best means to achieve this goal (Hartman et al. 2014, 483-484). Moreover, it suggests that the environment, as an output stakeholder, should principally not be harmed since it is also an input for our activities (we depend on it); while also the economic and social dimensions can largely be seen as output stakeholders that - in a sustainable sense - relate to the input as well.

For the remainder of this thesis, the discussion on CSR is based on the typology by Dahlsrud with its five - economic, social, environmental, voluntary and stakeholder - dimensions. Although not specific, this definition involves the recognition of the benefits for economic and social stakeholders, and the harms from which the environmental stakeholders should be withheld. The distinction that is made between the social, environmental and economic dimensions is a recognition of the different impacts that companies have (Dahslrud 2008, 6). As such, Dahlsrud's five interrelated dimensions are held together by ethical considerations. Furthermore, Dahlsrud's voluntary dimension implies that corporations should perform above regulatory requirements, as is included by Carroll's discretionary dimension. According to Dahlsrud, regulations set the minimum performance level deemed acceptable (Dahlsrud 2008, 6). Of course, the degree to which firms bear such responsibilities is point of discussion, which I address in *Chapter 5*.

2.2: REGULATORY AND MARKET-BASED MEASURES

Formal sanctions and economic incentives are two known sources of motivation for designing values in institutions (Miller 2015, 769). To improve CSR practices in a global context, the maritime industry increasingly refers to formal sanctions through enforced rules. The volatility of fuel oil prices and the globally rising energy demand could be economic drivers to engage in designing maritime CSR for energy sustainability. Measures that are of economic nature are called market-based measures (MBMs). In this section, I discuss the kind of measures and the regulatory stakeholders that may influence the design of maritime CSR for energy sustainability.

Regulatory measures

Regulation is one method to motivate the commencement of a CSR system and to control maritime organisations' conduct in order to guard the public interest (e.g., mitigating climate change, clean air and water, or marine life). Although there is no exact definition at present, here I define *maritime governance* as a method to regulate all sea traffic and sea traffic standards with regard to the (marine) environment and life and work at sea. This includes business operations at sea and - in relation to the voluntary dimension of CSR - it informs corporations on the minimum level of responsible behaviour. Maritime governance would certainly include legal, institutional and policy aspects concerning maritime activities such as: "the precautionary approach, ecosystem-based management, integrated management, transparency, science-based decision-making, accountability, compliance, enforcement and sanctions" (Takei 2018, 43).

The legal and institutional framework of global maritime governance is called UNCLOS, the United Nations Convention on the Law of the Sea (Takei 2018, 45; Stopford 2009, 663). All activities in the oceans and seas must be carried out within this convention. UNCLOS serves functions regarding the International Labour Organization (ILO), the International Maritime Organization (IMO) and the delineation of maritime zones. *Figure 2* shows a schematic representation of the structure of this maritime regulatory system. The IMO develops regulations on, inter alia, the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). These conventions also provide for general obligations concerning the protection and preservation of the maritime environment and provision for different sources of maritime pollution.

Other regulatory stakeholders for maritime corporations are the *flag state* of a ship - also regarded as its nationality - and the *coastal state* in which the ship sails. Depending on the type, or classification of a ship, flag states make the laws to govern the technical and commercial activities of ships; whereas port and coastal states enforce the regulations and maintain the 'good conduct' of ships in their own waters (Stopford 2009, xvi). Within the industry, *classification societies* are important non-governmental organisations, which are licensed by flag states and establish and maintain the technical standards for the construction and operation of marine vessels. Classification societies classify ships and validate that they are in accordance with the published standards by carrying out inspections at all stages of the ship's development, from building to operating and maintaining (Classification societies n.d., 5). The largest classification societies are members of an international association (IACS), which is given consultative status by the IMO (Classification societies n.d., 4). It is sometimes suggested that CSR collaborations and initiatives are helpful to facilitate the implementation of international shipping regulations (Takei 2018, 944). Importantly, shipowners need to cooperate with classification societies for the authorisation of technological innovations that may improve maritime energy sustainability. In other words, CSR practices of maritime firms and regulatory stakeholders may mutually influence each other.

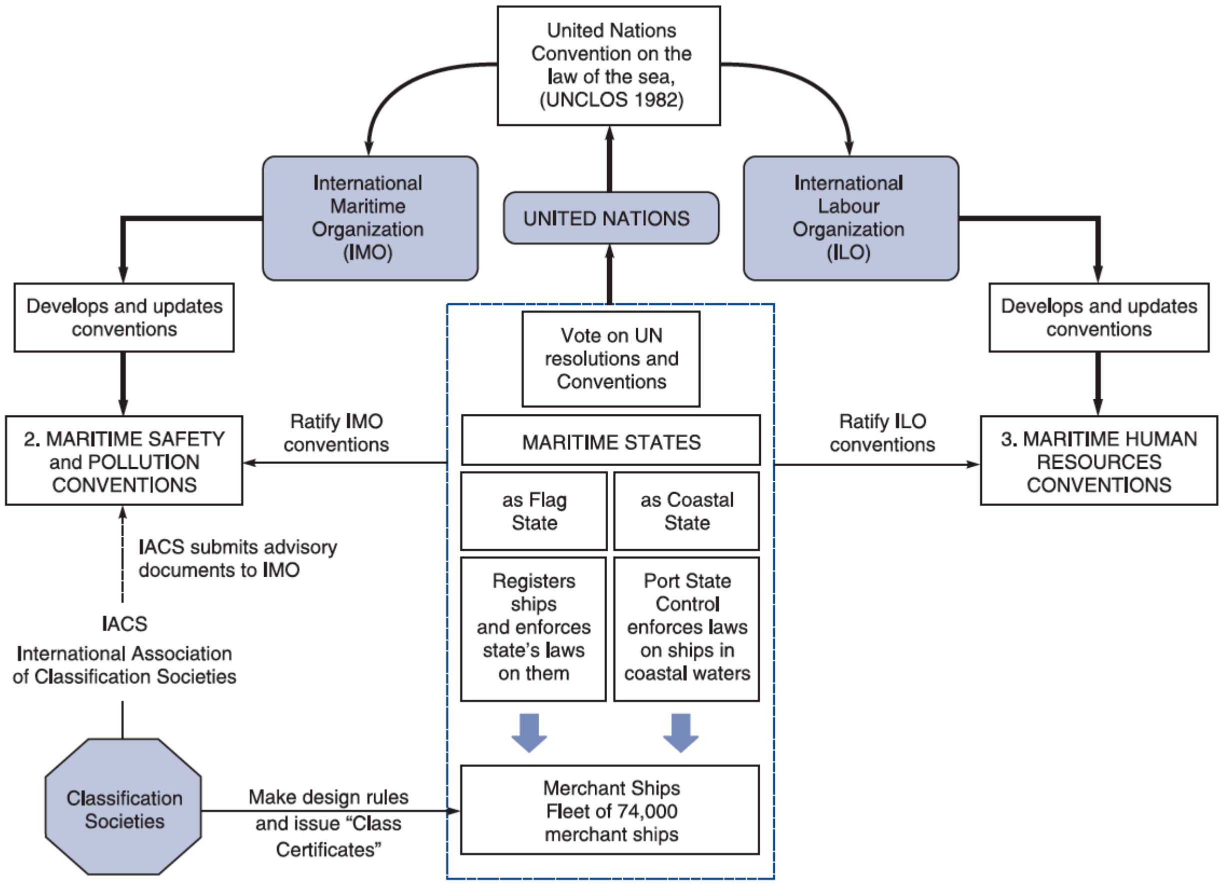


Figure 2: Maritime regulatory system (Stopford 2009, 657)

The UNCLOS rules do not stand alone but are complemented by sectoral rules and standards at a global and regional level. The most important regulatory measures that ensued from MARPOL with regard to energy and environmental protection are the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP). These measures should reduce energy consumption and, as such, be beneficial to both the shipping companies for economic reasons as well as the environment by resulting reduced ship's emissions (Fakhry & Bulut 2018, 17-19).

EEDI is a technical measure, expressed in grams of emitted CO_2 by the transported cargo distance, and applies only to newly designed vessels or ones that went through a major conversion. The index contains two values: 1) the achieved value of a ship, measured and calculated during design and after trials; 2) the maximum value that is allowed for the applicable ship type. Only flag states have the ultimate authority for EEDI verification[16] (ibid., 17-18). As there are no limitations included on how the required formula should be met, there are concerns that many corporations rather aim for compliance to minimum requirements instead of actually promoting energy efficient shipping (Ventikos et al. 2018, 213).

SEEMP is an operational measure for the handling and maintenance of a ship and its equipment. It applies to all existing ships - new and old. However, beyond the verification that a SEEMP is on board, no enforcement is expected regarding its implementation (Fakhry & Bulut 2018, 22-23). The first part of a SEEMP delineates four steps toward ship performance optimisation: planning, implementation, monitoring, and self-evaluation and improvement. The second part provides in a fuel consumption data collection plan, describing both the data collection methodologies and the reporting processes (ibid., 17-18).

Market-based measures

The United Nations Environmental Program (UNEP) defines MBMs as policy approaches that affect market signals. In fact, MBMs are regulatory measures that should compensate for market failures, situations where market activity leads to undesirable outcomes for society and/or the environment. For example, due to the absence of incentives for the market. The underlying assumption is that organisations and individuals are cost driven, and that a modification of the outline of the costs will lead to behavioural change (Rambarath-Parasram et al. 2018, 73). An example would be a 'polluter-pays' measure such as the taxation of carbon emissions.

The focus of MBMs on financial incentives should serve two primary purposes. First, the mentioned financial encouragement to reduce fuel consumption and promote technological innovation and operating enhancement. Second, to offset sectors other than shipping as a means to nominally reduce emissions from international shipping (Canbulat et al. 2018, 259). The idea of offsetting, the purchasing of 'reduction credits' has cost saving potential but has also been sceptically received due to doubts on its environmental effectiveness. On the long-term it is unlikely to be a sustainable solution in itself, as it reduces the incentive to actually improve the carbon intensity of the maritime industry (Morimoto 2018, 37).

[16] Port states may only verify whether the certificate is on board but are not fully permitted to check whether the vessel actually complies to the findings of the certificate (Fakhry & Bulut 2018, 23).

Considerations on MBMs for the maritime industry are currently focused on data collection and reporting. The Marine Environment Protection Committee (MEPC) of the IMO decided on a three-step approach towards environmental sustainability: (1) data collection, (2) data analysis; (3) decision-making on further measures, possibly market-based ones. This has resulted in IMO's regulations on the Data Collection System (DCS). Parallel to this, the EU has adopted regulations on Monitoring, Reporting and Verification (MRV) of CO_2 emissions from maritime transport, which "should serve as a model for the implementation of a global MRV system" (Morimoto 2018, 29). *Table 2* shows the six parts (A to F) a monitoring plan should consist of, according to the EU's MRV framework. Both MRV and DCS came in force recently (2018 and 2019 respectively) and are generally seen as a preamble to future implementations of market-based measures to reducing greenhouse gas emissions (e.g., Ölçer 2018, 3; Rambarath-Parasram et al. 2018, 79).

A	Record of revisions	
B	Basic data	Identification of the ship: Company information; Emission sources/fuel types; Emission factors; and Procedures, systems and responsibilities
C	Activity data	Exemptions; Fuel consumed; List of voyages; Distance travelled; Cargo carried and Number of passengers; Time spent at sea
D	Data gaps	Estimated gaps for fuel consumed; Distance travelled; Cargo carried, and time spent at sea
E	Management processes	Periodic reviews of Monitoring plan; IT management; Data validity; Corrections and corrective activities; Outsourced activities; Documentation
F	Further information	Definitions and abbreviations

Table 2: EU's MRV plan elements (as presented in Hansen & Fradelos 2018, 187)

Another potential advantage of the MRV method is effective compliance due to publicly available vessel data, which provides transparent information to clients and provides shipowners with a powerful tool to monitor and manage all aspects of ships' operations (Nikitakos et al. 2018, 55). The IMO's DCS ineffectively relies on flag states that issue the statements of compliance (Hansen & Fradelos 2018, 189). The EU's data collection regulation applies to all larger ships that call at ports in the European Economic Area (EEA), irrespective of flag state (ibid., 186). Consequently, the EU has appropriated more regulatory power - yet, not global - with regard to the shipping industry.

To conclude this section, several points can be noted about the implementation of maritime CSR motivated by formal sanctions and economic incentives.

First, the industry face global issues but lack sufficient global governance. Despite UNCLOS, the IMO and ILO have no global power of enforcement to ensure that nations and corporations equally adhere to the same regulations worldwide, neither close to shore nor in the middle of deserted oceans.

Second, relying on regulatory motivations to encourage CSR practices is not perceived to be adequate due to an underestimation of the corporations' influence on law, consumers and public opinion.

Third, from an ethical point of view, a firm cannot be regarded 'sustainable' merely by staying within the boundaries of the law. There are always possibilities to pursue profits with negative environmental consequences within these constraints (Hartman et al. 2014, 487-488).

Fourth, with regard to energy sustainability, regulations focus on economic viability and the prevention of environmental harm by technical or operational measures that take the ships as a starting point.

Fifth and last, MBMs are challenged by a variety of market failures such as anti-competitive behaviour (e.g., predatory pricing, monopoly power), information asymmetry (e.g., information inadequacy, experiential gap[17]), and externalities (e.g., when costs of an activity burden others than those involved). Current measures in the maritime industry predominantly focus on its greenhouse effects as such negative externalities, in combination with the persistent experiential gaps.

2.3: MARITIME CSR

Jan Skovgaard (2018) has discussed several reasons for the maritime industry's reluctance to engage with CSR activities, such as being a traditional and conservative industry, and the lacking or insufficient regulatory and market-based sources of motivation. Supposedly affecting the whole industry, many shipping companies still have a family foundation as a controlling shareholder with

[17] Briggle and Mitcham (2009) refer to this as the phenomenon that the experience of an action is distinct from the actual effects on the system at large (Geerts 2012, 96).

- traditionally - very little transparency[18]. Moreover, due to the industry's business-to-business (B2B) operation there is a distance between maritime firms and final customers and, therefore, less economic incentive. B2B industries are less inclined to report on CSR issues than business-to-customer (B2C) industries (Skovgaard 2018, 279-280). Another reason for the maritime industry to lag behind in CSR is the lacking power of regulatory institutions on a global playground.

Yet, these and other sources of motivation have played a role in the recent developments of maritime CSR. According to Froholdt (2018), there are indications that the way CSR in the industry is perceived is changing: "CSR activities in the maritime industry are evolving and transforming market conditions. There are now new demands from companies, regulators, customers, investors and NGOs in regard to energy efficiency, climate change, pollution, waste, hazards, spills and sustainable supply chain management" (Froholdt 2018, 14).

There are examples of countries in which maritime corporations are motivated through formal sanctions and where CSR is drifting from voluntariness towards regulation. India has amended the Companies Act in 2013, which states that certain companies have to spend 2 to 5% of their average net profit on CSR related activities, such as poverty reduction and/or promoting education, health, environmental sustainability, gender equality and vocational skill development (ibid., 8).

In Denmark, as of 2009, regulation was amended that obliged large companies to report on their CSR policies. Although CSR activity remained voluntary, it provided the government the opportunity to facilitate responsibility of companies. In the case of Maersk[19], that subsequently began its CSR reporting (ibid., 9), one could identify another source of motivation: the desire for control over one's own destiny and (possibly) power over others. In their 2010 report on sustainability progress, the company states that they will cooperate with regulators to raise the bar of the industry that would result in greater costs for less-sustainable competitors.

A last change in CSR thinking that Froholdt has noticed is the introduction of the circular economy concept in the industry. Described as a more holistic approach of the economic system, it focuses on eliminating waste by restoring and regenerating products and components instead of throwing away as garbage at the end of their lives. An often-used model for waste management is

[18] As we have seen in *Section 2.1* this is an important attribute of CSR. Recent regulatory developments in the maritime industry aim to account for it (*Section 2.2*).
[19] The Danish - world's largest - container shipping line.

the 'ladder of Lansink', representing an order of priority for the treatment of waste[20]. Maersk and Korean shipyard Daewoo cooperated in developing a 'Cradle-to-Cradle[21] Passport' to address such a recycling scheme. The passport documents approximately 95% of the ship's material in weight in order to enable better recycling of parts and material (Froholdt 2018, 9).

Moral motivations seem to play a role in the recent developments of maritime CSR as well. Fasoulis and Kurt (2019) found out that raising companies' understanding of sustainable development is the best means to achieve maritime sustainability. This increased their inclination toward a (more holistic) integrated management system (IMS) (Fasoulis & Kurt 2019, 11). According to these researchers, the contemporary understanding that CSR and the SDGs are closely connected is seen in the standpoints of various macro-level institutions in the maritime industry. For example, the IMO as well as the European Maritime Safety Agency (EMSA), the European Sustainability Shipping Forum (ESSF), several maritime associations (such as the Norwegian Shipowners' Association) and major classification societies emphasised a need to foster a sustainable shipping industry through the integration - and thus an adequate understanding - of the environmental, social and economic pillars of sustainable development (ibid., 5).

Forming such a management system implies the extensive integration of SDGs, IMO's strategic directions and flag state regulation, industry requirements, own company's processes, key stakeholders' expectations[22], and principles and requirements of individual management systems to facilitate company's goals. Based on their findings, Fasoulis and Kurt have proposed a pathway to structure CSR into business operations in five steps (see also *Table 3*; Fasoulis & Kurt 2019, 15): (1) top management's decisions to place sustainability at the core of business, and integrate the company's economic objectives with stakeholders' expectations, societal anticipations and environmental challenges; (2) integrate CSR in the management system to meet stakeholders' requirements; (3) conclude the process at the operational level with work instructions and procedures that align the CSR requirements, promote efficiency and ensure a safe workplace; (4) address CSR through quantifiable and defined indicators tailored to requirements of sustainable

[20] 1) Prevention, 2) Reuse of products, 3) Recycling of materials, 4) Valorisation by transformation into compost, 5) Incineration with energy recovery, 6) Incineration without energy recovery, 7) Landfilling in a controlled landfill (Block & Vandecasteele 2011, 113-114).
[21] The term cradle-to-cradle comes from the recycling concept in which all materials of a product will be reused in a new product without loss of quality and waste creation (Block & Vandecasteele 2011., 130).
[22] As key stakeholders, Fasoulis and Kurt refer to: employees, suppliers, charterers, labor unions and local communities.

development and measure and report CSR performance accordingly[23]; (5) Audit, evaluate and improve performance.

Step	Implementation	Informed by (e.g.)
1)	CSR Strategy	- IMO strategic directions - Flag Administration requirements - Port State and other regional regulations - Charterers requirements
2)	Build CSR in an IMS	- ISM, ISPS Code and MLC Convention - ISO 14001 - Environmental MS - ISO 9001 - Quality MS - OHSAS 18001 - Occupational Safety MS - ISO 500001 - Energy MS - ISO 31000 - Risk Management - SA 8000, ISO 26000 - Social Accountability - Charterers Requirements (OCIMF, RightShip, CDI) - Regional Requirements-PSC MoUs
3)	Operating Management System	IMS: - integrated manuals - integrated procedures - integrated work instructions
4)	Define SD indicators, and measure and report CSR performance	- Global Reporting Initiative framework - individual characteristics of respective company - UN Global Compact - OECD guidelines - SASB (Chia & Dev 2018, 38) - Clean Shipping Index (CSI; Chia & Dev 2018, 39)
5)	Audit and evaluate CSR performance, and improve IMS	- Internal audits - External audits (mandatory) - Third party voluntary audits

Table 3: Conceptual CSR framework for a sustainable maritime industry (Fasoulis & Kurt 2019, 15-16)

Thus, for improvement toward maritime sustainability, it is argued that considerations on benefits, harms and the corresponding values of the SDGs - that affect the direct stakeholders - should be integrated in maritime CSR practices. Noteworthy, for the design of maritime CSR there also appears to be a focus on institutional structure and less on culture. This is a tendency for

[23] Dedicated CSR measuring and reporting has not been a practice widely followed by shipping companies, although they usually do generate health, safety and environmental reports for internal use. To better integrate these practices with the broader stakeholders' requirements, it is necessary to measure and report on CSR performance (Fasoulis & Kurt 2019, 15).

institutional designers that Seumas Miller (2015) has identified as well, "perhaps because culture is more nebulous and less tangible than structure. However, [...] culture is often critical and, therefore, in need of an institutional designer's attention" (Miller 2015, 781).

2.4: MARITIME ENERGY MANAGEMENT (MEM)

The emerging research field MEM is probably most representative for the maritime industry's designing efforts of CSR for energy sustainability. MEM integrates considerations on stakeholders and the benefits and harms for them into research on organisational structures. In absence of a widely accepted definition of MEM, two researchers of the World Maritime University (WMU) in Malmö, Sweden, have proposed the following definition: "[1] Understanding the transformation of energy sources into different energy forms, and [2] Managing its consumption in an optimised way in order to be able to minimise negative environmental and economic consequences resulting from this consumption" (Ölçer & Ballini 2018, 131).

Although much attention of the sustainability discourse in the maritime industry goes to mitigating emissions, this is a definition beyond those issues and refers more to the core: the transformation / use / consumption of energy. Interestingly, the definition makes explicit reference to the environmental and economic but not the social stakeholders. However, the MEM field does present on its social - alongside the economic - dimensions, next to studies on regulations, energy efficient ship design and operation, alternative fuels (incl. wind propulsion) and on marine renewable energy applications (such as offshore windfarms, and wave and tidal energy) (Ölçer 2018, 10-11). Accordingly, findings of this field of research and the CSR framework as discussed mutually shape each other, so as to continuously improve the integrated management systems.

Olaniyi et al. (2018), for example, have contributed by researching the impact of sulphur emissions regulation in the Baltic Sea region and call for an "Investment Decision Tool" that incorporates economic costs and benefits and market potential of emission abatement technologies. Demirel et al. (2018) developed a new Life Cycle Costs and Environmental Impact Assessment model for antifouling coatings with regard to the lifecycle of a ship. Hansen and Fradelos (2018) described the preparations needed to comply with the EU's MRV regulations laid out in *Section 2.3*. They propose an integrated Vessel Performance Management System that includes Key Performance Indicators (KPIs) of the hull/propeller, main engine and base load as well as fleet benchmarking and environmental performance (Hansen & Fradelos 2018, 194-195).

That maritime energy efficiency is more than such indicators and vessel technology, is shown by an important contribution from Martin Viktorelius (2018). He demonstrated the human and social dimension of energy efficient ship handling. More specifically, he illuminated a dimension which seems often overlooked: the practical, localised, tacit and collective know-how of the crew members on board. This knowledge would have significant implications for energy management in relation to awareness and the development of training programs. It also relates to studies performed by Swe et al. (2018) who argue that MEM is mainly addressed in developed countries but not well-known in developing countries and that, therefore, the IMO should be working on model courses for MEM. Other areas of focus for MEM they mention are legislation, research collaboration, and regional cooperation. Two last interesting studies to refer to, specifically with regard to this thesis, are the studies by Kitada et al. (2018) and Ballini and Ölçer (2018). Kitada et al. focus on the role of gender in relation to maritime transport and a sustainable, energy efficient society (in the case of the Pacific Islands). Fabio Ballini and Aykut Ölçer elaborate on the role of the 'Energy Manager' in ports. According to them the role of an Energy Manager is crucial to the implementation of a 'Port Energy Management Plan' and requires a multidisciplinary background in relation to energy management as well as other members in corporate 'Energy Teams'[24] (Ballini & Ölçer 2018, 304). The appointed (Port) Energy Manager should set up and structure an Energy Team that will support the development, implementation and subsequent evaluation of the energy management plan. The position will be responsible for energy related (1) accounting and economic analysis, (2) maintenance, (3) auditing, (4) measuring and verification, and (5) coordination (ibid., 299). Although the authors explicitly refer to the complex energy management of ports, it is not hard to imagine the contribution of the idea to shipping corporation's energy management.

An energy efficient application of CSR entails an effective use of energy (with least energy losses) for a firm's maximum contribution to sustainable development. To judge the success of a corporation's engagement with efficiency - whether it refers to energy efficiency, efficient contribution to sustainable development or other efficiency questions - we need to attend the input, throughput and the output to form a complete picture. To reiterate, the sustainability of the energy chain is an accumulation of each of these stages. The breadth of discussions on energy efficiency and sustainability show that energy decisions are being made in many - if not all - departments of

[24] The appointed (Port) Energy Manager should set up and structure an Energy Team that will support the development, implementation and subsequent evaluation of the energy management plan (Ballini & Ölçer 2018, 299).

a maritime corporation. Therefore, in engaging with efficiency matters, the relationship with relevant stakeholders is important. Efficiency, however, could draw on many values. For example, for an economist (What are the cheapest flights to transport crew to the ship at the other side of the world?), it means something different than for a crew member (What is the quickest flight connection with the least change-overs?); and for an engineer (What maintenance is needed to keep everything running smoothly?), it is different than for the company (How will maintenance affect the firm's output in terms of cost and time?) or society as a whole (By what regulations can society benefit best from a ship's maintenance at a dockyard?[25]).

Whether in the context of ports or of ships, MEM appears to focus on the specific locations of these contexts. Thus, mainly taking the corresponding direct stakeholders into account. The above topics represent the research field of MEM and with regard to ship-level decision-making, they inform on the input, throughput as well as output. However, from the perspective of corporate level decision-making, the energy management of a ship can be seen as a processing department that predominantly deals with the company's energy throughput. In other words, it deals with what it is supplied with toward goals that are set, and it is supposed to do so in a most efficient way. Nonetheless, some research does involve the input and output mechanisms of companies as well - e.g., the mentioned contributions by Demirel et al. (2018) and Kitada et al. (2018).

2.5: CHAPTER CONCLUSION

In this chapter I have examined the definition of maritime CSR and its institutional design. To facilitate an understanding of maritime CSR in relation to energy sustainability, I have discussed its function, its structure, the sources of motivation that play a role for corporations to commence CSR practices, and the stakeholders and their interests that are commonly identified. The assurance of responsibility and sustainability are identified key values of CSR, which also has a task to provide accountability and transparency. Additionally, I have noted that - for the realisation of CSR's purpose - there appears to be more focus on the institution's structure than on its culture.

---

[25] Cruise line companies have been avoiding shipyards in the Netherlands since 2014, due to Dutch law enforcements on labour regulations. Representatives of the Dutch maritime industry argue that the Dutch interpretation of the law is too strict and inefficient for the Dutch society and leads to a loss of jobs and financial profit due to an unlevelled European playing field (Walker 2018). The Dutch minister of Social Affairs and Employment (Wouter Koolmees) has acknowledged the issues. However, at the same time the minister strives for "honest, healthy and safe working conditions" for each worker in the Netherlands (Tweede Kamer der Staten-Generaal 2018).

CSR is a typical internal institution that should address the issue of maritime energy sustainability - a nexus of economic, societal and environmental concerns. As such, maritime CSR and MEM are systems within maritime organisations that are supposed to deal with the apparent lack of maritime technologies that satisfy the requirements of each of the sustainability pillars. Regardless the source of motivation to commence a CSR system, it can be seen as a system that has the purpose to safeguard a company's contribution to sustainable development. This central and most important moral purpose of maritime CSR should give direction to the design of its structure and culture and assist the identification of stakeholders and values.

To some extent CSR focusses on the corporation's energy input and output in its connection with society and the environment and the energy throughput in terms of voluntariness and a responsible operation. MEM focusses on the input, throughput and output of the ships themselves. From a corporate level perspective this can be seen as a department that largely falls under the throughput mechanism of the firm. As such, MEM deals with processing the input (i.e., fuel) it gets through the company's (CSR) decisions and delivering the outputs that are both desirable (i.e., services) and undesirable (i.e., waste) in a most sustainable way.

Table 4 represents a brief summary of this chapter, showing the elements of maritime CSR and MEM in the analytical context of the input, throughput and output categories. It needs to be taken note of that the efficiency of (e.g.) corporate design will be informed by information of the energy input and output. However, engaging in efficiency improvements in itself is a process and therefore, in this overview, it is placed in the throughput category.

The presented conception of CSR in the maritime industry, and its implementation through MEM, seems to be able to inform maritime firms in a comprehensive manner on their (possible) contribution to sustainable development. However, these comprehensive approaches also leave a gap to energy sustainability due to a lack of coherency with regard to the input, throughput and output of energy and energy services of the maritime corporation. In other words, technological improvements could lead to a mitigation of carbon emissions or an improvement of efficiency, but these will have no environmental effect if the operational efficiency declines and might suppress societal sustainability through unsustainable production chains. Similarly, by contributing to some SDGs a company might improve its score on CSR rating without necessarily adhering to more sustainable forms of energy input or sustainable operations. As such, it is possible that a company's contributions to the SDGs are beneficial to different stakeholders than the ones that carry the burdens of energy (technology) production and use. Thus, we could conclude that designs of CSR that take shipping technologies or the firm's contribution to sustainable development as a starting point do not necessary lead to a sustainable use of energy.

In addition to assuring sustainability, also the assurance of responsibility is identified as a key value. In *Chapter 4* I conceptually investigate the phenomenon of energy itself and its relation to sustainable development. Subsequently, in *Chapter 5*, the maritime firm's responsibility to engage with this value.

	Input	Throughput	Output
Corporate level	- Fuel (e.g. HFO, LNG, emerging alternatives) supply chain - Technology - Human resources **CSR** **MEM**	- Degree of voluntariness and responsibility* - Relationship with stakeholders - Efficient corporate structure and culture - Technological investment - Efficient of corporate operations - Transparency **CSR**	- Economic, social, environmental contributions - Provided service - Positive and negative consequences **CSR**
	Input	***Throughput***	***Output***
Ship level	- Efficient design of ship - Energy (technology) supply chain - Diversity of equipment **MEM**	- Efficient operation of ship - Energy awareness - Measuring **MEM**	- Service - Waste and emissions - Knowledge of crew **MEM**

*Table 4: Concerns of maritime CSR and MEM, in the analytical context of input, throughput and output categories; *topic of Chapter 5*

CHAPTER 3: RESEARCH DESIGN

3.1: VALUE SENSITIVE DESIGN

For the structure of this thesis, I rely on the VSD approach as it has been developed by Batya Friedman and colleagues (2006), who originally applied it in the area of human-computer interaction. Although VSD is more commonly employed to design values into technological products, here I use the method for the design of a larger socio-technical system, namely CSR. This entails changes of social structures alongside technological changes.

Friedman et al. present the approach as a unique constellation of eight features: seeking to be proactive; enlarging the area of interest; iterative and integrative employment of conceptual, empirical and technical investigations[26]; enlarging the scope of human values; distinguishing between usability and human values; including all directly and indirectly affected stakeholders of a system; holding an interactional position[27]; assuming that some values are universal but may have different effects in different contexts (Friedman et al. 2006, 360-361). Conceptual investigations focus on affected stakeholders and the identification of implicated values; empirical investigations focus on the affected individuals, groups or larger social systems; technical investigations focus on the technology (or system) itself (Friedman 2001, 2-4).

Especially the feature of universal values is frequently critiqued: "The belief that there are universal values [...] has on occasion led to the further belief that a particular group, culture, or religion is the keeper of those values, and needs to impose them on others - with sometimes tragic consequences" (Borning & Muller 2012, as quoted in Davis & Nathan 2015, 21). This critique may be especially relevant when designing for maritime energy sustainability. From an environmental perspective, the energy intensive industry may be seen as extremely harmful. However, from social and economic perspectives the maritime industry has also been acknowledged to be extremely beneficial. Each of these perspectives could belong to a universal value of sustainability, but how such value is integrated into a system largely depends on the specific context of the system.

---

[26] In relation to the term 'technical investigation' it is good to emphasise here that the focus of this thesis is not with the design of the *technology* of ships, but rather the *technicality* of the CSR institution. Nonetheless, the shipping technology - as has been presented in the introducing chapter - will of course be a main thread throughout a thesis on maritime energy sustainability.

[27] Meaning that a design might support certain values and hinder other, but in the actual use of a system would depend on the people that interact with it.

3.2: CONCEPTUAL INVESTIGATION

The conceptual investigation for the design of maritime CSR for the value of energy sustainability takes place in *Chapters 4* and *5*. The investigation in *Chapter 4* focusses on considerations on energy and draws on literature from the academic fields of the Energy Humanities. The aim of this investigation is to enlarge the scope of human and non-human values by conceptualising an energy holism, which would take the broader meaning of energy distribution among society and the environment into account.

The investigation in *Chapter 5* focusses on the actual responsibility of corporations to engage with sustainable energy use. For this chapter I draw on literature from Business Ethics, and the philosophy of collective responsibility.

3.3: EMPIRICAL INVESTIGATION

The interactional position of VSD, holding that the actual use of a system (such as CSR) depends on the people that interact with it, requires to be informed by empirical investigation of the human context in which the system is situated (Friedman et al. 2006, 351). For the empirical investigation, I have used Q-methodology that is argued to provide a foundation for systematically studying different subjective perspectives on a topic (Brown 1993, 93), where other methods rather serve to study what is objective in human behaviour. This revealed the human user's value considerations and potential value conflicts that could occur by implementing a different starting point for the redesign of maritime CSR.

Q-methodology is a qualitative research method that is aided by quantitative tools, and it uses a relatively small number of research participants to map distinct (subjective) viewpoints on a selected issue. The methodology is usually applied by the six subsequent steps, which I explain further below: 1) concourse - defining the conceptual framework; 2) Q-sample - structure a sample of statements; 3) P-set - selecting participants; 4) Q-sort - ranking statements; 5) factor analysis; 6) factor interpretation.

In terms of VSD, this empirical investigation is expected to reveal *value dams* and *value flows* in relation with a possible holistic design of maritime CSR. In this case, value dams can be seen as value tensions between a possible holistic design of maritime CSR and direct stakeholders' views. According to VSD theory these tensions, once identified, could be addressed in the design process directly, or marked for attention at a later stage. Value flows are those features that most stakeholders are in favour of incorporating (Davis & Nathan 2015, 18).

Q-methodology

Q-research starts with a conceptual investigation to draw an as broad as possible outline of the topic of interest. This outline is what is called a *concourse*, which is typically voluminous (Brown & Good 2010, 1149-1150). The concourse is deduced from the findings of *Chapters 2, 4* and *5*.

The next step is to derive a set of statements (the Q-sample) that represent the anticipated viewpoints on the subject. I selected a set of 23 statements in total, which the respondents ranked. Along with the subsequent steps, the selection of these statements is discussed in *Chapter 6*.

The third step is forming 'the P-set' by selecting participants: sustainability managers that are employed by several maritime corporations from developed countries and which operate in a global context. Q-methodology seeks an in-depth understanding of respondents' views on the topic. A small sample of individuals that are knowledgeable on the matter provides insightful results. As such, the respondents are seen as representatives of sustainable development thought within their maritime corporations and assumed to be broadly knowledgeable on the drawn concourse.

For step four, the ranking of statements (the Q-sort), the participants first read all of the statements and sorted them on three different piles: 'least agreeing with statement', 'neutral / ambiguous to statement', or 'most agreeing to statement'. Thereafter, the cards were placed on a Q-sort grid (see *Figure 3* in *Chapter 6*), ranging from *least* to *most* with *non-salience* in the middle, with a matching number of spots and statement cards. Such a forced distribution of statements helps participants to reveal their subjective preferences. Considering the subjectivity of performing a Q-sort, there is no right or wrong way. There can be no criterion to validate a point of view.

The Q-sorts are carried out in a web-application called Q-method Software[28], which also allows for step five: a detailed analysis of the research. As a significant feature of the methodology, each statement in the Q-sort achieves its score relevant to all other statements. The analysis reveals a number of factors - two, in this research - that represent 'idealised Q-sorts' as a fictive participant would have arranged statements fully matching this particular perspective. The interest of Q-methodology is in the nature and the similarity or dissimilarity of these factors (Brown 1993, 94).

[28] https://qmethodsoftware.com

The sixth and last step, the factor interpretation, is closely connected to the previous one. The tendency for participants is to feel most strongly about the statements placed at the extremes and less engaged with respect to those placed near to zero (Brown & Good 2010, 1151). Therefore, particular attention is paid to these extremes. The list with distinguishing and consensus statements, as well as the post-sort interviews aid to highlight and explain the differences and similarities between the perspectives (De Graaf & Van Exel 2008, 77).

Validation

As a form of methodological triangulation, the findings of the research are compared to other academic publications on the perception of maritime CSR. In addition, the participants have been asked for feedback with regard to the completeness of the concourse and the derived statements, and for clarification on the statements they have placed at the extremes. It is presumed that only a limited number of distinct perspectives on each topic exist (De Graaf & Van Exel 2008, 70). The aim of Q-methodology is to be replicable in revealing these distinct topics, rather than the statistical reliability of demographic generalisations.

Research ethics

In order to guard the respondents and to prevent any damage to them, an elaborated ethical statement was formed prior to the research. The research was conducted with approval of the University of Twente's ethics committee.

Hereby I declare that no external organisations have commissioned or provided funding for this research.

3.4: TECHNICAL INVESTIGATION

In *Chapter 7* the focus is on the maritime CSR system itself, following the findings of the conceptual and empirical investigations. I integrate the value considerations on maritime energy sustainability into the design of maritime CSR and present the design requirements accordingly.

CHAPTER 4: ENERGY HOLISM

In this chapter I conduct a conceptual investigation of the phenomenon of energy, which generates a sharpened focus on the direct and indirect stakeholders of maritime energy use and their values. Currently, maritime CSR and MEM seemingly lead to incoherent contributions to sustainable development. In other words, the benefits and harms of maritime energy use do not seem to be distributed justly. As a starting point, designs of maritime CSR and MEM commonly either take the company's energy throughput - by a focus on shipping technologies and practices - or the firm's output in the form of its contribution to sustainable development. It is said that the value of energy sustainability depends on the reduction of emitted grams of CO_2 or on efficiency measures that reduce the throughput of energy with equal operations. However, as discussed in this chapter, the connection between energy and sustainability goes beyond such units of physics in many aspects. Just as we cannot explain the value of music by merely referring to decibels, it is impossible to discuss the value of energy by merely referring to joules, watts or grams of emissions.

In order to sufficiently improve on (maritime) energy sustainability, I argue that it is crucial to develop and integrate a more complete understanding of energy itself. Arriving at such an understanding is the subject of this chapter. With 'more complete' I refer to the awareness of energy's circular movement through the biophysical (and thus societal) system and, additionally, the necessity of comprehending what this means and does. First, energy's circular movement through the ecosystem implies that human energy practices result in an altered distribution of benefits and harms for the environment. Second, in a similar way both energy benefits and harms are distributed among society. From a corporate standpoint, systems such as CSR - in close connection with sustainable development - are meant to facilitate more just energy distributions. However, there appears to be a main focus on the distribution of societal benefits and the mitigation of environmental harm. Albeit important, what lacks in this sense is a notice of the distribution of societal harm and environmental benefits.

A comprehensive and coherent view on energy is what I call an *energy holism*: firstly, based on an ecocentric (as opposed to an anthropocentric) understanding; and secondly, recognising that energy both establishes and challenges sustainable development. Etymologically, anthropocentrism refers to holding the human as the central element of existence. Opposingly, ecocentrism puts the ecosystem as a whole most central in thinking. A relatively paradoxical term, as it would actually entail letting go of a 'centred thinking' in the first place and rather adhere to a holistic view on the ecosystem without putting any of its parts central. With regard to the contributions and challenges to sustainable development, it is also important to justly distribute energy services among societies, besides rethinking distribution to the environment.

According to energy anthropologist Sarah Strauss, investigations on energy should "shuttle back and forth among laws of physics, opportunities and constraints of ecological systems, and processes of culture", layers of reality that are intertwined materially, rhetorically, and metaphorically (Strauss et al. 2013, 12). Similarly, energy ethicist Giovanni Frigo (2018) has argued that one should look beyond physics and the engineering sciences and include other areas of human knowledge such as ecology, climate sciences, energy justice and environmental ethics (Frigo 2018, 132-134). Carl Mitcham and Jessica Smith Rolston (2013) draw a distinction between two types of energy ethics. In the first type a linear relationship between energy consumption and well-being is assumed, whereas the second type questions this connection. They argue that the current discussions of energy are too narrow and should be complemented by broader perspectives (Mitcham & Smith Rolston 2013, 313-314).

Correspondingly, this chapter includes multiple perspectives of different fields of research. In relation to VSD - and with energy instead of ships or the corporation as a starting point - this conceptual investigation serves to identify the benefits and harms for each stakeholder group and the related norms. To this purpose, in the next section, I discuss energy's circular movement through the ecosystem and elucidate the ecocentric versus the anthropocentric understanding of energy. Thereafter, I elaborate on the undeniable link between energy use and sustainability in three subsequent steps. I first discuss how energy use contributes to sustainable development. Secondly, I explore in what ways energy challenges sustainability. Thirdly, I question whether the United Nation's concept of sustainable development is equipped to set limits to or direct energy use. Because of its significance and apparent controversiality, I also elaborate on the notion of energy frugality as a solution for a sustainable use of energy.

4.1: AN ANTHROPOCENTRIC VERSUS ECOCENTRIC UNDERSTANDING OF ENERGY

Energy is not consumed but rather transformed and used. Energy is often explained as something real or material; something which can be consumed. However, as I discuss in this section, energy is rather transformed and used instead of being consumed. The key difference here is that a transformation entails that energy takes a different form or quality but holds its quantity, whereas consuming refers to 'to use up' and thus a loss of quantity. In other words, energy cannot be seen as a phenomenon that is reaped by or only comes to the benefit of humans. Rather, humans depend on the natural energy flow as much as we pass an energy flow on to the environment. Through environmental ethics, the distinction between these views relates to what could be called an anthropocentric understanding of energy versus an ecocentric one. Both of these contrasting perspectives I discuss in the following.

Definitions of energy

A common definition of energy - through the laws of thermodynamics - roots in the scientific, anthropocentric understandings of the phenomenon. It would be defined as having 'the capacity of doing work' and it is ascribed characteristics such as being indestructible and not creatable, but only transformable (Coelho 2014, 1361-1362). According to physicist John Beynon, the confusion with energy comes from treating it as something real rather than an abstract physical quantity (Coelho 2009, 2649). As the acknowledged physicist Richard Feynman expressed in his famous lectures in the 1960s:

> "[T]here is a certain quantity, which we call energy, that does not change in the manifold changes which nature undergoes. That is a most abstract idea, because it is a mathematical principle; it says that there is a numerical quantity which does not change when something happens. It is not a description of a mechanism, or anything concrete; it is just a strange fact that we can calculate some number and when we finish watching nature go through her tricks and calculate the number again, it is the same" (Feynman 2011, 33).

Feynman's explanation clarifies that the thermodynamic laws of physics symbolise a mathematical principle to equate different forms of energy rather than an understanding of what it actually is. The first law states that (in a closed system) energy is always conserved. The second principle - the law of entropy - states that all energy runs down to less useful forms. The law of entropy - a measure of the diffusion of energy - explains that concentrated forms of energy are able to do more work than diffused energy. Moreover, the change from concentrated to diffuse is a process that cannot be reversed: each energy conversion comes with an entropy increase. Yet, in this sense, entropy can be understood as forms of energy that are *less useful to humans* from the perspective of work and it thus overlooks the role that energy has throughout the ecosystem as a whole. Entropy is - anthropocentrically - sometimes described as 'waste'. A familiar example in relation to this thesis are human CO_2 emissions. However, although carbon dioxide can be seen as an energy form of human output that has become less useful to humans, it is essential for plants and trees.

The point here is not to discuss the exact components of these forms of energy or how they are (not) reintegrated in the environment. The main takeaway is the realisation that energy remains after human use, albeit in different forms. The desirability of these forms depends on the 'node' within the ecological system. As such, energy has a different meaning and a different value throughout this system. Biologist and system ecologist Howard T. Odum based his understanding of energy on the distinct values that different forms of energy have. More particularly:

> "Since the processes of the biosphere are infinitely varied and are more than just thermodynamic heat engines, the use of heat measures for energy that can recognise only one aspect of energy, its ability to raise the temperature of things, cannot adequately quantify the work potential of energies used in more complex processes" (Brown & Ulgiati 2004, 202).

Therefore, Odum initiated the development of the *emergy theory* (spelled with an *m*) as a comprehensive way to understand the complex ecosystem composed of interconnected parts (Raugei et al. 2014, 4). The use of energy units like kilowatt-hour or joules usually refers to the representation of a certain energy resource in terms of its mechanical or thermodynamic potential. In other words, a tree could represent 1 kilowatt-hour of energy, which means that it has the potential of delivering 1 kilowatt of heat for 1 hour if we would burn that tree. However, this unit does not represent the energy that has been transformed over the thirty years that it took the tree to become a tree. This work of geological, hydrological and biological processes of the environment is approximated by emergy. The theory helps to understand why we cannot equate a joule of solar energy one-on-one with a joule of oil energy. The latter quantity has not taken all of the preceding, earthly processes into account. Nonetheless, a solar joule is not useful to humans as such and it needs a technology to transform it into a kind of energy that is. Moreover, to be manufactured, that technology itself requires different forms of energy as well.

Ecocentrism versus anthropocentrism

In environmental ethics, an ecocentric understanding of nature opposes an anthropocentric understanding and is holistic in the sense that it deals with the ethical relationships between ecological wholes (e.g., ecosystems or species) as well as living and non-living natural objects. As an example, a holistic environmental ethics could allow for the hunting of individual animals as long as a population of its species will not be endangered. In terms of energy sustainability, carbon emissions could be allowed for as long it does not pose a threat on the ecosystem as a whole. By ecocentrism, anthropocentrism is mainly critiqued for attributing instrumental value only to the natural world. As such, it merely considers nature to be valuable because of its usefulness for humans. In this sense, a tree would only be attributed value for the paper or other products that can be made of it, the function it could have as a fuel for a heater, its aesthetics for an observer, or the like. The critique on anthropocentrism constitutes the view that the natural world should be assigned intrinsic value as well by recognising that (parts of) nature may be good in and of itself without necessarily being useful to humans. This has led to ecocentric understandings that attribute intrinsic value to natural phenomena or objects besides the human and other lifeforms.

The ecocentric notion to be emphasised here, is that the natural world can be assigned instrumental value but - as opposed to anthropocentrism - that does not inevitably mean that it is useful to humans. In such way, an apple may have instrumental value for a worm for its nutritiousness, and the wind for the pollination of flowers. The phenomenon of energy is predominantly discussed from an anthropocentric standpoint for its instrumental value for humans. However, by the many forms in which energy exists it has comparable value to the ecosystem and therefore it should rather be viewed from an ecocentric perspective.

Energy, as a mathematical principle, does not only have a biologic or organic dimension but a material one as well. Although we do not talk of matter as belonging to the living world, it does provide organisms with energy forms to live from. In other words, energy is part of the larger complex ecosystem materially as well as organically, which seems to be reflected in the thermodynamic laws. Energy appears to be stable (material) as well as susceptible to entropic processes of change (organic). Because it is both, energy cannot be understood as being merely anthropologic (or biologic), but rather ecologic of character.

This insight has the main implication that it "requires a change in mindset - about the human-energy-nature relationship - and not only a change in policies or technologies" (Frigo 2018, 3). Applied to the combustion of fossil fuels, we move from the thought of the work that these forms of energy can do for humans, to realising it also leads to the entropic forming of carbon dioxide, to seeing CO_2 as an energy form which is necessary for the growth of plants and trees.

However, carbon dioxide is not the only form of entropy due to the burning of fossil fuels and, as we have seen in the introduction of this thesis, fossil fuels are not the only carriers of energy. All of these carriers have material aspects that might change but do not vanish after energy use.

Experiential gap

Yet, as with most energy systems and technologies, people do not experience the amount of maritime energy throughput that is necessary for their daily activities or the many products and services that are provided. Nor is there an awareness of the material consequences of this energy use. The discrepancy between the human's perception of nature's provision of energy and the human's demand is what energy philosopher Geerts (2012) refers to as an *experiential gap*. In his own words: "a discrepancy between the experience of a consumer of electricity, and the effects of this consumption on the rest of the network" (Geerts et al. 2012, 102). Relating to the sequence that I have introduced in earlier chapters, in this definition, 'the network' refers to the whole (human) energy system as a throughput, where nature's supply refers to the energy input to the system and the human demand to its output. The problem with the experiential gap, according to Geerts, is that nature's provision of energy fluctuates, although - in most developed countries - this supply is experienced as being stable. However, the strong connection between energy use and sustainable development points out that the issue rather relates to the gap between the effortless experience of ever sufficient and reliable supplies of energy and the actual materiality of the phenomenon - with all its environmental and societal consequences.

Deep ecology

In addition to disruptions caused by excessive energy throughput, an ecocentric understanding of energy would account for disruptions caused by shortages as well. In fact, as CO_2 is a necessary component for living objects, it may just as well be said that the extraction of it from the air could only be allowed for up to a certain degree. Of course, momentarily we have problems with an overload and not a shortage of CO_2 disrupting the ecosystem. Nevertheless, the difference between these two examples of ecological disturbances and unsustainability is what the Norwegian philosopher Arne Naess (1973) defined as the distinction between *shallow* and *deep ecology*.

According to Naess, an environmental ethics against pollution and resource depletion could be described as a shallow ecology. A deep ecology, instead, would hold it necessary to investigate the social and human causes of pollution and depletion and rest on scientific ecological principles. In that sense, deep ecology accounts for the intrinsic value of nonhuman nature. As Desjardins

(2013) explains, "deep ecology has not developed out of one primary source, nor does it refer to one systematic philosophy" (Desjardins 2013, 207). Ultimately it is based on two norms through which people recognise their interconnectedness with nature and that all organisms and beings are equal members of the whole (ibid., 216). These aspects of deep ecology relate to an ecocentric understanding of energy and make some of its principles quite relevant to the topic of this thesis. Deep ecology could be seen as collection of environmental philosophies, ranging from generally non-anthropocentric to highly technical. *Table 5* represents a selection of rendered principles - relevant for the topic of this thesis - that are derived from these sets.

Principle	**Description**
Ecocentrism	Rejection of man/nature dualism - recognizing intrinsic value of human and nonhuman life
Drastic energy reduction	Energy use of advanced industrial societies needs to be reduced for man/nature harmony and the "appreciation of ecological realities"
Design with nature	Designs of human structures should be cooperative with nature's energy flows, not against it. Massive human-induced disruptions of ecosystems will be unethical and harmful for men
Diversity	Diverse use and distribution of energy is inherently desirable for both the society and the environment
Quality of life	Energy use and technologies should be seen as an appropriate tool to add quality to human life, not as an end in itself
Education	Educate to encourage the understanding of our interconnected relationship with the natural world and the meaning of which
Decentralization	Local autonomy, decentralization of power and less bureaucracy. This may be less efficient, but more effective in terms of deep ecology principles

Table 5: Compiled set of principles from the deep ecology environmental ethics; adapted from the work of Devall, Naess and Sessions, as presented in Desjardins (2013, 208) and Devall (2014)

To summarise, although energy is commonly understood in terms of being useful (for humans) before and useless after consumption, further analysis of the phenomenon reveals its inter-temporal and circular movement through the ecosystem and thus through society. Energy is not consumed and does not disappear; it merely *appears* in different forms whilst moving through the social and natural system. The human is not the beginning nor the end of the energy chain. Thus, energy does not only have meaning for humans but also for other stakeholders in the whole ecosystem; its material dimension has a complex function in ecological processes. Such an ecocentric instead of an anthropocentric understanding of energy is one aspect of what I call an energy holism.

4.2: ENERGY AND SUSTAINABILITY

In this section, in three steps, I show a second aspect of a holistic approach to energy: the influence of energy use on the concept of sustainability. First, discussing the contributions of energy use to sustainability reveals that energy use seems to define our view on sustainable development. Second, analysing whether the concept of sustainability is challenged by energy use illustrates how energy not only contributes but also challenges each of the sustainability pillars. Lastly, and in relation with the previous two steps, I discuss whether the United Nation's concept of sustainable development is equipped to set limits to or direct energy use.

Sustainable Development Goals	
Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable, and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient, and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
Goal 15	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Table 6: The United Nations' SDGs (United Nations General Assembly 2015, 16)

As I argue, it appears that the SDGs (see *Table 6*) provide few measures for setting limits to energy use and fail to explicitly include energy distribution to environmental stakeholders. As such, the SDGs account for access to energy in favour of social development but not for a sufficiency of energy use that could limit its challenges to each of the pillars of sustainable development. It is important to clarify upfront that criticising the SDGs is not a critique on its position on human justice and equity. The SDGs are - importantly - aimed at improving the circumstances of the least well-off and mitigating the most extreme consequences for the environment. However, the critique holds that - in terms of energy use - the SDGs should be more inclusive and non-anthropocentric to head towards "a truly just and sustainable energy future" (Frigo 2018, 3).

4.2.1: How does energy use contribute to sustainable development?

Many scientists from various disciplines[29] have concluded that the best way to analyse the long-term human history and contemporary events, is essentially by focusing on energy and the technologies used to exploit it. Their contributions have added to an understanding of economic, human and societal development through the use of energy. For example, the Austrian science teacher Edward Sacher (1834–1903) "viewed economies as systems for winning the greatest possible amount of energy from nature, and he tried to correlate stages of cultural progress with per capita availability of fuels" (Smil 2008, 7). Similarly, Laura Nader (2013), a forerunner in the anthropology of energy, addresses the complex relationships between rates of increase of energy use and gross national product, and per capita energy use and quality of life (Nader 2013, 264).

The correlation between economic development of countries and energy is one dimension of sustainability, but energy plays a role in a broader development of humanity as well. System ecologist Charles Hall and economist Kent Klitgaard (2012) concluded that, for the development of societies and civilisations, the surplus of energy[30] is most crucial. In accelerating steps, energy use and practices developed throughout history through hunting technologies, making fire, agriculture, metallurgy, domestication of animals and improved communication, which secured an

[29] As examples, Hall and Klitgaard (2012) listed the systems ecologist Howard T. Odum who I referred to in the previous section, chemists Frederick Soddy and William Ostwald, anthropologist Leslie White, archaeologist and historian Joseph Tainter, sociologist Fred Cottrell, historian John Perlin, sociologist and economist Nicolas Georgescu-Roegen, and energy scientist Vaclav Smil (Hall & Klitgaard 2012, 41).
[30] Surplus energy is broadly defined as "the amount of energy left after accounting the costs of obtaining the energy", determined by three factors: the quantity of it, the quality, and the rate it was or is delivered (Hall et al. 2009, 28-29).

intergenerational increased flow of energy (Hall & Klitgaard 2012, 46-51). Thus, the development output is determined by the quality of energy input and quantity of the energy throughput. This finding illuminates the "somewhat obvious but nonetheless important idea that for any being or system to survive or grow it must gain substantially more energy than it uses in obtaining that energy" (Hall et al. 2009, 25). Surplus energy is sometimes referred to as the energy return on energy invested (EROI or EROEI): the ratio of energy that is returned to society, in relation to the amount required to obtain that energy. Hall et al. (2009) argued that this calculation should be more extensive. Implicitly, they suggest including energy costs of supporting labour, compensation for environmental destruction, and of "all the things that we value about civilisation" but conclude that it remains elusive whether energy use should be "discretionary" or "directed to more fundamental things such as transport and agriculture" (ibid., 45).

Energy's contributions with regard to sustainable economic and societal development appears to be widely acknowledged. This is also recognised in the maritime industry, as energy use seems to be essential to many of the SDGs that reflect economic and social development Gjølberg et al. (2017). I would add that many such contributions, in fact, start with an energy conversion in order to reach these goals. Nonetheless, maritime corporations could, for example, contribute to SDGs such as SDG1 and SDG8 ('No poverty' and 'Decent work and economic growth', e.g., by providing affordable and sustainable transportation) or SDG2 ('Zero hunger', e.g., by facilitating harvesting and production of sustainable food from the ocean space). Maritime firms could also improve their own operations to contribute to SDG3 ('Good health and well-being'), SDG4 ('Quality education') and SDG5 ('Gender equality').

Energy justice is an emerging academic field that has responded to such contributions of energy use to sustainable development and aims to address related (potential) injustices. The concept claims to provide conceptual, procedural and decision-making tools for "a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making" (Sovacool & Dworkin 2015, 436). *Table 7* presents the principles of energy justice that are relevant for the discussion here and adjusted (where necessary) to a corporate context[31].

[31] 'Responsibility' would be a last principle that Sovacool and Dworkin (2015) have presented as a part of the energy justice framework and which is relevant in the context of this thesis. However, its notions - 1) minimize environmental degradation, 2) hold a "polluter-pays" principle, 3) protect future generations, 4) adhere to an ecocentric environmental ethic - are discussed in other parts of this thesis and this chapter in different ways.

Principle	Description
Availability	Concerning the financial, ecological and political security of supply, and matters of sufficiency and reliability of energy sources
Affordability	Corresponding to how value is created, captured and monetized
Equitable distribution of costs and benefits	Equitable distribution of the value created through energy production, transmission, distribution and supply
Due process	Transparent procedures to maintain or ensure justice and fairness in exchanges between actors, based on the principle of participation and meeting relevant standards and laws
Participation	Ensuring sufficient representation in all activities, inclusion of a variety of stakeholders in decision-making throughout the whole energy supply chain
Sustainability	Ensuring sustainable use of natural resources by meeting present human generation's demands without reducing the capacity of the environment to provide for future generations

Table 7: Energy justice principles; adapted from Sovacool & Dworkin (2015) and Hiteva & Sovacool (2017) and (where necessary) adjusted to a corporate context

The particular contribution of energy to environmental development has not been as much of a topic as its contribution to the social and economic pillars. Although it seems obvious that also nature (as we do acknowledge for humans) needs energy to develop and sustain itself, energy's particular contribution to environmental development has not received similar attention. However, the topic has been identified as a possible "new frontier" for further development of the energy justice concept[32] (McCauley et al. 2019, 918). I may also recall the emergy theory that I discussed in the previous section. Emergy explicitly focuses on the energy used by humans, but nevertheless comprehensively accounts for the work needed by nature "to replace what is used" (Raugei 2014, 4). It thus, indirectly, accounts for the environment's needs. On the other hand, a reference like 'replacing what is used' is significantly different from 'reaping what you have sowed'.

4.2.2: Does energy use challenge sustainability?

Reference to the environmental pillar of sustainability rather addresses protecting nature (avoiding harm) or restoring it (rectifying previous harm). A few of the United Nations' SDGs account for the protection of the ecosphere and can be seen as a precondition for the remaining goals. Nonetheless, due to a focus on the ecosystem's limits it seems that only symptoms of the issues are

[32] As such, through ecocentric principles - applied to a just energy system - "[a]n energy system is right when it tends to preserve the integrity, diversity, resilience, and flourishing of the whole community, involving direct caring relationships and formal rights of nature" (McCauley et al. 2019, 918).

notified and the direct link with energy use is not acknowledged. Moreover, the negative effects of energy use on sustainable social development are also overlooked and merely considered indirectly. In other words, as I explain below, energy use does challenge sustainability in several ways, although this is not acknowledged or - in some cases - it is underexposed.

Considering environmental sustainability first, there appears to be a focus on the ecosystem's limits but not on energy use as the underlying reason for challenging these. Causes and symptoms of the issues are notified: excessive greenhouse emissions, the warming of the planet, pollution or marine acidity. However, whether for desirable purposes or not, emissions, land degradation, diminishing biodiversity on land or under water, and many other issues may all be accounted to energy conversions through which environmental efforts are 'expropriated' by humans. The output (i.e., the converted forms of energy) does not correspond to the environment's needs and therefore the symptoms become excessive. For example, forests that took 30 years to grow are cut to provide heating for many human households in a time window of one winter, but the output in terms of emissions or other new (material) energy forms take many years more to be processed by nature again. In other words, the environment cannot keep up with the human's pace of energy transformations and the monotony of its output. This is the reason why environmental sustainability is challenged by the use of energy. The energy use of ships, as of yet largely depending on burning fossil fuels, can be analysed in the same way. The pace and the monotony of energy conversions of forms that took millions of years to take shape and the resulting monotonous output represent the challenge that maritime energy use puts on environmental sustainability.

Exploring the relation between energy use and economic and social sustainability, then, reveals a different story due to an apparent ambiguous understanding of the actual problem. As we have seen in the previous subsection, energy use can be considered to define these pillars of sustainability. How could it be that, at the same time, energy use would challenge economic and social sustainability as well? Although it seems that it has not received the broad attention that it deserves, quite some literature - sometimes directly, at other times indirectly - pointed out the societal burdens of energy use. The lack of attention to this existing literature could be explained by the ambiguity of the statement 'energy is not a technological issue, but a societal one'. Marianne

Minnesma, founder and director of the Dutch Urgenda foundation[33], would proclaim this understanding with the meaning that the technologies are there, the only thing it needs is the societal will to undertake action (Den Blijker & Straver 2018). However, a report by Ganzevles and Van Est on the so-called energy transition (titled 'Energy in 2030. Busting the Myths.'), conveys the exact same message but with the understanding that there is no technology available that could solve our present energy issues without creating new ones. Therefore, according to these authors, the issues are rather societal instead of technological (Ganzevles & Van Est 2013). Two very different understandings of the same issue. The first one representing a belief in a 'techno-fix', the second one calling for social besides technological innovation.

That societal sustainability is challenged by energy practices is also illuminated by a multidisciplinary selection of literature that focuses on energy issues. Benham Taebi (2011), for example, discussed the philosophical origins of sustainability - justice between generations (intergenerational justice) - in relation to the deployment of nuclear power. He argued that nuclear power production and consumption induces issues of intergenerational justice due to the energy input of uranium (a non-replaceable resource) and the output of radiotoxic waste that creates "potential burdens extending into the very distant future" (Taebi 2011, 146). Historian Gabrielle Hecht (2009) focused on nuclear power as well, but on a very different aspect of it. She explains how the radiation exposure of uranium were not acknowledged for a long time in the African mines and that it should be interpreted as "a form of colonial violence they [the African mineworkers] did not know they had experienced" (Hecht 2009, 925). By comparing uranium mining standards in Africa with those in other parts of the world, Hecht's focus has been on the challenge of energy use to sustainability in terms of intragenerational justice and equality with regard to health and safety of people on the producer side of the energy chain.

The issues with nuclear energy are also relevant to the topic of maritime energy practices and closely connected to this thesis in two ways. Firstly, maritime use of nuclear energy is seen as a potential solution to the problems of the ships' carbon emissions. Secondly, it throws a light on the indifferences of health and safety standards between users of energy technologies and the

[33] "The Dutch Urgenda Foundation aims for a fast transition towards a sustainable society, with a focus on the transition towards a circular economy using only renewable energy" (Urgenda, 2020). The foundation is known for its successful Climate Case against the Dutch government (first of its kind worldwide), establishing a legal duty to prevent dangerous climate change.

producers of them. For example, the mining of cobalt - still a necessary material for the popular energy technology of lithium-ion batteries - lead to similar issues (Goods 2015).

A last example of energy use leading to (potential) problems with social and/or economic sustainability is the emerging technology of biofuels, which is considered having an important potential as a renewable (maritime) source of energy (Balcombe et al. 2019, 85). Critics, however, have expressed concerns regarding the accompanied risks of concentrated knowledge and power of few leading companies, possibly resulting in economic injustices (Asveld et al. 2019, 132). Other potential negative effects of using biofuel are the impact on food security due to the competition between food and fuel, and the impact on biodiversity (Asveld et al. 2011, 26). Trade-offs between food and fuel are created by finite land availability, and the availability of water for one agricultural activity or the other. Research to co-production systems to achieve ecological sustainability and food and energy productivity has shown promising results, but also reduced economic feasibility (Hanes et al. 2018, 214-215).

In summary, in this subsection I have laid out how energy use challenges sustainability in each of the environment, social and economic dimensions. Human's energy conversions challenge the limits of the ecosystem. However, rather the symptoms of reaching those limits are addressed instead of the root cause: the pace and monotony of energy use. There are also societal challenges to be identified with the production and/or use of energy technologies that are currently or prospectively useful for the maritime industry (e.g., fossil fuels, batteries, biofuels or nuclear energy). Such challenges concern inter- and intragenerational justice, equality, health, safety, food security and economic justice. These widespread and varied issues illuminate that each energy practice comes with challenges to environmental but also social sustainability. These challenges may look different for distinct technologies. However, they are an inherent part of energy practices and therefore need to be accounted for *in relation to* and not *separated from* energy decision-making. Energy issues are not technological, as there are no technologies available that come without any challenge to sustainability. Energy issues are societal issues.

4.2.3: Does sustainability limit or direct energy?

In the previous subsections I have focused on the relation between energy and sustainability from the perspective of energy. This has also lit up some issues in the opposite direction - i.e., with regard to what sustainability has to say about energy - which is the topic of this subsection. Energy use directly benefits and harms sustainable development in both the social and environmental dimensions. This explicates the need of (1) a minimum access to energy as well as (2) a limitation on energy use, but also of (3) directing energy flows in order to spread the benefits as well as the harms. In this subsection I discuss whether the United Nations' concept of sustainable development - with an aim of improving the living standards of the least well-off and mitigating environmental harm - is equipped to deal with this need.

Sustainable development functions as a complex composition of a buffer between humans and nature's fluctuations, by which we are able to stand tall disasters and focus on living instead of surviving. The definition of sustainable development[34] that the Brundtland Commission put forward was based on two critical observations with regard to development based on economic growth only. The first critique was that a focus on development through economic growth failed to meet the minimum needs of many people (Desjardins 2018, 382). The *capability approach*, pioneered by economist and philosopher Amartya Sen and philosopher Martha Nussbaum, has been developed on the essential insight that development should not be assessed by available resources but by human capabilities (Oosterlaken 2009, 91). However, access to resources would contribute to the value of free choice of which capabilities to enjoy. Sabine Alkire explains this by the hand of comparing a fasting person with starving one. Both people would be in a state of undernutrition, but their situations differ in having access to (and thus the choice of having) food or not (Alkire 2005, as quoted by Oosterlaken 2009, 92). In other words, the insight implies that it is not the *use* of energy that necessarily contributes to sustainability, but the *access* to it. As such, sustainability - explained as access to energy - can be seen as a margin of tolerance for the irregularities of nature.

However, similar to - or perhaps due to - the issues with the experiential gap that I described in *Section 4.1*, it appears not to be recognised that energy use seems to be a nexus of many aspects of this buffer of sustainable development. In the United Nations 2030 agenda SDG7 supports the widespread access to energy, but - as we have seen in the previous two subsections - energy use is connected with many other aspects of sustainable development through multiple benefits and harms. The 17 SDGs and 169 underlying targets are to be understood as "integrated and indivisible and balanc[ing] the three dimensions of sustainable development" (United Nations General Assembly 2015, 3). An interdisciplinary group of researchers has identified evidence of

[34] "[...] to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987, section I.2. Sustainable Development).

relationships between 143 SDG targets (143 synergies and 65 trade-offs) and efforts to achieve SDG7 (Nerini et al. 2018). More recently it was found that - as countries are achieving targets of SDG1 (no poverty) and SDG3 (good health and well-being) - the demand for affordable and clean energy is rising. Therefore, it is called for investments and research to meet these demands "without putting too much pressure on planetary boundaries" (Kroll et al. 2019, 8). However, according to Rafaela Hillerbrand (2018), due to the SDGs' interconnectedness energy issues should not be addressed in isolation through technological advancements only but in the context of the socio-technical systems of which they are part. The SDGs fail to recognise this due to "[t]heir underlying analytic distinction between human well-being, the natural environment, and technology [which] hinders the perception of synergies among the three" (Hillerbrand 2018, 11).

This brings us to Brundtland Commission's second critical observation with regard to the economic growth model of development: the threat to future generations' abilities to meet their needs by present disregard of the limits of the ecosystem to produce resources and absorb wastes (Desjardins 2018, 382). However, the SDGs indirectly aim to limit energy use for environmental sustainability, but not to direct it according nature's demands. In line with the Brundtland's Commission's observation, ecosphere protection is seen as an essential precondition for social and economic sustainability. There are two remarks to this that could be made. First, the references to protection and conservation - or the 'planetary boundaries'[35] in the words of Krol et al. - lead to questions on what it actually is that needs to be protected. As it seems, there is a naturalistic conception integrated in the SDGs that defines environmental sustainability in terms of the absence of disruption (e.g., climate change). Therefore, there is a direct focus on such symptoms and the specific forms of waste that cause them. Secondly, in the preamble of the United Nations' 2030 Agenda for Sustainable Development it is declared that one of the aims is "to heal and secure our planet" (United Nations General Assembly 2015, 3). However, such a reference to the 'planet's health'[36] suggests that there are other strategies possible than thinking in terms of reducing harm and/or symptom mitigation. As I have mentioned in *subsection 4.2.1*, it seems obvious that also the environment needs a certain amount of energy - in any form - to sustain itself.

[35] In the article by Christian Kroll et al., who analyse trade-offs and synergies within and between the SDGs, the exact definition of 'planetary boundaries' remains unclear. As the article most frequently refers to 'limiting climate change', 'climate action' and 'climate friendly communities' it may be assumed the definition relates to this.
[36] This reference is also used for SDG 14 (conserve and sustainably use oceans) with point 14.a "[...] to improve ocean health [...]" (United Nations General Assembly 2015, 26).

Interestingly, the social dimension of sustainable development seems to have an inverted approach to energy: a focus on minimum capabilities of people rather than on the sufficiency of energy use. The SDGs importantly contribute to directing energy flows towards the people in need, but lack in indicating sufficiency of energy use, which could be a powerful measure against global degradation. A focus on minimum capabilities seems quite logical, as the energy buffer of sustainability does improve the lives of the least well-off. For example, comparisons of countries' per capita energy use and the inhabitant's infant mortality rate, female life expectancy at birth or malnutrition, or the countries' scores on the Human Development Index and (to a lesser degree) the Political Freedom Index indicate a strong correlation between energy use and the quality of life (Smil 2010, 722-726). However, here there are two remarks one could make. First, there appear to be no fundamental gains for the quality of life beyond certain levels of energy use[37] (Smil 2010, 726). In other words, although excessive energy use threatens environmental as well as social sustainable development, it doesn't seem to significantly contribute to it. Secondly, the ecosystem as well as the social system are already being disrupted by excessive energy use and this is, quite obviously, not by the specific stakeholders for whom a minimum access to energy is so important. Thus, this suggests that there is an urgency to include indicators of both sufficient energy use and energy use capabilities, although the first aspect is not integrated in the SDGs.

To conclude this section, investigating the relations between energy use and sustainable development has illuminated several characteristics of energy that a holistic approach should account for. First, a broad selection of literature indicates the important role of energy use for the sustainable development of the economy and society. However, although the environment must have a certain minimum energy need just as well, this topic seems not to have received similar attention. Second, it may be clear that environmental sustainability is significantly challenged by energy use. Importantly, and seemingly overlooked or underexposed, energy use not only *contributes* to social and economic development but also *challenges* these dimensions. Identified challenges amount to issues with inter- and intragenerational justice, equality, health, safety, food security and economic justice. Lastly, these findings explicate some deficiencies of the United Nation's SDGs with regard to the direction and limitation of energy use. The SDGs do provide

[37] Vaclav Smil points at the amount of energy use of 110 giga joule (GJ) per capita per year, while countries such as the USA and Canada (around 350 GJ), or the Netherlands, Germany and Japan (around 200 GJ) use much more than that per capita per year (Smil 2010, 722-726).

instruments to better direct minimum energy use to societal stakeholders but not to environmental ones. Similarly, the SDGs thus account for access to energy in favour of social development but not for a sufficiency of energy use so as to limit the challenges that energy use puts on sustainable development in each of its dimensions.

4.3: ENERGY FRUGALITY AND SUFFICIENCY

Limiting excessive energy use can be seen as a fruitful measure for energy sustainability as it would reduce harmful consequences without necessarily challenging the gains of energy use for the quality of life. However, the SDGs seem to insufficiently address such a limitation. It seems to be controversial even through the logic that factors of sustainable development such as increased transport, movements and/or construction inherently involve the use of (much) energy. Because of this potential value conflict, the general idea of absolute energy reductions - or the value of energy frugality[38] - and the thoughts behind it will be discussed in this section.

Seemingly, energy use has defined and expanded our conception of sustainability. Through technologies it appears to function as a buffer between nature's fluctuations and the human. Maritime energy use, for example, has made it possible to protect countries from rough seas, provide communities with nutritious sea food and drive the modern global trading economy. As such, ships - and energy technologies in general - are not simply a means to the goals of sustainable development, but simultaneously shape the concept of sustainable development and provide it with new goals. By relying on technological solutions, 'sustainability' is explicated in terms of clean fuels, renewable energy share and energy efficiency as a ratio of energy use versus GDP[39].

However, especially concerning maritime energy technologies, there are some challenges with such a focus on technological solutions to issues of sustainability. First, a strong belief in a 'techno-fix' involves an is-ought fallacy - sustainability *is* the ultimate good, therefore we *ought* to find technological solutions that provide for it. Secondly, it relies on an if-then fallacy - *if* we cover the Sahara with sufficient solar panels, *then* we provide the whole planet with sustainable energy'.

---

[38] Instead of 'frugality', in deep ecology one could find reference to 'drastic energy reduction' (see *Table 5*). However, 'reduction of energy use' as a principle would refer to an always decreasing amount of used energy and at some point, one has to admit, that cannot be met anymore since each process - whether natural or industrial - needs a base level use of energy. Therefore, I propose to phrase it as 'energy frugality', which is in close connection with 'energy sufficiency' due to the required deliberation on the essence of distinct energy practices.

[39] Respectively, referring to the indicators 7.1.2, 7.2.1 and 7.3.1 of SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all (United Nations General Assembly 2017, 7).

Lastly, there seems to be a difficulty in defining an optimal amount of energy use. Therefore, as I argue, there should be a focus on limiting *energy intense activities* and not - or not merely - the *energy intensity of activities*. In other words, energy efficiency should lead to sustainable development by using less energy in absolute rather than relative terms.

Is-ought fallacy

Firstly, regarding the is-ought problem[40] there seems to be a tendency to reason from quantity to quality amongst the proponents of technological solutions to ensure access to energy. Quantity adds value as more 'clean energy' is considered to be better. However, as we have seen in the previous section, Vaclav Smil (2010) has provided evidence that there appears to exist a certain threshold above which more energy use does not automatically lead to more quality of life.

Moreover, according to Rafaela Hillerbrand (2018), "it is far from obvious what 'clean' actually refers to when applied to energy, since all means of energy conversion come with downsides" (Hillerbrand 2018, 3). An energy technology might be technologically assessed as CO_2 neutral, but whether such a technology may be considered sustainable - and ought to be scaled up and implemented - depends on many other factors concerning different concepts of social and environmental justice. However, as sustainability is associated with a moral good, such a technological optimism to provide for sustainable energy too quickly runs the risk of overlooking such aspects (ibid., 6). Frankly, if sustainability *is* the ultimate good (and any restriction of good is bad) and we believe that technological advancements equal sustainability, then it logically follows that restricting these advancements is bad and we thus *ought* to increase technological innovation. Therefore, to avoid an is-ought fallacy, sustainability of energy use should be assessed in its socio-technical system instead of the mere technological one that is implied by 'renewables'.

If-then fallacy

The second issue, the if-then fallacy[41], is that proponents of technological advancements also seem to lean on speculations and move from the statement that technologies *could* improve sustainability

---

[40] The is-ought fallacy refers to the false assumption that because things are a certain way, they ought to be that way.
[41] The if-then (or denying the antecedent) fallacy refers to a faulty reasoning that moves from the statement 'if A, then C' (if I am rich, then I buy a castle) to 'if not C, then not A' (if I do not buy a castle, then I am not rich). This is a fallacy as there are multiple explanations possible for A not to happen (maybe there is no castle available). Similarly, affirming the consequent is fallacious by moving from 'if A, then C' to 'if C, then A' (if I can buy a castle, then I am rich). This is a fallacy as there are other explanations possible for C to happen (maybe I could buy a castle for the symbolic price of 1 euro).

to the statement that technologies *will* improve sustainability. The problem with stating *'if* sustainability is the ultimate good, *then* we ought to increase technological innovation' is that it is unclear whether the antecedent is true (i.e., whether energy technologies expand sustainability). For example, a combination of technological energy solutions promises to achieve up to 80% reductions of GHG emissions[42], modern sailing ships[43] are said to reduce these by 90% and nuclear ships would even 'completely make the issue disappear'[44]. However, this first requires significant financial investments and technological innovations before even some promises have delivered.

Improving on energy efficiency is seen as one of the best solutions for sustainable shipping. Although energy efficiency indeed leads to direct savings, indirectly they seem to evaporate due to organisational designs that lack (internal) transparency, fragment responsibilities and action, or inhibit learning and innovation (Johnson & Andersson 2016, 94). Another reason for the disappearance of energy savings are the prospected increases in demand of ships' services. Even the achievement of 50% efficiency improvement would not lead to any decrease of energy use with the projected doubling growth of the maritime industry.

Moreover, recall that many energy technologies - including the fossil fuel ones - are controversial from (other) social, economic and/or environmental perspectives and thus demand the inclusion of those aspects in decision-making. In other words, energy use and/or technological improvements may not lead to sustainability. Reversely, sustainability is not necessarily achieved by technological improvements or increases in energy use. Purely focusing on technological efficiencies - by virtue of the if-then fallacy - or even setting the boundaries of the socio-technical system at the ships or the firm may not result in the energy use reductions that are needed.

The value of energy frugality

The third problem of a focus on technological solutions relates to the problem of setting limits to energy use by the SDGs, as discussed in the previous section. There appears to be a difficulty in defining what the optimum amount of energy use would be. Ideally, this would be at least sufficient yet not undue. However, questions arise when energy use is sufficient and what essential purposes

---

[42] Balcombe et al. (2019), 82.

[43] A yet to be developed design of "the world's largest sailing vessel" is said to have a loading capacity of 700 cars that may be transported at half the speed of fossil fuel containerships. The Wallenius Oceanbird is promised to reduce GHG emissions by 90% (Blain 2020, September 14).

[44] Duurzaam Bedrijfsleven refers to a - to be developed - innovation of a molten salt reactor that should supply ships with "unlimited amounts" of electricity, making the ship "100% emission free and sustainable" (Seijlhouwer 2020, November 3).

would be. Sustainable development aims for a minimum access to energy for humans and limiting or mitigating the resulting symptoms of a degrading environment. As such it stands for the presence of human benefits and the absence of environmental burden as characteristics of sustainability, but in a lesser sense for the absence of human burden (through energy-related issues) and the presence of environmental benefits (through energy access). This results in conflicting approaches in finding an optimum by increasing and limiting energy use at the same time.

One solution would be to apply principles of energy justice and environmental ethics so as to improve the fairness of energy distribution and, as such, disperse human and environmental burden. However, technological solutions are presently not available, and we are already unduly affecting the ecosystem due to the present monotonous extraction and discharge of energy forms. Thus, merely improving the distribution of energy would not be sufficient and the following logical step - to focus on efficiency - I have just criticised.

The total global human use of energy needs to be reduced and therefore, as long as there are no good alternatives available, a value of frugality should be taken into account. Obviously, this cannot come from 'energy poor' societies or industries and thus a limitation on energy use has to be applied to energy intense activities. Here, I am explicitly referring to limiting *energy intense activities* (by rules of frugality and sufficiency) and not to limiting the *energy intensity of activities* (by a focus on efficiency). The difference between these seemingly similar expressions is the difference between radical or proportional change. Efficiency should not only be strived for in the engineering and operation of ships, or their equipment. that limit the *energy intensity of activities*. Efficiency should rather be applied to the whole system, referring to a radical change of properly limiting and distributing *energy intense activities*.

4.4: CHAPTER CONCLUSION

A holistic approach to energy - an energy holism - illuminates a broad meaning of energy use. The dominant understanding of energy, informed by the physical and engineering sciences, contributes to an energy holism but lacks the ability to grasp the deeper meaning of energy for societal and environmental stakeholders. Therefore, it is necessary to include specific views on energy from the perspectives of ecology as well as the social sciences. In that way, an energy holism would be helpful to account for comprehensive and coherent contributions to sustainable development - a necessary aspect for the design maritime CSR for energy sustainability.

In this chapter I have depicted what a holistic approach to energy entails and, along the way, how such an understanding would provide insights of the connection between energy use and the value of sustainable development in its economic, social and environmental dimensions. Additionally, I have shown sets of principles, adapted from the fields of deep ecology and energy justice, that are relevant for the presented perspective on energy. An energy holism would include the following three elements.

1) The value of ecocentrism, recognising that: energy is material and has an organic function as well; the environment cannot be seen as mere resources for human use; the human is not an end station of energy use; and that energy has a complex function in ecological processes.

2) The value of sustainable development: energy use benefits the economic, societal as well as the environmental stakeholders. For society, access to energy functions as a buffer between the human's demands and nature's fluctuations. However, also the environment has a minimum need for access to energy.

3) The values of energy justice: human's and ecosystem's sustainability, inter- and intragenerational justice, equality, safety, food security and economic justice. Each energy conversion potentially harms the value of environmental sustainability due to the pace and rate of human's demand. Moreover, energy use also challenges the above-mentioned values of societal sustainability.

Lastly, I have also presented arguments to include the potentially controversial value of energy frugality in designs of maritime CSR. This holds that there should be a primary focus on limiting *energy intense activities* instead of limiting the *energy intensity of activities*. Not only from the perspective of the corporation at large, but also from the perspectives of ship operation and individual energy decisions.

These findings elucidate the need to direct minimum energy flows to societal but also environmental stakeholders and to limit energy use based on principles of frugality and sufficiency. In other words, an energy holism suggests the need to account for the distribution of environmental benefits and mitigation of societal harms in addition to the distribution of societal benefits and mitigation of environmental harms.

CHAPTER 5: BUSINESS ETHICS AND COLLECTIVE RESPONSIBILITY

In this chapter I discuss the key value responsibility and the value conflicts that may occur in a maritime CSR design for energy sustainability. A central question is to what extent we may hold a firm morally responsible to act according to such a policy. In *Chapter 2* it is shown that CSR practices relate to a company's contribution to sustainable development and include stakeholders that are part of society, the company itself and the natural environment. The previous chapter revealed that energy and sustainable development are complex concepts, appear to be closely connected and can be associated with a wide variety of issues. Through the presented concepts of maritime CSR and MEM it appears that maritime energy use may benefit different stakeholders than the ones that are burdened by it. This suggests that the (kind of) obligations that firms have towards distinct stakeholders require further investigation.

One feature of VSD is to distinguish between usability and human values: "[u]sability refers to characteristics of a system that make it work in a functional sense, including that it is easy to use, easy to learn, consistent, and recovers easily from errors" (Friedman 2006, 360). Nonetheless, usability may not always align with certain values. For example, a very usable maritime CSR policy may be to significantly reduce the installed maximum power of a firm's containerships. This will have the effect of a lower maximum speed and less energy consumption, which - for the firm - may ultimately be either economically beneficial or not. However, a too significant reduction might not be a socially acceptable measure based on the moral value of safety that may be affected in extreme weather conditions.

Demarcating a maritime corporation's responsibility with regard to such value conflicts has two functions. First, it depicts what kinds of minimum efforts may be expected from the maritime corporation to solve the issues without going beyond certain responsibility conditions. Secondly, and in line with the first purpose, depending on these responsibilities and corresponding with the previous chapters, a set of statements can be drawn that represent how maritime sustainability managers may think of the subject. This is an important step for the empirical investigation.

To this purpose, I conduct a conceptual investigation of the key value of responsibility and identify potential value conflicts with the help of literature from the fields of Business Ethics and the philosophy of collective responsibility. I first discuss contemporary ideas on stakeholder theories and negative versus positive ethics. Subsequently, I elaborate on the responsibilities of a collective such as a maritime corporation, followed by its collaborative responsibility.

5.1: NEGATIVE VERSUS POSITIVE ETHICS AND STAKEHOLDERS

Two of the most important ethical issues regarding the holisticness of CSR relate to (1) the discussion whether companies should merely avoid harmful acts or actively do good (e.g., emitting less CO_2, or planting trees or forests that could process these emissions); and (2) the scope of companies' obligations in terms of who are included as stakeholders and to what degree they have obligations towards them (Frederiksen & Nielsen 2013, 28). The essence of 'holism' is commonly described as "the whole is more than the sum of its parts" (Desjardins 2013, 171). The term is frequently referred to in CSR theories and it then usually argues for a broader understanding of the corporation as a more integrated agent in society. I would like to emphasise that a holistic concept of CSR would entail a genuine focus on all of its dimensions, as merely taking some of the dimensions into account has been described as CSR practice as well[45]. However, only a diverse attention to its parts and their coherence would lead to a holistic conception that is more (as a whole) than any contribution to sustainable development of only one part.

Negative and positive duties

The first essential discussion for CSR is sometimes referred to as the difference between a negative or positive ethic. In other words, a focus on avoiding harm refers to a negative ethic, and a focus on actively doing good to a positive ethic. As an example, through a negative ethic, it only follows from someone's right to life the negative duty not to kill that person, but not the positive duty to provide in the basic needs that are necessary to live the good life. Frederiksen and Nielsen (2013) refer to the UN Global Compact (UNGC) as probably the most widespread of all CSR principles. Although the UNGC charter mainly concerns respecting negative rights (e.g., the right to life), it also contains elements of positive rights (e.g., rights to healthcare and education). This means that companies would commit themselves not only in preventing harm, but also in actively engaging in positive human rights. Based on these arguments and on studies of companies' CSR perception, according to Frederiksen and Nielsen, companies that merely apply a negative ethic would go against common CSR practice (Frederiksen and Nielsen 2013, 29). Moreover, the 'Global Compact' refers to the formal agreement between different parties. In other words, the *social contract* by which organisations operate in society. Such a social contract can be seen as an implied

[45] Of the 37 different definitions of CSR that Dahlsrud analysed, only 8 included all five dimensions (2008, 5).

contractual permission that represents the multitude of explicit and implicit expectations that society has about the functioning of a corporation (Azizul Islam 2017, 328).

Nonetheless, in many activities not doing harm at all is impossible, which is certainly the case for the energy intensive maritime activities. In that way, the only option to prevent prospective harm completely is by not using the ships any longer, and then still it will be a challenge to decommission them without any harmful consequences. On the other hand, a firm that omits (or is not able) to do any good, should not be allowed to be harmful. Of course, the maritime corporation can defend itself by saying it is contributing to SDGs through the services they provide and/or the (often global) employment of people. This signifies the difficulty to quantify aspects of harm and good. This is not the place to get to the depth of weighing out negative versus positive duties or even whether it is possible to do so due to the incommensurability of distinct welfare components[46]. However, following the previous, some degree of harm will remain part of providing maritime services that are valuable to society. It seems fair to say that doing harm cannot be balanced out by preventing other harm. When we step on someone's toe, we usually do not make up by saying that we will not hit that person's head either. Instead - if apologising is not sufficient - we would rather offer that same person a cup of coffee. In other words, when harm cannot be prevented, outbalancing that should be done by doing good to the corresponding stakeholder. Therefore, I hold that maritime CSR - with a holistic approach to energy, as discussed in *Chapter 4* - should include negative as well as positive duties.

Natural contract

The stakeholder theory, the second ethical discussion in the field, has been called the central tenet of contemporary business ethics and that what actually constitutes CSR (Bragues 2018, 34). A broader stakeholder theory displaces a shareholder theory that sees a company as a nexus of individuals (persons or organisations) within which management liability is foremost directed at the owners of the firm. In contrast, in a stakeholder theory the corporation is regarded as a legal privilege conditionally granted by the state instead of a collective that is separated from society

[46] Philosopher Jeremy Bentham expressed the doubt that pleasure and pain are quantifiable. Different solutions are proposed to solve the resulting ranking problem, the issue to accurately analyse welfare costs and benefits. A well-known attempt to formulate adequate welfare measures is the Human Development Index (HDI), which uses so-called objective-list conceptions of conditions that are universally considered good (e.g., health, education, security, etc.). However, such welfare components remain immeasurable on the same scale, either resulting in arbitrary single linear scales or in the difficulty of comparing multidimensional scales (Nolt 2015, 162).

(ibid., 34). While being this 'organic part' of a larger system - as I called it in the introductive chapter - this privilege cannot be seen as a negative right to exist. In this, the corporate citizenship differs from human citizenship. However, it does come with certain other (e.g., financial) rights that human citizens do not have; at least on the condition that the burdens on society do not outweigh the benefits. Therefore, its management is ultimately obliged to conciliate the interests of all stakeholders affected by the firm's actions: "customers, employees, creditors, suppliers, governments, local communities, in addition to shareholders" (ibid., 34). Nonetheless, it remains open for discussion who can, more specifically, be regarded as a stakeholder and to what degree corporations have obligations toward them.

It should not only be asked whether or how an environmental decision affects an individual animal of a certain type (i.e., humans), but also - more holistically - whether it concerns a diversity of plant and animal life or whole ecological communities. As has been emphasised in *Section 2.1*, the contemporary understanding of CSR holds the environment as a stakeholder in itself. This would extend Bragues' enumeration significantly and would have crucial ethical implications. With the environment as a stakeholder, an environmental ethic would provide insights for a shift from an anthropocentric to a non-anthropocentric view of nature. For example, philosopher Holmes Rolston (2011) has argued that we should expand the view of a social contract to a *natural contract*. Instead of thinking of our responsibility to nature as remote ones, due to its dimension or vagueness, it should be seen as our most fundamental responsibility. "Responsibilities increase proportionately to the level and vagueness of the reality in jeopardy" (Rolston 2011, 24). Assuredly, this responsibility is closely connected with the more local responsibilities of a social contract that appears to be more tangible to us.

The implications of a natural contract for a stakeholder theory are far-reaching when considering the implementation of negative or positive duties. Namely, it would be the distinction of not doing any harm and (passively give space) to the environment versus actively devoting energy to nature's flourishing. The question is to what extent a maritime corporation has the responsibility to engage with this and if it matters whether the corporation should be seen as a collective (of individuals that form the organisation, for example) or rather as an individual (by its corporate citizenship). This is the topic of the next section.

5.2: COLLECTIVE RESPONSIBILITIES

Both energy use in general and the maritime industry seem to exist far from public experience, have global effects - positive as well as negative - and lack sufficient global governance. Recalling Dahlsrud's five CSR dimensions - the economic, social and environmental aspects, voluntariness and stakeholders - the discussions on stakeholders and positive or negative ethics are closely connected with the subject of the actual responsibility of firms. In *Section 2.2* I have explained that the regulatory and market-based sources of motivation did not lead to satisfactory contributions to sustainable development by the maritime industry. Market failures such as the presence of externalities and information asymmetries are typical issues that presently appear with the use of energy and the maritime industry.

There appears to be a responsibility gap, grounded in arguments of the negligibility of the caused harm and/or the believe that individual reduction will make no difference or is too demanding (Hedberg 2018, 65). No matter how small, if one thinks of the dispersed environmental consequences of a single company on a huge globe, the majority of made (energy) decisions have a global effect. The energy intensity of modern ships amplifies this issue for the maritime industry. A concept of justice, in this sense, could be to propose that the polluter pays. However, as a polluter here we could understand the actual company that pollutes whilst providing the service that is asked for, or we could understand it as the end customer (either an individual or a collective) who ultimately benefits from the services provided, combinedly with the financially profiting business. Importantly, as an individual, a customer's share to pollution is close to zero and, as a collective, groups of customers are of a dispersed type. The thousands of people that - independent of each other - travel on cruise ships and the many more that benefit of the global transportation of goods are collectives that are unaware of their connection. Due to the - relatively small - effect of a single company on the global environment and the dispersed responsibility of a disconnected collective, the accumulated harm for the benefit of a few seemingly remains unaddressed.

According to Stephanie Collins (2019), we can distinguish between three kinds of collectives (diffuse, teleological and agential) and four[47] kinds of responsibility (causal, predictive causal, moral and prospective) to identify different types of responsibility gaps and recognise whether it is defensible to claim that a collective has certain duties or not. Collins has contributed

[47] Collins' paper only concerns three types of responsibility, but the author clarifies on the fourth type (2019, 945).

to the philosophy of collective responsibility by addressing gaps "[in] situations in which we are unable to attribute all the responsibility we might pre-reflectively want to attribute to collectives, such as business corporations and states" (Collins 2019, 943). It is a broad philosophical field[48], but with this section I mainly depict what we might expect and what not of maritime corporations, with regard to sustainable development, by acting in a corporate socially responsible manner. To this end, Collins' contribution to the literature is helpful, as it has been acknowledged that 'collectives' as well as 'responsibility' are both seen as ambiguous.

Types of collectives and responsibilities

The distinction between the different collectives can be explained as follows. *Diffuse collectives* are groups of agents that (1) are not united and do not act responsively to one another and (2) do not act under a collective-level decision-making procedure (e.g., clients of a shipping service). Members of *teleological collectives* do (1) act responsively to one another as they work toward a common goal but, (2) "lack clear procedures for forming decisions, intentions, beliefs, and desires that are attributable to the collective" (e.g., 'the maritime industry' with the common goal of a thriving industry). Lastly, *agential collectives* in which members both (1) act responsively to one another and (2) have well-defined collective-level decision-making procedures (e.g., maritime corporation Maersk; Collins 2019, 944).

Subject of discussion in this thesis is this latter group, the agential collectives that single maritime corporations are with (1) members that work toward a common goal (e.g., transporting smartphones) and (2) a decision-making process that is operationally distinct from that of its members. These processes could differ in the sense that reasons or beliefs may vary, methods are dissimilar (e.g., democratic or authoritarian), and that the collective's decision outcomes are no straightforward conjunctions of the members' decisions (ibid., 944). For example, a sustainability manager might have the conviction that contributing to alternative fuel research is most effective to achieve sustainable shipping, although the company - as a collective - decides that its focus, and therefore the manager's focus, should be on energy efficient ships. As such, an agential collective

[48] For example, for thorough discussions on factors that have an influence of what can be considered as "the 'fair share' of corporate responsibility for global problems", Wettstein (2012) refers to several articles by Santoro, Young, Hsieh and himself (Wettstein 2012, 159). On the responsibility of individuals, Walter Sinnott-Armstrong (2005) argued that there are no moral obligations to stop emitting greenhouse gases but rather to getting governments to prevent excessive global warming. There are several refutations of this view such as Baatz (2014) who claims that individuals do have such a moral duty to some extent, depending on specific circumstances, and Hedberg (2018) who argues there is a duty, which is based on an integrity principle.

may have a certain *quality of will* (e.g., decision, volition, intention, attempt) different from such quality of some, most or even all[49] members (ibid., 952). A company (an agential collective) - can only be morally or prospectively responsible if it is a moral agent. And it can only be a moral agent when the corporate structure is set up in such a way that there are decision-making procedures in place to respond appropriately to moral reasons[50].

Next, according to Collins, there are four ways to attribute responsibilities. Attribution of *causal responsibility* refers to (i) a past impact or influence but (ii) without praise- or blameworthiness, whereas the attribution of a *predictive causal responsibility* refers to (i) a possible future impact or influence, which also (ii) does not involve praise- or blameworthiness (ibid., 945). In other words, these types of responsibilities do not imply moral judgement, which is a focus of this thesis. Therefore, of interest here are - what Collins calls - moral and prospective responsibilities. *Moral responsibility* concerns with (i) past events, like causal responsibility, but now (ii) including a liability to praise or blame for. *Prospective responsibility* refers to (i) future events that (ii) imply moral judgement; thus, if one faces the prospect of moral responsibility due to not carrying out the respective duty (ibid., 945). The question about what duty a company has to execute in the future makes a responsibility prospective.

This draws closer attention to the kind of responsibility CSR that is about: concerning what moral reasons business has for future action. We could understand this as the moral reason that is theoretically decisive in decision-making. In other words, whether a company has the prospective responsibility to do X, means whether a company - all moral things considered - ought to do X in the future (ibid., 945). It is important to recognise that also the moral or prospective responsibility over certain outcomes (or their absence) requires a certain quality of will, alongside (past or possible future) actions (ibid., 952).

---

[49] With regard to an outcome in which all members individually have a different will than that of the group, Collins (2019) refers to cases of discursive dilemmas. For example, imagine a situation where motions A, B and C are each necessarily accepted separately to accept a potentially bad action X. If three people would vote on these motions, it is likely that none of them has a will in favour of X (who would be in favour of a bad action?). However, whilst applying majoritarian voting - a commonly accepted method - it could occur that the three people each vote *for* two motions, but also *against* a different one, which would lead to passing motions A, B *and* C, and therefore also the acceptance of bad action X (Collins 2019, 952).

[50] For example, if the decision-making procedure is set up so that its members cannot present moral reasons to the agential collective, the collective as such cannot be held responsible (Collins 2019, 952), but rather certain individual members of it; e.g., for not having ensured or assisted to have the proper procedures in place.

The different collective and responsibility types that Collins covers reveal distinct gaps and tells us what kind of responsibilities we might attribute to certain collectives and which we cannot. Here, I will especially focus on responsibility (gaps) for corporations - as agential collectives - and, in relation to CSR, the prospective responsibility more particularly. With the previous in mind, assigning causal responsibility to a corporation is only defensible if its influence or action is decisive for the presence or absence of an effect (ibid., 951). For example, imagine a company that has all procedures in place (as to independent assessment) to prevent a certain disaster from happening during a project. The employees do follow the procedures, but still - unforeseeable - a disaster does occur. In this case the company bears a causal responsibility over the event but is not blameworthy. In a contrasting situation, when the company would not have the right safety procedures in place, it would have been a lot more likely that such disaster would occur, and the collective does have a moral responsibility. A moral responsibility gap arises when - intuitively - a company has a moral responsibility (e.g., for being the company working on the specific project) but is not actually praise- or blameworthy for a certain outcome, like in the first situation. This gap also opens up the issue with regard to whose benefits a company has been working on a certain project. Did the disaster occur whilst working - as one part of the whole - on a project to the benefit of the larger system, or merely for its own financial gains? In other words, if it is purely that, merely its presence at the catastrophic site could be enough reason to be blameworthy.

Ability, justification and fulfilment conditions

Whether we can assign prospective responsibility to a company depends on the existence of other (corresponding) gaps: ability, justification and fulfilment gaps. We could speak of an ability gap when a certain outcome is desirable - a good to be produced or harm to be avoided - but the company that would have the prospective responsibility of that outcome is not able to actually produce it (ibid., 948), e.g., due to a lack of monetary or human resources. In other words, a firm could only have a prospective obligation if it meets - what I call - an *ability condition*.

A justification gap occurs when a corporation is capable of producing a desirable outcome, but a compelling justification lacks for why they are morally required to do so (ibid., 948). For example, imagine that a large shipping company such as Maersk has sufficient monetary resources to provide each COVID-19 infected person in the world with medicine to mitigate potential symptoms, but Maersk would not have caused COVID-19 to exist, nor be culpable for or benefit from it. The question could arise whether merely having sufficient resources to or being capable of producing a certain outcome could be enough reason to be prospectively responsible of doing so. As there are more issues in the world than just COVID-19, the moral value of the prospected outcome would be relative to other possible outcomes an agent could produce. One the other hand, a moral justification might be closer if one, or one company, is literally the only one capable of producing the desired outcome. Indeed, the ability-justification nexus is closely related to the stakeholder theory that has been previously discussed. For example, the broader the stakeholder definition, the less able one might be to be of help; and the more accumulated harm or benefits an outcome has (due to the many stakeholders and/or the intensity of an action), the more justifiable a certain action could be. In other words, it needs to be morally justified for a company to be prospectively responsible. I call this the *justification condition*.

Lastly, I refer to the *fulfilment condition* as questioning whether a firm has the prospective duty relative to other entities' capability to play a role. A fulfilment gap occurs if a certain entity is morally responsible for not fulfilling a prospective responsibility, even though it was able to and it was morally justified. The question could then arise whether other collectives had or have the prospective responsibility to compensate in some way for the refused or failed of others (ibid., 948). In other words, what moral reasons there could be for a firm to have the prospective responsibility to repair harm or do good without having the moral responsibility of the existence of that harm or the absence of the good to date. An interesting example could be a situation at sea in which a ship is the only one near a drowning person after another ship failed to save that person (e.g., because the crew did not see it). Apart from having the legal responsibility, one could imagine that such a ship also has the (moral) prospective responsibility to save a life by stopping and get the person on board.

Taking the example one step further illuminates the difference between a negative versus positive ethic in such a situation. While the crew on the ship has the (legal and) prospective responsibility to save the person's life (a negative duty), it would be unfair to expect the ship to sail to the person's desired destination, completely out of route, for any reason (a positive duty). First, to fulfil the persons desire would demand discrepant efforts. Second, regarding the first obligation to save a life, the ship has the ability to help and is the only one in the vicinity that could help within an urgent timespan; while regarding the second obligation - if the ship is able to sail to the person's desired destination - there are probably many other entities that could fulfil the person's desires, once he or she has been brought ashore safe and sound.

To conclude, in dealing with value conflicts that may occur with the design of maritime CSR for energy sustainability, one could revert to moral conditions of ability, justification and fulfilment. Corresponding with the previous, I hold that the prospective responsibilities regarding (maritime) energy decisions at each of the input, throughput or output mechanisms must pass such moral conditions. Moreover, for it not to face the prospect of the moral responsibility of wrong or harmful energy decisions, the maritime corporation - as an agential collective - also has the responsibility to ensure that its employees make the right energy decisions (whatever that means). Only sufficient commitment in putting the right measures and procedures in place could relieve the corporation from wrong choices, decisions and intentions.

5.3: COLLABORATIVE RESPONSIBILITY

The example with the COVID-19 medicine in the previous section brings us to one last aspect of responsibility that I would like to cover here. It suggests that there is a degree of collaboration needed to be able at all to progress in solving large issues. The example shows that collaboration might be a moral requisite if the issue with the virus should be solved. Merely providing COVID-19 medicine might not be sufficient to achieve the sustainable development goal of ensuring a healthy life. People might not have access to adequate medical facilities, infrastructures and monitoring. Moreover, certain cultures or religions possibly oppose such medical treatment. As one part of the whole, an individual or a company might have the monetary resources or capabilities to solve an aspect of the complete problem, but this will not be possible without the cooperation of other important institutions. At the same time, each and every part or aspect of the whole is indispensable. However, only the whole and not the parts on itself may solve such large issues since none of the parts might pass the above discussed moral conditions and only the parts together - seen as a whole - would. This would also be the case, for example, with global environmental issues due to intensive maritime energy use.

Literature shows a strong consensus on the collaborative responsibility of firms by holding stakeholder dialogue and engagement as an essential element of CSR (Roszkowska-Menkens 2017, 76). This implies communication on what matters and what issues to address, but also a 'working together' towards the corresponding goals. According to Goodpaster (2018), taking into account a broader set of stakeholders would expand the decision-making horizon of corporate responsibility considering the "goods and harms for multiple parties" (Goodpaster 2018, 194).

Ethically attending to these multiple parties in decision-making, which he calls "comprehensive moral thinking", entails a shift of subject and therefore calls for cooperation between involved institutions (ibid., 197).

As we have seen in the previous section, Stephanie Collins would argue that in some cases it is not possible to attribute moral responsibilities to certain collectives due to their nature. However, it could be argued that, for example, a diffuse or teleological collective may be held responsible for not forming an agential collective that would be able to address large-scale issues (Wettstein 2012, 165). To clarify this, Florian Wettstein (2012) uses an example that philosopher Virginia Held provided in her elaboration on collective moral responsibilities:

> "[...] the example of seven strangers sharing a subway car. Suddenly, one of them throws another one to the floor, beating and strangling him. It appears that without intervention, the assaulted person might eventually be beaten to death. While the perpetrator might be too strong to be subdued by any single one of the witnesses, it seems evident that if they acted together as a group, they would be able to restrain him. The moral urgency of the situation is clear to any reasonable person in this situation and it seems similarly clear what kind of action is needed—that is, a physical intervention by two or more of the witnesses" (Wettstein 2012, 164).

According to Held, if these seven strangers - that Collins would call a diffuse collective - would fail to act as an agential collective (with the goal of saving the assaulted person's life), we would hold the group responsible for precisely that failure. As such, omission to act can be seen as a responsibility decision as well. There are situations imaginable in which the necessary actions to solve a global problem are not as clear. Then still, responsibilities of dialogue and engagement imply a minimal duty to actively participate in exploring the matter in question and potential solutions (ibid., 164-165). To some, unsuccessful efforts to collaborate relieves a corporation from further responsibilities (Goodpaster 2018, 197). With Held's example in mind, I argue against that. Whether or not efforts to collaborate are demanded does not depend on past efforts or success, but on whether the respective issue is solved or not. In fact, due to the inherent conflicting interests of coexisting, interdependent stakeholders, such issues will always remain and require collaboration.

From the previous chapters it is clear that maritime corporations and other institutions acknowledge the global issues and the need for action to address them, although the approprate actions are less known. Wettstein (2012) proposes a concept of collaborative responsibility as a solution, characterised by five key elements: (1) based on a moral imperative for collaboration with regard to global issues; (2) looking at what corporations do but also what they do not; (3) this implies a corporate positive responsibility beyond negative duties to do no harm; (4) collaborative obligations are framed as political responsibilities[51]; (5) the responsibility to involve in and support efforts to improve the global human right situation (Wettstein 2012).

Through this holistic lens of collaborative responsibility, and in line with the previous sections and chapters, a maritime corporation can be expected to address the industry's global issues and contribute to sustainable development in a number of ways. First, it should collaborate with other maritime organisations and regulatory institutions to improve efforts addressing issues with relation to the global maritime industry. Second, a corporation should initiate (or at least be open to) contributions to collaborative efforts and/or the formation of agential collectives. Third, a maritime firm ought to use energy for economic, social and environmental prosperity. Fourth, it should engage in transparent communication with the public regarding the industry's issues and potential solutions. Fifth, and lastly, the maritime corporation ought to be guided by and help improving global human rights situations.

5.4: CHAPTER CONCLUSION

In this chapter I have shown what we might and might not expect of corporations in terms of responsibilities to society and the environment. The duties of a maritime firm may reach, but there are limits to the attribution of responsibilities to corporations. This reflection on potential value conflicts can be seen as supplementary to the findings of *Chapter 2* (the purpose of maritime CSR is to safeguard a company's contribution to sustainable development) and *Chapter 4* (energy and sustainability are complex and interconnected concepts with a variety of issues). In this chapter I have drawn a number of subsequent conclusions.

Firstly, through the social contract by which organisations operate in society and the inherent harm due to the operation of ships, a maritime CSR should include negative as well as positive duties to the respective stakeholders.

---

[51] With 'political responsibility' Wettstein refers to a "deliberative responsibility of corporations" that entails "to at least not refuse communicative engagement" with regard to "[a]ny problem on the public agenda that requires collaborative solutions and for which corporate capabilities seem essential ..." (Wettstein 2012, 175).

Secondly, with the environment as a stakeholder of CSR, I have transmitted the idea of expanding the view of a social contract to a natural contract. The implications of such an idea, are illuminated by the distinction between negative and positive duties to nature. Should we focus on not harming and restricting nature's flourishing or should we actively devote energy to it?

Thirdly, to deal with value conflicts, firms (or the 'CSR designer') should revert to the ability, justification and fulfilment conditions. In other words, the extent to which a maritime corporation has responsibility with regard to the value considerations depends on moral conditions surrounding the respective issue(s) at each of the input, throughput or output mechanisms of the firm's processes. Is a company able to engage in solutions, is it a morally justifiable obligation, and what is its responsibility to fulfil this duty relative to other entities' capabilities?

I further concluded that, fourthly, to prevent moral responsibility of wrong or harmful energy decisions by individual employees, the maritime corporation should commit in developing the right measures and procedures to prevent such deficiencies.

Moreover, fifthly, the shift in stakeholder thinking with regard to the values of a single party (shareholders) to those of multiple parties calls for cooperation between the involved entities. Therefore, a moral collaborative responsibility exists to form agential collectives to address issues that go over one's head. This responsibility to engage and going to dialogue with stakeholders can be seen as a minimal duty for the corporation in addressing unsolved issues. Such a collaborative responsibility remains as long as there are conflicting interests of multiple parties, which is a natural occurrence in any interdependent coexistence.

The above conclusions entail the minimal responsibility of maritime organisations to collaborate with other such organisations and institutions, cooperate in the formation of agential collectives, reduce harm but also actively contribute to the good, be transparent, and be guided by human rights and help improving global situations accordingly. Here, I would like to recall that a move from a social contract to a natural contract would not only imply (negative and positive) duties toward humans, but also towards the environment.

The conducted empirical research for this thesis served to investigate the value considerations of sustainability managers in the maritime industry in relation to energy-related issues. In the following, I first present the selection of statements (the Q-sample) that is drawn from the overview of the topic that has been developed in the previous chapters. The Q-sample is based on an anticipated difference in viewpoints that could be described as beliefs in either a technological fix, human solutions or a more holistic approach. Subsequently, I discuss the selected sample of participants. Lastly, I present the findings of this empirical investigation, concluding that the factor analysis pointed to an interpretation based on the input, throughput and output of the energy chain instead of the anticipated factors.

As has been presented in *Chapter 2*, there appears to be a controversy with regard to the best approach to maritime energy sustainability, which - in turn - leads to quite dispersed approaches. Comprehensive, one could say, spread over different firms. However, except for one participant that leaned mostly towards a holistic line of thought, none of the participants adhered to a coherent approach to energy sustainability decision-making. The clearest value conflict that came to the surface, what that of energy frugality versus the corporations' interests.

6.1: Q-SAMPLE

The Q-sample, the set of statements for the Q-methodology research, are based on the findings of the previous chapters and should accurately represent the defined concourse. I frame the Q-sample in this case as: *Maritime energy decisions - for the corporate and ship level - that contribute to sustainable development*. In other words, the Q-sample represents the energy decisions that ought (or ought not) to be made on the corporate and on the ship level in the input, throughput and output mechanisms. To be accurate, the sample of statements should be selected from the anticipated viewpoints of categories of the concourse. Informed by the concourse it is anticipated that there are three main viewpoints on sustainable use of energy in the maritime industry, which I have called a belief in (1) a Technological fix (or 'Tech'), (2) Human solutions (or 'Human'), or (3) a Holistic approach (or 'Holism'). It is to be noted that - as it is an explorative study - I am not hunching at predetermined hypotheses here. Rather, these anticipated viewpoints should assist with the selection of a diverse set of statements that is representative for the concourse.

Through strategic sampling, more or less equal numbers of Q-statements are derived from each of these categories. The Holistic approach category includes nine statements (versus seven statements each for the other two categories). However, CSR in the maritime industry is clearly part of a socio-technical system which makes that the lines between these categories may be somewhat blurred. Statement 6, for example, is categorised in the 'Human' factor but has a technological, and comprehensive and holistic idea behind it as well. Similarly, 'Holism' statement 19 might be qualified as 'Tech' just as well, due to the necessary technological equipment that would be necessary to measure. Furthermore, the questions are also more or less equally represented in each of the sections of the concourse (i.e., the input, throughput and output sections of the corporate as well the ship-level energy decisions). This results in 23 statements that are to be sorted by the participants as shown in *Figure 3*. It is not to be expected that someone who believes more in a technological fix would rank all of the 'Tech' statements highest, and that someone who holds a more holistic believe would rank all of the 'Holism' statements highest. It is possible, of course, but one would rather expect that a participant would (overall) rank these statements higher relative to other statements in the same ranking. Hence, the Q-sort ranking may be quite dispersed but still show preferences to one of these factors.

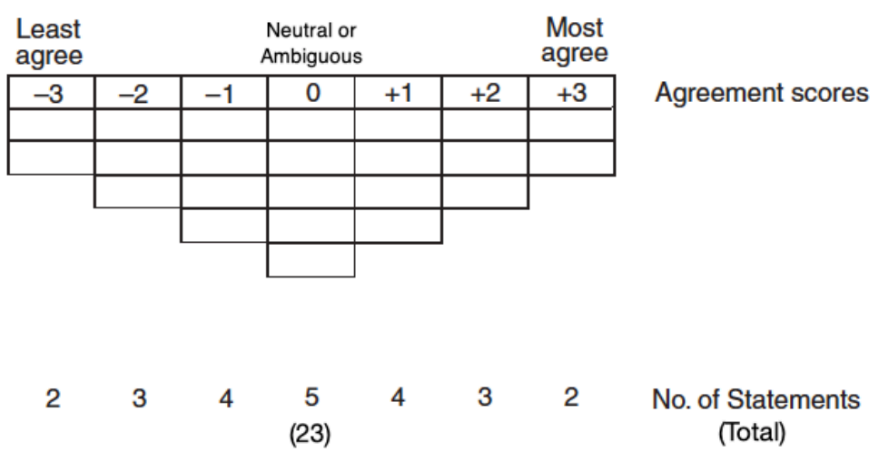


Figure 3: The Q-sort grid. Refer to Appendix I for the actually used Q-grid

According to Lee (2017), Q-methodology founder William Stephenson called this the difference between correlating variables for analysis, which he named an R-approach, or correlating people, which he named a Q-approach. Lee explains this with the following analogy:

> "One day the current author asked class students to raise their hands. Then he pointed at a hand that was the smallest an asked the students whether it was small. All the

> students said in unison it was small. The author asked why it was small, which was followed by puzzled looks from the class. Their reasoning was based on comparing this small hand with the other hands raised. This is R-approach. In Q-approach, this hand would be compared with other body parts of the selected student [...] Then it could turn out to be normal, not small at all" (Lee 2017, 81).

Hence, even a certain statement that is ranked the same by two participants (e.g., +2), its meaning may be different in the context of the ranking of all other ranked statements.

The Q-sort grid is usually designed as a quasi-normal distribution and its kurtosis (i.e., the sharpness of the peak) depends on the controversiality of the research topic. If the knowledge and engagement of the respondents is expected to be high or relatively few statements are salient, the kurtosis should be sharper to leave more spaces open for ambiguity and indecisiveness (De Graaf & Van Exel 2008, 75). In this case the knowledge of the respondents is expected to be high and the number of salient statements as well. The shape of the Q-sort grid is chosen accordingly.

Table 8 represents the most important topics in each of the concourse sectors. *Tables 9a* and *9b* show the accordingly derived statements. It must be said that Q-methodology research aims to reveal subjectivity and are therefore meant to stimulate contemplation. Moreover, this research is aimed at systematically studying the opinions one could have on a holistic approach to maritime energy decisions. Participants were not presented contradicting statements but rather the extremes that this holism represents. Hence, it is not the aim to find out if the participants are for or against certain possible solutions that are derived from the concourse; instead, the value agreements and disagreements should be revealed of a diversity of solutions. For example, as such, instead of a statement like "There is no full technological solution for maritime energy consumption; it is a corporate and societal issue", the participants are presented the following: "Maritime corporations and society can rely on technological advancements to solve energy issues".

Lastly, all of the statements are also tested, if applicable, whether they meet the *ability*, *justification* and *fulfilment conditions*. Therefore, it is not asked whether maritime corporations "should account for all materials involved (e.g., batteries, filters, coatings, etc.)", but whether they "should aim to account for ...", since the first statement - possibly - would not meet the ability condition as of yet. The survey information sheet that was sent to the participants (together with the consent form and login information) can be found in *Appendix I*.

Sector	Topics
Corporate - Input	Fuel
	Human resources
	Technology
	Input, Throughput, Output of the energy supply chain
Corporate - Throughput	Collaboration, and degree of voluntariness and responsibility
	Efficient corporate structure and culture
	Technological investment
	Efficient corporate operation
Corporate - Output	Stakeholders + positive duties
	Stakeholders + negative duties
	Collaboration
	Experiential gap (energy reporting to stakeholders)
Ship - Input	Efficient design of ship
	Energy sustainability
	Diversity of energy equipment
	Energy awareness
Ship - Throughput	Efficient operation of ship (equipment)
	Efficient operation of ship (crew + context (e.g. weather, current, swell))
	Measuring
	Experiential gap (energy awareness of crew)
Ship - Output	Service
	Waste
	Energy knowledge

Table 8: Concourse sectors with belonging topics, adapted from Table 4 (Chapter 2)

Category	No.	Statements
Corporate - Input	1	Alternative fuels (e.g. bio-methanol, electricity) will make up for the largest part of sustainable maritime energy developments [1]
	2	Our company will thrive if every department has employees with knowledge of sustainable energy use [2]
	3	Maritime corporations and society can rely on technological advancements to solve energy issues [1]
	4	International sustainability criteria for all maritime energy sources are essential for a more sustainable industry [3]
Corporate - Throughput	5	Our company has the responsibility to cooperate with governments and the IMO to achieve a stronger global authority for sustainable maritime energy use [3]
	6	Our company hires, or should hire, an Energy Manager with a specific energy focus in 1) accounting and economic analysis, 2) maintenance, 3) auditing, 4) measuring and verification, 5) coordination [2]
	7	Economic prosperity of our company is necessary to make an energy transition possible [1]
	8	Our company should move towards reducing the total energy consumption [3]
Corporate - Output	9	Our company should actively and equally put energy in environmental, social and economic prosperity [3]
	10	Our services should not harm any of our economic, social and environmental stakeholders [3]
	11	Our company contributes to sustainable technological progress by sharing knowledge [1]
	12	Transparency to society about maritime energy consumption is an important part of a sustainable industry [2]

Table 9a: Twelve Q-statements relating to corporate-level decision-making; in the Statements column, between [ ] are viewpoint categories: [1] Technological fix, [2] Human solutions, [3] Holistic approach

Category	No.	Statements
Ship - Input	13	Due to direct energy savings, energy efficient ship design is essential for sustainable ship operation [1]
	14	To evaluate sustainable use of energy our company should aim to account for all materials involved (e.g. batteries, filters, coatings, etc.) [3]
	15	Since there is no absolute sustainable energy solution, it is best to install a diversity of energy technologies on board ships [1]
	16	All crew members should receive specific energy awareness training to achieve sustainable energy use cultures on the ships [2]
Ship - Throughput	17	Technological advancements are essential for energy efficient ship operation [1]
	18	Maritime officers' navigational and mechanical skills and understanding of the conditions at sea are essential for energy efficient ship operation[1] [2]
	19	On board our ships it is important that we measure energy use as accurately as possible for as much equipment as possible [3]
	20	Each of our crew members are aware, or should be aware, of the amount of energy use that comes with each of their operations [2]
Ship - Output	21	Our company should withdraw from a project or service if a ship will use too much energy (e.g. due to demanded speed, travel distance, or the weather conditions) [3]
	22	Close to all energy waste (e.g. heat or emissions) should be prevented, reused or regenerated [3]
	23	Crew's energy saving knowledge is extremely helpful to improve the energy sustainability of our fleet and the maritime industry in general [2]

Table 10: Eleven Q-statements relating to ship-level decision-making; in the Statements column, between [ ] are viewpoint categories: [1] Technological fix, [2] Human solutions, [3] Holistic approach

6.2: P-SET

Q-methodology is a qualitative research method that is aided by quantitative tools, and it uses a relatively small number of research participants to map distinct (subjective) viewpoints on a selected issue. The group of participants (the P-set) for this investigation are purposely selected with the idea that they will be knowledgeable on the combination of the discussed subjects. As such, the P-set is expected to be involved with energy-related questions with regard to the economic and technological side of things but may as well have a broader view on the environmental and societal aspects. The position titles of the candidates are (Global) Sustainability Director or Manager, or Environmental Coordinator.

Unfortunately, due to the short period of time and a pandemic that scourges the world in general and the maritime industry in particular, it has not been possible to successfully grow a network of sustainability managers that could partake. However, although it is a rather limited number of participants, five people did participate, and three of them have been interviewed after the sorting exercise as well. This has been sufficient to draw some conclusions and identify focal points for further investigation in this thesis and for future research. All of the respondents were Belgian or Dutch and worked for companies that are involved with projects worldwide and are based in these countries as well. Four of them worked for maritime construction firms in dredging and/or offshore constructing (e.g., wind parks, oil platforms or land reclamation), the other candidate was a sustainability manager of a shipping management company. Such a firm is not an owner of ships, nor does it decide on the type of service that is delivered. However, they do often lead the newbuild projects, completely manage the maintenance systems of ships and the human resources necessary to operate them.

One of the participants was a professional contact before this research, the others have been reached by the method of snowball sampling. This method is motivated by the need to identify people who are not particularly easy to find, especially because of the specific demanded criteria and the non-existence of a collective in which the sustainability managers cooperate towards a common goal.

6.3: FINDINGS: Q-SORTS

Factor analysis and interpretation

Due to the small number of participants, it has not proven helpful to analyse the participants' Q-sorts completely in the traditional manner through factor analysis. Therefore, the analysis relies more on a qualitative strategy than a quantitative one. However, the statistical analysis of the Q-sorts[52], which reveals the ranking of statements relative to each of the other statements in the same sort, does provide some initial handles for the interpretation process. Although a focus on the anticipated factors ('Tech', 'Human', 'Holism') intuitively highlights the preferences of some participants, the z-score tables elucidate a focus on the input, throughput and output of a firm's energy flow.

---

[52] *Appendix II.*

With a larger P-set sample the anticipated factors could prove to be a helpful perspective of analysis. However, the conducted Q-sorts seem to be too dispersedly ranked to come to such a conclusion. Nonetheless, one could see that participant A seems to have a stronger preference for 'Holism' statements, and participant B clearly agrees most with 'Tech' statements. Yet, splitting the five Q-sorts in new factors, after a varimax factor rotation and calculation of z-scores, would place both candidates in the same 'idealised Q-sort'. Although this is merely a split of three people (group 1) and two people (group 2), there is an interesting distinction to be seen that evolves around the points of disagreement between the two newly revealed factors.

Interpretation

Let me first state that, for the sake of clarity, in the interpretation I am using words like 'agree/disagree' with statement, or 'support/reject'. However, as has been communicated with the participants as well, all of the statements arguably represent some approach to maritime energy sustainability issues. It is therefore well possible that, where I write 'candidate X rejects statement Z', the candidate does not actually disagree with the statement but just agrees more with other solutions. As participant A - who also appeared to have the most holistic viewpoint - stated[53]: "I would have agreed with all of the statements". On the other hand, one candidate was also very clear about one of the statements in the opposite direction: "I just do not agree with that". Moreover, considering the subjectivity of performing a Q-sort, it needs to be said that there is no right or wrong way and there can be no criterion to validate a point of view.

Whereas the first group strongly believes that sustainable maritime energy development will mostly come from alternative fuels, the second group seems to disagree with that thought. Further analysis of the pair of group 2 shows more similarities between the two respondents. Both of them disagree that each department of the company should have energy-knowledgeable people on board, although that was a thought that all respondents held. Opposingly, candidate C and D were the only ones to disagree more with statement 4 (to have international sustainability criteria for all maritime resources) and to rather agree with statement 18 (on the importance of maritime officer's navigational and mechanical skills).

---

[53] Semi-structured post-sort interviews took place - in which participants A, C and E added supplementing thoughts on the four statements that were placed in the extremes of the Q-grids. Each can be found in *Appendix III*.

Looking at it from the input, throughput and output perspectives - and categorising the ship's energy decisions largely in the corporation's throughput section in line with the findings of *Chapter 2* - one could notice that both participants largely focus on the energy throughput processes of the firm. More than the group 1 respondents. In other words, for these people it seems to be mostly important that energy use is accurately measured and that the crew on board the ships are energy aware and are listened to ashore. These participants also mostly disagree with each of the statements belonging to the corporate-level energy input decisions category.

Thus, all of the group 2 preferences notably focus on the throughput processes within the firm and - even more so - on ship-level decision-making. Only statement 6 (hiring an energy manager) - a throughput statement - scores significantly positive as a company-level statement by participant C. Otherwise, the only statements that may arguably not belong to the throughput stage but that the group 2 participants do agree with, are statement 17 (on technological advancements) and statement 22 (on energy waste). From statement 17 one could say it largely depends on the technological development of the 'outer world', on which a company does not have a lot of influence and thus rather belongs to the (company-level) input category. Statement 22 aims at practices such as energy waste prevention, reutilisation or regeneration. These are active processes (throughput), but energy waste in itself is clearly something that belongs to the output section of energy sustainability questions.

Instead, group 1 seems to prefer to aim for solutions in either the input or the output stages of the maritime energy chain. Even though some of the ranked statements do weaken this line of thought. For example, statement 8 (reduction of total energy consumption), statement 15 (diverse energy technologies) and statement 23 (crew's energy saving knowledge) each received some positive attention from at least one of the group 1 respondents. The same counts for statements 17 and 22, but - as we have seen - these do not necessarily belong to throughput categories. Something similar could be said of statement 7, which states that economic prosperity of the firm is a necessary premise for an energy transition. This statement is initially placed in the throughput category with the idea that the process of achieving economic prosperity belongs to throughput decision-making. However, one could also argue that it is translatable as 'money first' before a possible transition could take place. In other words, seeing it as an indispensable, economically sustainable input that is ranked higher than and would come before any of the other stages of energy sustainability.

Such an interpretation would lead to the view that group 1 has - at least - a slight preference for a focus on the input and output, whereas group 2 has a strong preference for the throughput. This finding makes it interesting to have another look at some main disagreements between the two groups. We could then see that two out of three respondents of group 1 appear to favour energy sustainability decisions that lead to diverse energy input technologies (statement 15) in line with the trust of each of this group's respondents in the technological solutions of - especially - alternative fuels (statement 1). And this was, as we saw, the most significant disagreement between the two groups. It is likely that this difference also grounds the lower ranking of statement 4 (international sustainability criteria for all maritime energy sources) by group 2. If alternative fuels will not be the main solution for future energy sustainability, it also deems less necessary to work on such criteria. Rather, this group focusses on the knowledge and skills of efficient ship operation by the crew (statements 18), which is significantly less important for group 1.

The last aspect of this investigation that attracts attention is the consensus around two statements. Most of the participants strongly disagreed with statement 2 and statement 21. Statement 2 is based on the thought that energy decisions appear to be made in every department and each hierarchical level of the company. By using the words 'our company will thrive', the statement might be somewhat ambiguous, because what is to 'thrive'? Of course, it could - for example - also refer to the well-being of crew members or the firm's employees in general. Here, I assume that it is most likely that it is taken to mean 'economic prosperity', or at least 'do well' of which the financial aspect is an important part. This would lead to two possible explanations. The respondents either deny that each department should be involved with energy decisions, or they hold that this is - economically - not interesting.

Four out of five participants were also clear about decisions that prioritise a value of energy frugality (statement 21) in conflicts with the fulfilment of a certain project or service. They oppose that the company should reject projects that demand too much energy, or they would just not see it happen. Only participant D related more neutral to this statement.

Validation

It seems that the findings of this empirical investigation are in line with the findings of *Chapter 2*. Namely, that (CSR) decision-making on energy sustainability is practiced in separated parts of the corporate's maritime energy chain. In other words, there appears to be controversy of how to approach the issue in the best way. A comprehensive ray of possibilities does exist and different solutions from that collection appear to be practiced. However, a strategy that coherently combines and links these solutions seems to be missing. To reiterate the observation of Roszkowska-Menkes (2017), not the absence of a universally accepted definition of CSR is problematic but rather that there is insufficient guidance on managing the related issues (Roszkowska-Menkes 2017, 75).

This is not to say that the participants were not aware of the interconnected topics with regard to maritime energy sustainability. On the contrary. It is rather that the respondents had their own preferences in approaching the subject. In the post-sort interview with participant C, for example, this sustainability manager emphasised the importance of linking the ship-level energy input with the ship-level energy throughput: "Ships are built with a certain philosophy, but each crew member has own experiences and they should learn to deal with the new ship. There is no point in building a frugal and efficient vessel if you do not pay attention to the crew". On the other hand, the same participant disagreed with the statement that each department of the company should have employees with knowledge of sustainable energy use. Through this person's eyes, energy sustainability is a separated branch of expertise: "I don't think everyone is interested in the environment and that's fine; others are more interested in making sure things run smoothly". However, it may well be possible that this conviction underlies the lack of a coherent approach to tackling issues of energy sustainability. In the interview this participant's position was described as the dedicated environmental person on the technical department. The question is, more specifically, whether one such position on one such department is sufficient to tackle the dire issue of maritime energy sustainability. Moreover, a further question would be whether - with regard to sustainability - there should be a focus on one such topic, the environment.

Remarks on anticipated factors

In addition to the Q-sort analysis that indicated differences in focus on the input, throughput or output of the maritime energy chain, a discussion of the additional post-sort interviews sheds a light on the initial approach of this investigation as well. The above discussed respondent was one of three participants that leaned to one of the anticipated factors of 'Tech', 'Human' and 'Holism' most clearly: in this case, the 'Human' factor. The preferences of these maritime sustainability managers indicate that the original idea was not far-fetched at all and may be a fruitful point of entry for future research. Of the remaining two interviewed participants, one seemed to prefer aiming for a technological fix while the other one scored higher on holistic approaches.

In line with these anticipated viewpoints, the Q-sort of participant E matched a more 'Tech' way of ranking. Summarising the interview, this perspective was clearly presented by remarks such as "use another fuel, which is also circular, and then you're actually already there", "we need to emphasise more on the economic, then the social and then the environmental aspects", "morally speaking the corporation does not have responsibility for this [cooperation toward sustainability with authorities]" and "[if] all used energy is renewable, then you could use as much of it as you wish". The issues with this view have been briefly discussed in the introduction and are addressed more specifically in the next.

Lastly, the interview with participant A - that rather matched a 'Holism' perspective to maritime CSR on energy issues - could be summarised in just one answer the person gave: "We have to act responsibly in every aspect. Momentarily it is still an accepted opinion if coral is ruined at one side, when at the other side something very good is done economically or societally. In the long run this is not tenable". In other words, indirectly, this respondent claims that it would not be a sustainable approach if energy decisions do not come to the benefit of each of the pillars of sustainability; referring, in that sense, to whether an energy sustainability approach is coherent or not.

6.4: CHAPTER CONCLUSION

The main take-away of this empirical investigation certainly is the finding that approaches to energy sustainability by the different managers predominantly focus on either one (or two) of the sections of the energy chain, but not all three. Moreover, as suggested in *Chapter 4*, the research confirms a value conflict surrounding measures that prioritise the value of frugality.

The empirical data correspond with the presentation of *Chapter 2*, in which I concluded that maritime CSR practices seemed to be comprehensive, but lack in coherency. Some hold that it is all about having a sustainable input of energy supply, others focus on the output as well, and some find the throughput section of utter importance. One of respondents ranked the holistic statements highly but seemed to have ranked the Q-sort more or less in line with this finding as well. However, the post-sort interview with this participant revealed a more coherent story and thus a holistic perspective in which 'the whole' of energy sustainability is more than its parts. It lacks sufficient data to conclude that this is a subjective viewpoint that is held by more maritime sustainability managers.

CHAPTER 7: MARITIME CSR DESIGN REQUIREMENTS

In this chapter I operationalise the value considerations of an energy holism in the context of the maritime industry by integrating them into the organisational structure of maritime CSR. A holistic understanding of energy would recognise (1) that energy is not consumed (and used up) but merely transformed into different forms, (2) that each energy transformation has its positive as well as negative environmental and societal consequences, and therefore (3) that this requires a just distribution of both energy use's benefits and harms among environmental as well as social stakeholders. Integrating the corresponding value considerations into the design of the maritime CSR leads to changes in the social as well as the technical system.

As such, an energy holism would have distinct implications on each of the stages - the input, throughput and output - of the maritime energy chain, which I discuss in the subsequent sections of this chapter. Useful contributions have come from the environmental ethic of deep ecology and the field of energy justice. These fields consider a just energy system as one that recognises humans' interconnectedness with nature and all organisms and beings as equal members of the whole ecosystem (Desjardins 2013, 216), and as "a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making" (Sovacool & Dworkin 2015, 436). As I have explained in the introduction, sustainable processes - in order be framed as such - will need to comply with principles of sustainability throughout the energy chain. A sustainable energy chain can be seen as an accumulation of the sustainability of each of its stages. For maritime energy sustainability this entails that the supply of energy, the energy processes within the firm and on board the firm's ships, as well as the energy output should all meet corresponding values of sustainability.

In the following sections I discuss the design requirements that follow from the value considerations energy (*Chapter 4*), responsibilities (*Chapter 5*) and the findings of the empirical investigation (*Chapter 6*). I have partitioned these considerations to correspond with each of the stages of the maritime firm's energy chain (see *Table 10*). The topic of the first section relates to changes in the CSR design for sustainability assessment and decision-making with regard to the maritime energy input. Similarly, in the second section I discuss throughput decision-making. In the last section I discuss the maritime CSR requirements for two different kinds of maritime energy output. Namely, the output of types of energy and the output of types of service.

Input values	Throughput values	Output values
compliance with input, throughput and output sustainability: - environmental (i.e., ecological) continuity  - economic continuity  - social continuity 	*frugality, sufficiency and compliance with a natural contract, by:* - use of diverse energy resources and technologies - education and training on: - the interconnected energy relationship with natural world - energy frugal skills and practices - design with nature - just, fair and transparent measures and procedures with inclusive stakeholder representation: - collaborate with associate organisations and institutions - cooperate in the formation of agential collectives - local autonomy and decentralisation of power	*equitable and diverse (i.e., intra- and intergenerationally just) distribution of social and environmental costs and benefits of the energy output:* - meeting human's needs and complying with human rights and help improving global situations - meeting nature's needs and reducing harm to the natural environment - meeting economic needs

Table 11: Overview of values and CSR design requirements for maritime energy sustainability, originated in the considerations on energy holism (Chapter 4) and corporations' responsibilities (Chapter 5)

7.1: INPUT

Regardless the type of project, for this section it first needs to be said that the same input-throughput-output sequence applies to the input stage of maritime energy use itself as it would to the whole firm's process. As such, the energy holism framework would serve as an analytical tool rather than being practically oriented. As long as a maritime corporation is not the producer of fuels, it may not be of their concern to apply principles of energy ethics to the production chain. However, although it goes beyond the purpose of this thesis to get into detail about each energy technology production chain, it should be of the maritime corporation's concern to assess the sustainability of the energy input as a part of the energy sustainability of the whole firm.

For example, biofuels - as an emerging energy input for maritime corporations - would only be sustainable when (a) the initial conditions comply with aspects of sustainability such as the farmer's financial situation, the farmers' communities' living and working conditions, and the environmental condition of the agricultural land (input); when (b) the local biomass producers remained autonomous in their decision-making (throughput); and when (c) the benefits and harms of this biomass production are distributed among the direct and indirect stakeholders (output). Within a biomass energy chain, from which biofuel but also food is made, the output refers to the purposes for which it will be used. For example, regeneratively, for food or for biofuel production. Frankly, a biofuel could not be called sustainable when it harms food security on the short- or the long-term. On the contrary, based on the presented output principles, a biofuel production may only be called sustainable when - at the same time - it benefits food security (and thus future growth of crops) as well.

Similar value conflicts may be seen in the energy chain of storage technologies (batteries, particularly) or nuclear technologies. The mining of the necessary materials for these energy carriers and sources could only be called sustainable when the mining practices would not only minimise harm but also increasingly be beneficial for the mineworkers. However, especially for nuclear technologies, issues with intergenerational equity illuminate a value conflict between present generations benefits and future generations harms. It seems to be uncertain whether the future generations will benefit from nuclear technologies due to the scarcity of the needed material, while the nuclear waste problem might well be a prolonged issue for future generations. Although ethics of nuclear energy is more complex than this presentation[54], currently it seems to be impossible to call it a sustainable energy. Even when a large number of present stakeholders may benefit from this technology and the waste problem in terms of space would not seem large, the effects are severe for many (human and non-human) generations to come.

These potential energy value conflicts require multidisciplinary assessments of the societal, environmental and economic sustainability of the energy technologies. Therefore, collaboration is needed with those institutions that are able to provide such information if the maritime corporation lacks capability. Examples of such institutions could be governmental and non-governmental organisations, universities and formed collectives with other maritime firms.

[54] For example, see Taebi & Kadak 2010, Taebi 2011, McCauley et al. 2018, or Sovacool et al. 2019.

To conclude the maritime energy input section, what matters mostly here is whether the local conditions of environmental and social sustainability are met, before the maritime supply is secured. In other words, according to this framework, in maritime decision-making on sustainable use of energy lexical priority should be given to the principles of environmental and social sustainability over the economic sustainability through maritime firms' needs (see *Table 11*).

Input values	CSR design requirement	Examples of implementation
Compliance with input, throughput and output sustainability of the energy supply (technologies)	assessment of: - environmental (i.e., ecological) continuity - social continuity - economic continuity	collaboration with: - universities, and governmental and non-governmental organisations - other maritime organisations (e.g., shipowners and classification societies) in cooperatively formed collectives

Table 12: Energy holism input values, maritime CSR design requirements and examples of implementation

7.2: THROUGHPUT

Derived from a holistic approach to energy, the main values for a sustainable energy throughput relate to energy frugality and sufficiency, as well as a compliance with a natural contract. In this section I discuss the CSR design requirements that should provide for these values (see *Table 12*). As Seumas Miller (2015) has pointed out with his examination of designing for values in institutions, systems of organisations (such as CSR) have a function that directs - and is facilitated by - its structure and culture. In other words, maritime CSR with the function of contributing to energy sustainability should align the organisational structure and culture accordingly. Regarding the interconnected relationship between human and nature, Giovanni Frigo (2018) demonstrated that "this will require a change in mindset [...] and not only a change in policies or technologies" (Frigo 2018, 3). Similarly, energy decision-making in accordance with frugality and sufficiency principles may require changes of skills, practices and procedures within the corporation. Or, also here, in some cases it might merely require a change of mindset to employ existing skills, practices and procedures for the adjusted CSR function.

Recalling the findings of *Chapter 6*, a value conflict has been identified with regard to the principle of energy frugality. As discussed in *Chapter 5*, such a conflict should be dealt with by reverting to the ability, justification and fulfilment conditions

Throughput values	CSR design requirements	Examples
Frugality, sufficiency and compliance with a natural contract	1) just, fair and transparent measures and procedures with inclusive stakeholder representation 2) local autonomy and decentralisation of power 3) education and training on: - the interconnected energy relationship with natural world - design with nature	1) compliance with MRV regulations 2) collaborate with associate organisations and institutions; cooperate in the formation of agential collectives 3) training of and deliberation on energy frugal design, skills and practices of all employees that involved in energy decisions 4) start sustainability office 5) use of diverse energy resources and technologies; use of wind and currents for route planning and design of ships, and for the design of construction projects

Table 13: Energy holism throughput values, maritime CSR design requirements and examples of implementation

Measures and procedures

The first maritime CSR design requirement regarding energy throughput relates to the necessary environmental and social sustainability of a maritime corporation's energy input. This puts forward the inevitability of collaboration with associate organisations and institutions. Other throughput principles similarly stand in close connection with the input's origin and/or the output's objectives. Matters such as efficiency, and the optimum and fairness of energy use ask for operational transparency to close experiential gaps and the hearing of multiple sides, representing direct and indirect stakeholders. Among those are the environmental stakeholders that may need to be represented by human scientists. The energy needs of the environment may not always be as clear as the energy damage that is (being) done to it.

Furthermore, energy decisions are being made by groups or individuals at each level of the maritime firm, from corporation wide to specific departments, on to the ship level. This requires monitoring, different degrees of transparency for distinct direct and indirect stakeholders in line with the EU's MRV regulations, as presented in *Section 2.2*, Additionally, it needs organisational structures that encourage learning and innovation (Johnson & Andersson 2016, 94). These requirements thus emphasise the role of *examples 1)* and *2)*: appropriate energy decision-making measures and procedures, collaboration with associated organisations and institutions, and cooperation to form agential collectives[55].

Local autonomy

The second CSR design requirement in this section refers to the autonomy of those that are involved in energy decisions. The value of compliance with a natural contract[56] entails that energy decision-making with respect to the design of ships and projects will put the needs - and not only the limits - of the ecosystem high on the list. Even though this may result in value conflicts relating to the speed or even the rejection of fulfilling a service.

This could lead to value conflicts between local, context dependent concerns and those of the end customer and/or the management's side. For example, practically, when weather conditions do not allow safe energy frugal operation there are two safe options: either no or a non-frugal operation of the ship. The aim for efficiency on a ship within the context of particular weather and water conditions should prevail over the economic factors, in line with the value of energy frugality. Moreover, with respect to the ship level, we have already learned that the practical, localised, tacit and collective know-how of the crew members on board is essential for energy efficient ship handling (Viktorelius 2018). This confirms local autonomy as an important principle within the throughput section. However, it also elucidates that energy frugality practices and skills require the appropriate training of the crew on board and the desirability of deliberation between crew, management and (possibly) other stakeholders.

Another conflict may be a design of ships that would be sub-optimal in terms of efficient operation but ecologically more effective. This might be the case with a diversity of energy sources that likely demand more space than fossil fuel, or with the installation of thermal insulation as another effective measure for energy frugality.

The above reveal the importance of *example 3)*: the training of and deliberation on energy frugal design, skills and practices of all employees that are involved in energy decision-making. Which refers to all employees that make *any* energy decision for their work for the company and thus, practically, each employee.

---

[55] In *Chapter 5, agential collectives* have been defined as (1) including members who work toward a common goal and act responsively to one another, and (2) having a well-defined collective-level decision-making process that is distinct from that of its members (Collins 2019, 944).

[56] Recall that a natural contract implies (negative and positive) duties toward the environment, in addition to those toward humans (see *Chapter 5*).

Training and education

This brings us to a third CSR design requirement for maritime energy throughput: education and training that aims for comprehending the interconnectedness of humans with nature, particularly through the use of energy. The people on board ships will have to work towards goals that are decided upon by the organisation with the available equipment. In other words, decisions with regard to the design of ships, the types of (energy) technologies and the types of projects that need to be carried out are all being made by collectives that consist of other individuals or departments within and outside the firm. Therefore, in order to contribute to energy frugality and to comply with a natural contract, energy sustainability education and training concerns employees of many - if not all - of the maritime firm's departments.

Example 4) represents an ideal concept for this requirement: starting a sustainability office. The Green Office model is well-known by universities across Europe and won a UNESCO-Japan Prize on Education for Sustainable Development. It is a 'sustainability hub' which empowers students and "informs, connects and supports students and staff to act on sustainability" (Green Office Movement, 2020). In other words, the structure of the concept works with top-down and bottom-up change of organisational cultures and - although not yet implemented in corporate environments - may be helpful to connect and inform people in firms as well.

For example, technical departments will need to be trained at *example 5)*: diversifying their energy technology designs. This should lead to diverse extraction of energy resources from nature and a release of diverse energy forms to nature.

Similarly, employees are to be trained to design ships and maritime projects in accordance with the forces of nature. Examples that could be named for this requirement are plentiful. A typical ship that is designed with nature is the sailing ship, but also routes may be adjusted so that there is an optimal usage of the currents in seas and oceans. An example of a maritime construction project that is designed with nature is the construction of the sand engine (De Schipper et al. 2016). This is a 'nourishing' peninsula that was made at the coast of South-Holland in the Netherlands to reinforce the Dutch coastline by the sea's currents that transport the peninsula's sand.

Economically, such examples may not be in the direct interest of maritime firms. Ships may not sail the fastest routes and coastlines that are reinforced by peninsula's ultimately require less ships for sand replenishment. However, these designs with nature are exemplary for meeting sustainable output requirements that are the topic of the next section.

7.3: OUTPUT

For the topic of sustainability of the energy output of a maritime firm I will split this subsection in two distinct outputs: types of energy and types of service. Both relate to a holistic understanding of energy and decision-making in all layers of a corporation. Nonetheless, types of energy output would mostly link to ship specific design and operation, whereas strategic decision-making rather concerns the types of service. As such, as I will discuss in this section, a sustainable output refers to the ecological circularity of energy flows and a socially and environmentally just distribution of energy services (see *Table 13*).

Output principles values	CSR design requirement	Examples
Equitable and diverse distribution of social and environmental costs and benefits of the energy output	Assessment of: - contribution to human's needs, compliance with human rights and help improving global situations - contribution to nature's needs and reduction of harm to the natural environment - contribution to economic needs	Output of energy: - disperse types of energy output - collaboration with parties increase vegetation that processes CO_2 (especially practical when biofuels are employed) - employment of regenerative technologies such as waste heat recovery systems or kinetic energy recovery systems Output of service (assessment): - Collaboration with: - universities, and governmental and non-governmental organisations - associate organisations and institutions

Table 14: Energy holism output values, maritime CSR design requirements and examples of implementation

Output of energy

There are two main reasons to rethink how energy is distributed in the ecosystem. First, material that is important for human energy use is taken from many different parts of the ecosystem. Think of drilled oil, mined minerals or biofuels from agricultural biomass. Second, the energy use only transforms the type of energy and thus continues to play a role in the ecosystem. Instead of merely mitigating certain types of emissions, it should rather be questioned what types of energy could be useful for specific environmental stakeholders.

The first dimension of an energy holism - regarding the circularity of energy flows - has several consequences for maritime energy sustainability. Firstly, in addition to efforts to stay within the limits of the ecosystem's capacity (which often refers to the reduction of emissions), maritime corporations should focus on the actual needs of the environment. In other words, while CO_2 emissions have been superfluous for the environment, other types of energy output may be useful to certain environmental stakeholders or at least put less pressure on the ecosystem as a whole. This supports the idea of the employment of a diverse range of energy technologies so as to diversify the output of them as well. While maritime use of fossil fuels is responsible for significant amounts of CO_2 and other emissions, even a partial supply of energy through alternative technologies such as biofuels, e-fuels or the joint use of electricity producing technologies with energy storage technologies would contribute to such diversity. It is important to understand that this diversity does not contribute to energy frugality in any sense, it would merely disperse the types of output. Moreover, also these technologies should again be subject to sustainability assessments as described in *Section 7.1*.

As a second consequence of the circularity of energy flows, we could further reflect on CO_2 emissions as an example. CO_2 is known to be an important substance for the growth of trees and plants. An energy holistic focus on that need would demand for the maritime corporation's collaboration with parties that put effort in a flourishing environment of a - literally - increasingly green world. Indeed, especially with the maritime employment of biofuels, a link with the input stage of the energy chain is easily made. As we have seen in the input section, biomass production should sustain future growth of crops and secure local food security. In addition, for maritime energy output, biomass production should then also be sufficient to not only facilitate the reduction of carbon emissions compared to the current standards, but to actually reduce the total proportion of CO_2 in the ecosphere.

The principle of energy frugality may be achieved by throughput improvements on (e.g.) the hull or thermal insulation, but also by a practical focus on regenerative energy technologies. The output of maritime energy use does not only lead to forms of energy such as gaseous emissions or other material 'waste' but also the production of excessive heat and motion. Clearly, thermal insulation would be preferable over thermal heating to the regulation of temperatures on board, as that would prevent energy use. However, temperature regulation could be combinedly achieved by the employment of waste heat recovery systems[57]. Similarly, kinetic energy recovery systems[58] could be applied to regenerate energy that has been used to set machinery in motion. As a direct contribution to the throughput's principle of energy frugality, the design of ships should aim for the reutilisation of as much of these energy outputs as possible.

Output of service

The second and third elements of an energy holism relate to the contribution and challenges to sustainable development by the use of energy. The output of maritime energy use in terms of provided service should therefore be subject to a similar sustainability assessment as the input of maritime energy use. As discussed above, with regard to the sustainability of energy input, it would matter how the output of biomass production is distributed among the societal, environmental and economic stakeholders. Similarly, it also matters how the output of maritime energy is distributed. We have just seen that a sustainable output of energy should partially contribute to environmental development. Additionally, energy should be justly distributed among the social and the economic dimensions. After all, the outcome of the maritime activities should serve the continuation of the corporation. Yet, as I demonstrate in the following, it is unlikely that we could refer to a sustainable use of maritime energy if the services would not benefit societal development as well.

Although the maritime industry knows many different kinds of ships that may be employed for numerous purposes, the same kind of value conflicts could be identified with most maritime activities such as tourism, transportation of goods or maritime construction work. In the end, what matters mostly is the accumulated sustainability of the energy and energy technologies that are used as an input for the activity, how much and through what procedures energy is used, and in what way the maritime energy use contributes to sustainable development. With the transportation of goods, there would be a clear distinction between a sustainably built sailing ship[59] or a modern containership. The distribution of harm of the first type of ship is probably negligible and the sustainability factors of the energy throughput and energy output would thus be of lesser

---

[57] Waste heat recovery (WHR) systems are used to regenerate energy from excess heat of combustion engines as well as fuel cell applications. With combustion engines WHR converts heat from the exhaust and coolant into mechanical or electrical energy and is estimated to reduce fuel consumptions with 4-16% (Balcombe et al. 2019, 81).

[58] The regeneration of energy that is used to set objects in motion is widely applied in car braking systems (e.g., Wen & Tien 2018; Latha et al. 2019). A similar technology has also successfully been applied in other industrial machineries such as cranes (e.g., Lin et al. 2017).

[59] In modern times there are traditional, 'engine-less' sailing ships active for the transportation of goods around the world as well. For example, the Tres Hombres and the Nordlys of Fairtransport Holding B.V. (http://fairtransport.eu).

importance. As long as the output of the maritime services are not harmful otherwise, it does not seem to matter much how many miles a sailing ship would cover. Contrarily, a modern containership - for which we have seen there are no technological solutions available within the foreseeable future to significantly diminish environmental and prevent societal harm - would certainly need to score well on the throughput and output factors to morally legitimate its energy intensive activities. Such a ship that would score low on the energy input factor due to the polluting fuels, may not be called sustainable without significant efficiency improvements (throughput factor) or if it merely transports Japanese Sea water to the Atlantic Ocean (not contributing to sustainable output).

Practical maritime examples of energy use that contributes to sustainable (environmental development) would span from rectifying previous harm through The Ocean Cleanup (2020) or a Coral Rehabilitation Initiative (Ter Hofstede et al. 2019), to actively devoting energy to nature's flourishing by saving stray marine life or rehabilitation centres for seals (e.g., The Marine Mammal Center n.d.). However, a critical remark needs to be made when such projects require additional use of energy since they are not part of normal operations, which is often the case. Moreover, it needs to be admitted that such projects - as of yet - depend on alternative business models or philanthropy. In other words, a long-term societal systemic change might be required, which could be influenced by efforts to change maritime CSR practices.

It could also be defendable to call the use of maritime fossil fuels sustainable (with room for improvement) if a ship's output completely contributes to SDGs such as energy access for schools and hospitals in the developing world[60]. This reveals some potential value conflicts within the output stage of maritime energy use between environmental, economic and social development. The introduction of some extreme (and perhaps unlikely) scenarios of building a wind park at sea, might clarify how such value conflicts may be approached.

Let us think about an imaginable wind park to be built at sea. This would be an energy intensive maritime project due to the transportation of windmills and other construction materials, and the heavy-duty activities of constructing and laying cables. Thus, the energy costs - i.e., the

[60] A special type of ship that is worth mentioning here, is the emerging type of 'powerships' (Günel 2017). Relatively speaking, these ships do not use much or any energy for propulsion and hardly any for the crew's life on board; the one and only function of these ships is to serve as floating, and therefore flexible, energy plants wherever they are needed. Powerships are fuelled by different types of fuels (Karadeniz Holding, n.d.): the regular maritime heavy fuel oil (HFO) or liquid natural gas (LNG).

social and environmental harm - will be inherently significant. In itself such a wind park could contribute to a much more sustainable energy supply of the area, even taking the energy into account that it costs to build the park[61]. However, the question whether the wind park contributes to sustainable development depends on the purposes for which the wind energy will be used. For example, what if the output of the wind park is never connected ashore and the wind energy is never used? Or, what if the energy is used, but instead of supplying hospitals, schools and universities it is used only to supply energy for the heating of football stadiums, purely for human comfort for which an alternative would be available[62] in the form of clothing? Lastly, as an even less likely however clarifying example, what if the windmills' energy will be primarily used for dark purposes of death or destruction?

These cases are putting some value conflicts and other issues forward that should be incorporated in the assessment of the sustainability of the maritime energy output. The problem with such assessments may be that it is not in the hands of the maritime firm whether the powerlines are actually connected ashore or not, or - subsequently - how and to which stakeholders the energy will be distributed. The shipping companies may have limited knowledge, influence and responsibility. However, I believe the examples show that the involved maritime companies should consider the future plans with a wind park before accepting the construction project, whilst constructing and even after finishing their part. In other words, for sustainable energy management this highlights the importance of (again) collaboration with the associated organisations and institutions; principles of just, fair and transparent procedures (of the wind park owner in this case); and the equitable and diverse distribution (of both the maritime energy output as well as the output of the wind park).

Section conclusion

With regard to the energy sustainability's output stage, this section continued on the elements of an energy holism, as presented in *Chapter 4*. These elements ought to be built in or to be assessed, as a maritime CSR design requirement, to secure a sustainable maritime energy output. First, the

---

[61] This would be a typical project for which EROEI calculation (see *Chapter 4.2*) could be used to calculate whether the wind energy that the park is expected to gain outbalances the energy investment.

[62] If there would be no alternative available, the situation would become somewhat more complex. The question whether human comfort in a football stadium contributes (sufficiently) to sustainable social development might depend on subjective opinions, but also on the societal role of the events that take place at such locations.

circularity of energy flows demands a dispersed output of energy types and thus a diverse employment of energy technologies on board ships.

Second, maritime corporations should not merely focus on the mitigation of negative environmental consequences of their energy output but also on how it could contribute to environmental flourishing. This requires a change of mindset of people involved and a focus on designing with nature, both topics that have been discussed in the previous (throughput) section. Such changes require a (macro-level[63]) long-term societal systemic change. However, this may be achieved or influenced by efforts in changing maritime CSR practices.

Third, a holistic approach to energy reveals not only the contribution but also the challenges to societal development by energy intense maritime projects. As such, a sustainable energy output of the maritime corporation should explicitly contribute to energy input sustainability as well. This has the implication that maritime firms should consider the equitability and diversity of services they are contributing to. Therefore, it should be assessed whether these services satisfy the energy sustainability principles, similar to the assessment of the maritime firm's energy input.

7.4: CHAPTER CONCLUSION

In this chapter I have identified maritime CSR design requirements and some related potential value conflicts by discussing its implementation. The overview of maritime energy sustainability principles and CSR design requirements, as presented at the beginning of this chapter and each of the sections, may serve as a compass for a maritime CSR design. It may also be useful as an initial sustainability assessment tool for the input and output of the maritime energy chain.

Some of the suggestions may 'merely' require a change of mindset but could lead to energy (and thus financial) savings by just that. Other maritime CSR design requirements may demand a long-term systemic change. To reiterate from *Chapter 5*, maritime corporations have a minimal duty to collaborate to address such global issues that maritime energy use leads to.

[63] As discussed in the introduction, for the design of institutions, Seumas Miller (2015) distinguishes between micro-, meso- and macro-levels of institutions. Although depending on many other factors and piecemeal change, according to Miller, alterations on the micro-level (e.g., CSR) or on the meso-level (e.g., a corporation) could affect the macro-level (e.g., an industry) as well (Miller 2015, 781).

CHAPTER 8: CONCLUSION

8.1: FINDINGS

The main research question that guided this thesis was: *How could a holistic approach to energy contribute to maritime energy sustainability?* This question was answered in multiple steps making use of the VSD method to investigate the topic at different levels: (i) conceptually; (ii) empirically; and (iii) technically. All in all, with the purpose of developing energy holistic design requirements for the maritime CSR system.

Maritime energy use is a nexus of economic, social and environmental issues. Therefore, related questions of sustainability require a holistic approach. Maritime CSR is understood as the main internal system (or institution) within a firm that should advance corporations' contributions to sustainable development. For this thesis, I have facilitated an understanding of the design of maritime CSR and argued that - towards energy sustainability - the (re)design of this institution should start from a focus on energy. The conceptual investigation of energy itself demonstrated the deeper meaning of the phenomenon for societal and environmental stakeholders. The empirical investigation through Q-methodology research revealed the subjective opinion on the topic of maritime sustainability managers as experts and direct stakeholders. Finally, through a technical investigation the findings have been translated into CSR (re-)design requirements and practical examples of the social and technical changes that an integration of energy values should lead to.

The dire maritime energy issue amounts to sustainability challenges at the input of the maritime energy chain (i.e., fuels and energy storage technologies), the energy throughput (relating to the firm's and ship's processes), and the output (i.e., the types of energy and the services that are provided by these processes). Maritime energy sustainability refers to the accumulation of the sustainability of each of these stages. If any of these stages of the maritime corporation's energy chain lack in sustainability, the whole chain lacks in sustainability. Acknowledging that there are no purely sustainable solutions available in the foreseeable future for the energy input, it is thus of utter importance to design for sustainability in each of the energy chain's stages.

In *Chapter 2*, as a first step to answering the main research question it was presented how maritime CSR deals with energy sustainability. The key values of CSR that were identified are the assurance of responsibility and the assurance of sustainability. It was revealed that the burdens at one stage of the operational processes (whether of a ship or of the firm as a whole) are either mitigated insufficiently or compensated for at other stages, and to different stakeholders. It was concluded that maritime CSR may be called comprehensive but does not warrant sustainability due to the lack of coherency between the distinct stages of the energy chain.

In *Chapter 4*, by taking energy as a starting point for the design of the maritime CSR system, I have identified the direct and indirect stakeholders of maritime energy use more accurately. I have investigated the phenomenon of energy more broadly than the predominant explanation in physical units. Just as it is impossible to investigate the value of music by referring to decibels, we cannot discuss the value of energy by considering joules, watts or grams of gaseous emissions only. Contributions to literature in the energy humanities (e.g., energy anthropology, philosophy, ethics and justice), related fields such as the environmental ethic of deep ecology, and an investigation of the tight connections between energy and sustainable development, helped to depict an energy holism.

A holistic understanding of energy would first recognise that human is not a starting point nor an end station of energy use. Energy has a remaining function in ecological processes, also when it is not used by humans. Secondly, an energy holism acknowledges the energy needs of both society and the environment, as well as the energy challenges for sustainable economic, social and environmental development. Both the societal and the environmental stakeholders require a minimum access to energy. Moreover, to mitigate harms to the respective stakeholders, there is a need to limit energy intense activities based on a principle of frugality.

In *Chapter 5*, I have discussed what we may expect of maritime firms in terms of responsibilities to society and the environment. It was concluded that firms should revert to moral conditions of ability, justification and fulfilment in dealing with potential value conflicts, and have a minimum responsibility to collaborate in forming agential collectives for solving global issues such as those with maritime energy sustainability. To prevent moral responsibility of wrong or harmful doing by employees, a corporation should commit in right measures and procedures. Furthermore, with the environment as identified stakeholders, it was suggested that a maritime corporation should not only operate by a social but rather a natural contract. Therefore - due to the inherent harm done by the operation of ships - firms bear negative as well as positive duties to the corresponding stakeholders. As put forward by the incoherency of maritime CSR practices, there appears to be a distributive mismatch between the performed negative duties (e.g., the mitigation of harm) and positive duties (e.g., contributions to the stakeholders' flourishing).

In *Chapter 6*, this incoherency was confirmed by the empirical investigation as a subsequent step of the research project. Q-methodology served to investigate maritime sustainability managers' viewpoints on energy issues within their firms. This also revealed a clear value conflict with regard to energy frugality principles.

In *Chapter 7*, the final step that was made towards answering the main research question by operationalising the above findings in terms of design requirements for maritime CSR. This led to distinct conclusions for the input, throughput and output stages of a sustainable maritime energy chain. First, for the input stage it was concluded that lexical priority should be given to environmental and societal over economic sustainability. Second, for the energy throughput stage the institution's structure and culture should be designed so that it supports principles of energy frugality and compliance with a natural contract. Third, the output of maritime energy use should be diverse in terms of distributed harm as well as benefits to both societal and environmental stakeholders. Each of these findings were supported with concrete examples for social and technical changes with maritime firms through applying a (re-)designed maritime CSR.

8.2: CONTRIBUTIONS

The maritime industry has been called a laggard when it comes to applying and reporting CSR activity and is appealed to cooperate with regulators, educators and researchers to promote the CSR agenda and "lift this task in a sustainable manner" (Froholdt 2018, 1). In recent years, there is a development to be seen in academic literature with regard to maritime CSR and its implementation in MEM. However, what seems to be missing are contributions to these fields that take the actual societal and environmental value of energy into account. With this thesis I am contributing to literature on maritime CSR with a thorough conceptual investigation of energy, which provides useful insights for further academic research.

Furthermore, this thesis contributes to VSD literature by the application of the approach to the design of CSR, as an institution of the maritime firm, instead of a technological product. First, as application and translation into industry circles is still rudimentary (Jenkins et al. 2020, 12). This is not a completely new approach for social innovations; however, currently, it has not been implemented often yet.

A third and last theoretical contribution, are the considerations of an energy holism that is in dialogue with multiple fields within the energy humanities, which recognises a wide ray of aspects of the maritime energy system. As such, it responds to calls from the emerging field of Energy Justice by exploring ecocentric considerations (ibid. 2020, 8)

Practically, this thesis contributes to the possible implementation of energy sustainability values in the maritime corporate organisation by proposing design requirements for maritime CSR.

8.3: LIMITATIONS

The conducted empirical investigation revealed some interesting perspectives but, due to a limited number of participants, some of the findings rather indicated fruitful points of entry for further research than clearly pointing at shared viewpoints.

Moreover, for reasons of limited time and the development of a rather unconventional concept of energy holism, the empirical investigation focused more on the perception of a holistic approach to maritime CSR and less on integrated principles of an energy holism. Surely, there was a clear overlap between the drawn concourse of a holistic maritime CSR and an energy holism. However, it is likely that this has limited the possibility to reveal more (or more clearly) value conflicts relating to the implementation of CSR design requirements for maritime energy sustainability. As a result, the overview may have been more complete and/or with more meticulous attention to the particular application for the maritime industry.

Lastly, the discussion on responsibilities has been rather one-sided due to a matter of available space. For this thesis, the investigation has served two main purposes. First, it has depicted what kinds of minimum efforts the maritime corporation should put in solving issues of energy sustainability. Second, it has helped to demarcate the empirical investigation with maritime sustainability managers as participants. However, especially the controversiality of energy frugality and sufficiency elucidate the remaining conflicting perspectives on the responsibilities of the firm and of the individual within the firm. The controversiality of moral principles do not necessarily mean that such principles are wrong. Yet, it leaves room for a more-sided elaboration on responsibilities with specific consideration on the main subject of this thesis, maritime energy sustainability.

8.4: SUGGESTIONS FOR FURTHER RESEARCH

The question whether maritime firms should withdraw from projects that use too much energy due to weather conditions or other circumstances, brought a significant tension with regard to energy frugality to the surface. In a post-sort interview, one of the participants (C) said that it was desirable from an environmental perspective but not thinkable that such a decision would be made. However, a follow-up question whether maritime firms should (temporarily) withdraw from certain projects for reasons of safety was responded to with a definite yes, "as everyone would be involved". According to the respondent, "safety is easier to incorporate in that sense.

This demonstrates two aspects that relate to required changes in the function, structure and culture of institutions. First, many people are involved with regard to safety decisions and the safety of the crew prevails. Research has shown that safety on ships relates to operational level as much as strategic management (Manuel 2018, 274). Second, there appears to be an experiential gap between (maritime) energy use(rs) and the consequential environmental and societal harm. In other words, while the safety of the crew (justly) prevails - or should prevail - in any decision made during operation, the interests of less direct stakeholders with respect to energy decision-making do not seem to be valued.

This also indicates two potentially interesting lines of research. The first one relating to the apparent experiential gap. In line with the research for this thesis, how is energy sustainability perceived on the user side (i.e., by the employees of the maritime firm), not only by sustainability managers but rather by all direct stakeholders? In other words, if the aim is to (re-)design maritime CSR by implementing a holistic approach to energy, it will also be necessary to know how those people affected by changed CSR policies perceive the matter on forehand. Additionally, the other side of the gap demands more knowledge building on the actual related environmental and societal harms related to emerging fuels (e.g., biofuels) and other energy technologies (e.g., batteries).

A second suggestion for further research may lie in the corporate structural and cultural changes that Manuel (2018) has referred with for matters of safety. As Seumas Miller (2015) has suggested, designing for values in institutions relates to organisation's functions, structures and cultures. Research on how to implement a maritime CSR designed for the value of energy sustainability, may find inspiration in investigations on cultures of maritime safety.

♈

A key motivation for this project was the idea that a mere focus on units of physics wouldn't reveal the true meaning of maritime energy use. Therefore, a final thought on decibels, music and energy:

If male birds would attract females by using the most energy - and not the best melody - for their songs, the world would be one deafening cacophony.

Ahlgren, F., Thern, M., Genrup, M., & Mondejar, M.E. (2018). Energy Integration of Organic Rankine Cycle, Exhaust Gas Recirculation and Scrubber. *Trends and Challenges in Maritime Energy Management* (pp. 157-168). Springer, Cham.

Allwright, G. (2018). Commercial Wind Propulsion Solutions: Putting the 'Sail' Back into Sailing. *Trends and Challenges in Maritime Energy Management* (pp. 433-443). Springer, Cham.

Aluchna, M. (2017). Is Corporate Social Responsibility Sustainable? A Critical Approach. *The Dynamics of Corporate Social Responsibility* (pp. 9-25). Springer, Cham.

Asveld, L., Van Est, R., & Stemerding, D. (2011). Getting to the core of the bio-economy. A perspective on the sustainable promise of biomass.

Asveld L., Osseweijer P., & Posada J.A. (2019) Societal and Ethical Issues in Industrial Biotechnology. *Sustainability and Life Cycle Assessment in Industrial Biotechnology. Advances in Biochemical Engineering/Biotechnology, vol 173*. Springer, Cham.

Azizul Islam, M. (2017). CSR Reporting and Legitimacy Theory: Some Thoughts on Future Research Agenda. *The Dynamics of Corporate Social Responsibility* (pp. 323-339). Springer, Cham.

Baatz, C. (2014). Climate change and individual duties to reduce GHG emissions. *Ethics, Policy & Environment*, *17*(1), 1-19.

Badino, A., Borelli, D., Gaggero, T., Rizzuto, E., & Schenone, C. (2012). Noise emitted from ships: impact inside and outside the vessels. *Procedia-Social and Behavioral Sciences*, *48*, 868-879.

Balcombe, P., Brierley, J., Lewis, C., Skatvedt, L., Speirs, J., Hawkes, A., & Staffell, I. (2019). How to decarbonise international shipping: Options for fuels, technologies and policies. *Energy conversion and management*, *182*, 72-88.

Baldauf, M., Benedict, K., Kirchhoff, M., Schaub, M., Gluch, M., & Fischer, S. (2018). Energy-Efficient Ship Operation: The Concept of Green Manoeuvring. *Corporate Social Responsibility in the Maritime Industry* (pp. 185-218). Springer, Cham.

Ballini, F. & Ölçer, A.I. (2018). Energy Manager Role in Ports. *Trends and Challenges in Maritime Energy Management* (pp. 295-305). Springer, Cham.

Blain, L. (2020, September 14). Oceanbird's huge 80-meter sails reduce cargo shipping emissions by 90%. Retrieved November 18, 2020, from https://newatlas.com/marine/oceanbird-wallenius-wing-sail-cargo-ship/

Block, C., & Vandecasteele, C. (2011). Municipal solid waste. Treatment, management and prevention. *What is Sustainable Technology?* (pp. 108-131). Sheffield, UK: Greenleaf Publishing Limited

Borning, A., & Muller, M. (2012). Next steps for value sensitive design. *Proceedings of the 2012 ACM annual conference on human factors in computing systems*. ACM, New York, pp 1125–1134

Bouman, E.A., Lindstad, E., Rialland, A.I., & Strømman, A.H. (2017). State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping–a review. *Transportation Research Part D: Transport and Environment*, *52*, 408-421.

Bragues, G. (2018). Theorists and philosophers on business ethics. *The Routledge Companion to Business Ethics* (pp. 23-37). Routledge.

Briggle, A., & Mitcham, C. (2009). Embedding and networking: conceptualizing experience in a technosociety. *Technol. Soc. 31*, 374–383.

Brown, S.R. (1993). A primer on Q methodology. *Operant subjectivity*, *16*(3/4), 91-138.

Brown, S.R., & Good, M.M.R. (2010). Q Methodology. Salkind, N. J. (Ed.). (2010). *Encyclopedia of research design (Vol. 3),* 1149-1155. Sage.

Brown, M.T., & Ulgiati, S. (2004). Energy quality, emergy, and transformity: HT Odum's contributions to quantifying and understanding systems. *Ecological Modelling*, *178*(1-2), 201-213.

Brundtland, G.H. (1987). *Report of the World Commission on Environment and Development: our common future*. United Nations.

Canbulat, O., Aymelek, M., Turan, O., & Boulougouris, E. (2018). A Bayesian Belief Network Model for Integrated Energy Efficiency of Shipping. *Trends and Challenges in Maritime Energy Management* (pp. 257-273). Springer, Cham.

Carroll, A.B. (1979). A three-dimensional conceptual model of corporate performance. *Academy of management review*, *4*(4), 497-505.

Classification societies - their key role (n.d.). Retrieved January 6, 2020, from: http://www.iacs.org.uk/about/

Coelho, R.L. (2009). On the concept of energy: History and philosophy for science teaching. *Procedia-Social and Behavioral Sciences, 1(1)*, 2648-2652.

Coelho, R.L. (2014). On the concept of energy: eclecticism and rationality. *Science & Education, 23(6)*, 1361-1380.

Collins, S. (2019). Collective Responsibility Gaps. *Journal of Business Ethics, 154(4),* 943-954.

Dahlsrud, A. (2008). How corporate social responsibility is defined: an analysis of 37 definitions. *Corporate social responsibility and environmental management*, *15*(1), 1-13.

Davis, J., & Nathan, L.P. (2015). Value sensitive design: Applications, adaptations, and critiques. *Handbook of ethics, values, and technological design: Sources, theory, values and application domains*, 11-40.

De Graaf, G., & Van Exel, J. (2008). Using Q Methodology in administrative ethics. *Public Integrity, 11(1),* 63-78.

Demirel, Y.K., Uzun, D., Zhang, Y., & Turan, O. (2018). Life Cycle Assessment of Marine Coatings Applied to Ship Hulls. *Trends and Challenges in Maritime Energy Management* (pp. 325-339). Springer, Cham.

De Schipper, M. A., De Vries, S., Ruessink, G., De Zeeuw, R. C., Rutten, J., Van Gelder-Maas, C., & Stive, M. J. (2016). Initial spreading of a mega feeder nourishment: Observations of the Sand Engine pilot project. *Coastal Engineering*, *111*, 23-38.

Den Blijker, J., & Straver, F. (2018, October 05). Marjan Minnesma: 'Zolang het klimaat te redden is, ga ik ervoor'. Retrieved October 16, 2020, from https://www.trouw.nl/nieuws/marjan-minnesma-zolang-het-klimaat-te-redden-is-ga-ik-ervoor~b216ff1c/?referrer=https%3A%2F%2Fwww.google.com%2F

DesJardins, J.R. (2013). Environmental Ethics: An introduction to environmental philosophy, 5th edition. Belmont: Wadswoth. *Thomson Learning*.

DesJardins, J. (2018). Business, nature, and environmental sustainability. *The Routledge Companion to Business Ethics*, 376-392.

Devall, B. (2014). The Deep Ecology Movement. In *Philosophy of Technology: The Technological Condition: An Anthology, 2nd Edition* (pp. 482-490) Hoboken, New Jersey: John Wiley & Sons.

DNV GL (2019). Assessment of selected alternative fuels and technologies. *DNV GL—Maritime*. Retrieved May 15, 2020, from https://www.dnvgl.com/maritime/publications/alternative-fuel-assessment-download.html

Fakhry, A., & Bulut, B. (2018). MARPOL Energy Efficiency: Verging on Legal Inefficiency? *Trends and Challenges in Maritime Energy Management* (pp. 15-28). Springer, Cham.

Fasoulis, I., & Kurt, R.E. (2019). Embracing Sustainability in Shipping: Assessing Industry's Adaptations Incited by the, Newly, Introduced 'triple bottom line'Approach to Sustainable Maritime Development. *Social Sciences*, *8*(7), 208.

Feynman, R. (2011). *The Feynman Lectures on Physics, Vol. I: Mainly Mechanics, Radiation, and Heat*. New York: Basic Books.

Frederiksen, C.S., & Nielsen, M.E.J. (2013). The ethical foundations for CSR. In *Corporate Social Responsibility* (pp. 17-33). Springer, Berlin, Heidelberg.

Friedman, B., Kahn, P.H., & Borning, A. (2001). Value Sensitive Design: Theories and Methods. University of Washington Technical Report, University of Washington, Washington D.C., 2002, pp. 1-8.

Friedman, B., Kahn, P.H., & Borning, A. (2006). Value Sensitive Design and Information Systems. *Human-computer interaction and management information systems: Foundations* (Vol. 5), pp.348-372. ME Sharpe.

Friedman, B., Kahn Jr, P.H., Borning, A., & Huldtgren, A. (2013). Value sensitive design and information systems. *Early Engagement and New Technologies: Opening up the Laboratory*, pp. 55–95. Netherlands, Dordrecht: Springer.

Frigo, G. (2018). *Toward an Ecocentric Philosophy of Energy in a Time of Transition.* (Doctoral dissertation, PhD Dissertation, University of North Texas).

Froholdt, L.L. (Ed.). (2018). *Corporate Social Responsibility in the Maritime Industry (Vol. 5)*. Springer.

Froholdt, L.L. (2018). The Perception of Corporate Social Responsibility in the Maritime Industry. In *Corporate Social Responsibility in the Maritime Industry* (pp. 5-23). Springer, Cham.

Ganzevles, J., & Van Est, Q.C. (2013). Energy in 2030. Busting the myths. The Hague, Netherlands: Rathenau Institute.

Geels, F.W., Sovacool, B.K., Schwanen, T., & Sorrell, S. (2017). The socio-technical dynamics of low-carbon transitions. *Joule*, *1*(3), 463-479.

Geerts, R.J. (2012). Self-Practices and the Experiential Gap: An Analysis of Moral Behavior around Electricity Consumption. *Techné: Research in Philosophy and Technology, 16*(2), 94–104.

Gjølberg, M., Longva, T., & Aalbu, K. (2017). Sustainable Development Goals: Exploring Maritime Opportunities. Høvik, Norway: DNV GL

Goodpaster, K.E. (2018). Stakeholder thinking. *The Routledge Companion to Business Ethics* (pp. 184-203). Routledge.

Goods, C. (2015, June 8). How do batteries affect the environment? Retrieved June 20, 2020, from http://www.weforum.org/agenda/2015/06/how-do-batteries-affect-the-environment/

Green Office Movement. (2020, May 11). *23 Green Office case studies from European universities*. Retrieved January 2, 2021, from https://www.greenofficemovement.org/green-office-case-studies/

Grewal, D. (2018). The Growth of CSR and Its Acceptance in the Maritime Industry. *Corporate Social Responsibility in the Maritime Industry* (pp. 25-42). Springer, Cham.

Günel, G. (2017, October 24). Electric. *Society for Cultural Anthropology*. Retrieved September 02, 2020, from https://culanth.org/fieldsights/electric

Hall, C.A.S, Balogh, S., & Murphy, D.J.R. (2009). What is the minimum EROI that a sustainable society must have? *Energies 2: 25–47*.

Hall, C.A.S., & Klitgaard, K.A. (2012). Energy and the Wealth of Nations: Understanding the Biophysical Economy. *Springer Science+ Business Media*. LLC, New York.

Hanes, R.J., Gopalakrishnan, V., & Bakshi, B.R. (2018). Including nature in the food-energy-water nexus can improve sustainability across multiple ecosystem services. *Resources, Conservation and Recycling*, *137*, 214-228.

Hansen, S., & Fradelos, S. (2018). An Integrated Vessel Performance System for Environmental Compliance. *Trends and Challenges in Maritime Energy Management* (pp. 185-198). Springer, Cham.

Hartman, L.P., DesJardins, J.R., & MacDonald, C. (2014). *Business ethics: Decision making for personal integrity and social responsibility.* New York: McGraw-Hill.

Hecht, G. (2009). Africa and the nuclear world: labor, occupational health, and the transnational production of uranium. *Comparative Studies in Society and History*, *51*(4), 896-926.

Hedberg, T. (2018). Climate change, moral integrity, and obligations to reduce individual greenhouse gas emissions. *Ethics, Policy & Environment*, *21*(1), 64-80.

Hiteva, R., & Sovacool, B.K., 2017. Harnessing social innovation for energy justice: a business model perspective. In *Energy Policy 107*, 631–639.

Jenkins, K.E., Spruit, S., Milchram, C., Höffken, J., & Taebi, B. (2020). Synthesizing value sensitive design, responsible research and innovation, and energy justice: A conceptual review. *Energy Research & Social Science*, *69*, 101727.

Johnson, H., & Andersson, K. (2016). *Barriers to energy efficiency in shipping*. WMU Journal of maritime Affairs, *15*(1), 79-96.

Karadeniz Holding (n.d.). *Powership*. Retrieved September 02, 2020, from http://www.karadenizholding.com/en/group-companies/powership

Kirstein, L., Halim, R., & Merk, O. (2018). Decarbonising Maritime Transport: Pathways to zero-carbon shipping by 2035. *Paris, France: International Transportation Forum*.

Kitada, M., & Tansey, P. (2018). Impacts of CSR on Women in the Maritime Sector. In *Corporate social responsibility in the maritime industry* (pp. 237-251). Springer, Cham.

Kitada, M., Rabo, K., Toua, O.O., & Nervale, T. (2018). The Role of Maritime Transport from the Perspective of Energy and Gender: The Case of the Pacific Islands. *Trends and Challenges in Maritime Energy Management* (pp. 367-380). Springer, Cham.

Kroll, C., Warchold, A., & Pradhan, P. (2019). Sustainable Development Goals (SDGs): Are we successful in turning trade-offs into synergies?. *Palgrave Communications*, *5*(1), 1-11.

Kurzweil, P. (2015). Lithium Battery Energy Storage: State of the Art Including Lithium-Air and Lithium-Sulfur Systems. *Electrochemical energy storage for renewable sources and grid balancing* (pp. 269-307). Elsevier.

Latha, O.H., Talluri, B.K., & Ali, M.H. (2019). Design, Fabrication and Testing of a Flywheel for Kinetic Energy Storage. Journal of Innovation in Mechanical Engineering, 2(1), 23-26.

Lee, B. (2017). The fundamentals of Q methodology. *Journal of Research Methodology, 2(2),* 57-95.

Leopold, A. 1949. *A Sand County Almanac. And Sketches Here and There.* Oxford - New York: Oxford University Press.

Lin, T., Chen, Q., Ren, H., Huang, W., Chen, Q., & Fu, S. (2017). Review of boom potential energy regeneration technology for hydraulic construction machinery. *Renewable and Sustainable Energy Reviews, 79,* 358-371.

McCauley, D., Brown, A., Rehner, R., Heffron, R., & Van de Graaff, S. (2018). Energy justice and policy change: An historical political analysis of the German nuclear phase-out. *Applied Energy, 228,* 317–1232.

McCauley, D., Ramasar, V., Heffron, R.J., Sovacool, B.K., Mebratu, D., & Mundaca, L. (2019). Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research. In *Applied Energy 233-234,* 916-921

Manuel, M.E. (2018). Safety and Risk Management Considerations for CSR. In *Corporate social responsibility in the maritime industry* (pp. 252-278). Springer, Cham.

Miller, S. (2015). Design for values in institutions. *Handbook of ethics, values and technological design: Sources, theory, values and application domains* (pp. 769-781). Springer, London Ltd..

Mitcham, C., & Smith Rolston, J. (2013). Energy constraints. *Science and Engineering Ethics*, *19*(2), 313-319.

Molland, A.F. (2008). *The maritime engineering reference book: a guide to ship design, construction and operation.* Oxford, UK: Elsevier Ltd.

Morimoto, S. (2018). Analyzing Approaches to Set Greenhouse Gas Reduction Targets in Anticipation of Potential "Further Measures" for International Shipping. *Trends and Challenges in Maritime Energy Management* (pp. 29-40). Springer, Cham.

Mutarraf, M.U., Terriche, Y., Niazi, K.A.K., Vasquez, J.C., & Guerrero, J.M. (2018). Energy storage systems for shipboard microgrids—A review. *Energies*, *11*(12), 3492.

Nader, L. (2013). The three-cornered constellation: Magic, science, and religion revisited. *The Energy Reader*, 259-276. USA, New York, NY: Routledge

Naess, A. (1973). The Shallow and the Deep, Long-Range Ecology Movement. *Inquiry 16 (1973):* 95–100.

Nerini, F.F., Tomei, J., To, L.S., Bisaga, I., Parikh, P., Black, M., Borrion, A., Spataru, C., Broto, V.C., Anandarajah, G., Milligan, B., & Mulugetta, Y. (2018). Mapping synergies and trade-offs between energy and the Sustainable Development Goals. *Nature Energy*, *3*(1), 10-15.

Nikitakos, N., Dalaklis, D., & Siousiouras, P. (2018). Real Time Awareness for MRV Data. In *Trends and Challenges in Maritime Energy Management* (pp. 53-63). Springer, Cham.

Nolt, J. (2015). Non-anthropocentric nuclear energy ethics. *The Ethics of Nuclear Energy: Risk, Justice, and Democracy in the Post-Fukushima Era*, 157-175.

Okpara, J.O., & Idowu, S.O. (2013). Corporate social responsibility: A review of the concept and analysis of the business case for corporate social responsibility in the twenty-first century. *Corporate Social Responsibility* (pp. 3-15). Springer, Berlin, Heidelberg.

Olaniyi, O.O., Prause, G., & Boyesen, J. (2018). The Impact of SECA Regulations on Clean Shipping in the Baltic Sea Region. *Trends and Challenges in Maritime Energy Management* (pp. 309-323). Springer, Cham.

Ölçer, A.I. (2018). Introduction to Maritime Energy Management. In *Trends and Challenges in Maritime Energy Management* (pp. 1-12). Springer, Cham.

Ölçer, A.I., & Ballini, F. (2018). Energy management in the maritime industry. *Corporate social responsibility in the maritime industry* (pp. 131-148). Springer, Cham.

Oosterlaken, I. (2009). Design for development: A capability approach. *Design issues*, *25*(4), 91-102.

Prentiss, M. (2015). *Energy revolution: The physics and the promise of efficient technology*. Harvard University Press.

Rambarath-Parasram, V., Singh, S., & Aiken, D. (2018). Overcoming the Challenges to Maritime Energy Efficiency in the Caribbean. *Trends and Challenges in Maritime Energy Management* (pp. 65-82). Springer, Cham.

Raugei, M., Rugani, B., Benetto, E., & Ingwersen, W.W. (2014). Integrating emergy into LCA: potential added value and lingering obstacles. *Ecological Modelling*, *271*, 4-9.

Ravasi, D., & Schultz, M. (2006). Responding to organizational identity threats: Exploring the role of organizational culture. *Academy of management journal*, *49*(3), 433-458.

Rolston, H. (2011). The future of environmental ethics. *Royal Institute of Philosophy Supplements*, *69*, 1-28.

Roszkowska-Menkes, M. (2017). Was Friedman Right? Moving Towards Strategic CSR Agenda. In *The Dynamics of Corporate Social Responsibility (pp. 71-89)*. Springer, Cham.

Sampson, H. (2016). Seabirds matter more than us! Understanding the complex exercise of CSR in the Global Shipping Industry

Schmidpeter, R. (2013). Corporate Social Responsibility: A New Management Paradigm? In *Corporate Social Responsibility* (pp. 171-180). Springer, Berlin, Heidelberg.

Seijlhouwer, M. (2020, November 3). Varen vrachtschepen straks op kernenergie uit thorium? Retrieved November 18, 2020, from https://www.duurzaambedrijfsleven.nl/logistiek/35005/thorium-schip

Sinnott-Armstrong, W. (2005). It's Not My Fault: Global Warming and Individual Moral Obligations, Advances in the Economics of Environmental Research, AECE-V005.

Skovgaard, J. (2018). Response to institutional processes: A study of corporate social responsibility in Danish shipping companies. *Corporate social responsibility in the maritime industry* (pp. 279-293). Springer, Cham.

Smil, V. (2008). *Energy in nature and society: general energetics of complex systems*. MIT press.

Smil, V. (2010). Science, energy, ethics, and civilization. *Visions of Discovery: New Light on Physics, Cosmology, and Consciousness*, R.Y. Chiao et al. eds., Cambridge University Press, Cambridge, pp. 709-729.

Sovacool, B.K., & Dworkin, M.H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy*, *142*, 435-444.

Sovacool, B.K., Hook, A., Martiskainen, M., & Baker, M. (2019). The whole system energy injustice of four European low-carbon transitions. *Global Environ. Change, 58*

Stopford, M. (2009). *Maritime economics, 3rd edition.* London, GB, & New York, USA: Routledge

Strauss, S., Rupp, S., & Love, T. (2013). Powerlines: cultures of energy in the twenty-first century. *Cultures of Energy: Power, Practices and Technologies*, 10-38.

Swe, T.H., Kitada, M., & Ölçer, A.I. (2018). The Need for Education and Training in Maritime Energy Management in Myanmar. *Trends and Challenges in Maritime Energy Management* (pp. 351-367). Springer, Cham.

Taebi, B. (2011). Ethics of Nuclear Power: How to Understand Sustainability in the Nuclear Debate. *Nuclear Power – Deployment, Operation and Sustainability*, 129-150.

Taebi, B., & Kadak, A.C. (2010). Intergenerational considerations affecting the future of nuclear power: Equity as a framework for assessing fuel cycles. *Risk Anal., 30*, 1341–1362.

Takei, Y. (2018). Governance of Maritime Activities: Legal, Policy and Institutional Aspects. *Corporate Social Responsibility in the Maritime Industry* (pp. 43-61). Springer, Cham.

Ter Hofstede, R., Elzinga, J., Carr, H., & Van Koningsveld, M. (2019). The coral engine: The way for local communities to sustainably produce corals for Reef Rehabilitation at a large scale. *Proceedings of 22nd World Dredging Congress and Exposition, WODCON 2019*. Chinese Dredging Association (CHIDA).

Thaler R, Sunstein C (2008). Nudge: improving decisions about health, wealth and happiness. Yale University Press, New Haven

The Ocean Cleanup. (2020, July 31). Retrieved August 11, 2020, from https://theoceancleanup.com/

The Marine Mammal Center. (n.d.). Retrieved January 02, 2021, from https://www.marinemammalcenter.org/

Tweede Kamer der Staten-Generaal. (2018, May 18). Antwoord op vragen van de leden Remco Dijkstra en Wiersma over het bericht "Rotterdamse droogdok is al drie jaar besmet". Retrieved January 02, 2021, from https://zoek.officielebekendmakingen.nl/ah-tk-20172018-2114.html

United Nations General Assembly (2015). *Resolution A/RES/70/1: Transforming our world: the 2030 Agenda for Sustainable Development*. Division for Sustainable Development Goals: New York, NY, USA.

United Nations General Assembly (2017). *Resolution A/RES/71/313: Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development*. United Nations Statistics Division: New York, NY, USA.

UN calls for shipping 'propulsion revolution' to avoid 'environmental disaster' | UN News. (2019, October 30). Retrieved February 15, 2020, from: https://news.un.org/en/story/2019/10/1050251

UNCTAD (2018). Ch.2: Structure, Ownership and Registration of the World Fleet. In *Review of Maritime Transport 2018* (2018, pp.21-42). New York, USA: United Nations Publications.

Urgenda. (2020, June 18). Retrieved October 16, 2020, from https://www.urgenda.nl/en/home-en/

Van den Hoven, J., Vermaas, P.E., & Van de Poel, I. (Eds.). (2015a). Handbook of ethics, values, and technological design, 1-7.

Van den Hoven, J., Vermaas, P.E., & Van de Poel, I. (2015b). Design for values: An introduction. *Handbook of ethics, values, and technological design*, 1-7.

Ventikos N.P., Louzis, K., & Koimtzoglou, A. (2018). Underlying Risks Possibly Related to Pwer/Manoeuvrability Problems of Ships: The Case of Maritime Accidents in Adverse

Weather Conditions. *Trends and Challenges in Maritime Energy Management* (pp. 213-230). Springer, Cham.

Viktorelius, M. (2018). The Human and Social Dimension of Energy Efficient Ship Operation. *Trends and Challenges in Maritime Energy Management* (pp. 341-350). Springer, Cham.

Walker, J. (2018, May 3). Royal Caribbean Boycotts Rotterdam Shipyard After €1,000,000 Fine? Retrieved January 02, 2021, from https://www.cruiselawnews.com/2018/05/articles/crew-member-rights/royal-caribbean-boycotts-rotterdam-shipyard-after-%E2%82%AC1000000-fine/

Wen, M.T.X., & Tien, D.T.K. (2018). Analysis of a Hybrid Mechanical Regenerative Braking System. *MATEC Web of Conferences, Vol. 152,* 02011

Werhane, P. (2008). Corporate social responsibility, corporate moral responsibility, and systems thinking: Is there a difference and the difference it makes. *Leadership and business ethics (issues in business ethics volume 25)* (pp. 269–289). Dordrecht, Netherlands: Springer.

Wettstein, F. (2012). Corporate responsibility in the collective age: Toward a conception of collaborative responsibility. *Business and Society Review, 117(2),* 155-184.

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121-36. *Journal of the American Academy of Arts and Sciences*

Yoon, I.R., Choi, J.M., & Seo, K.S. (2018). Technology Assessment: Autonomous Ships. Seoul, Republic of Korea: Korea Institute of Marine Science & Technology (KIMST).

APPENDICES

APPENDIX I: INFORMATION SHEET - MARITIME ENERGY SUSTAINABILITY RESEARCH

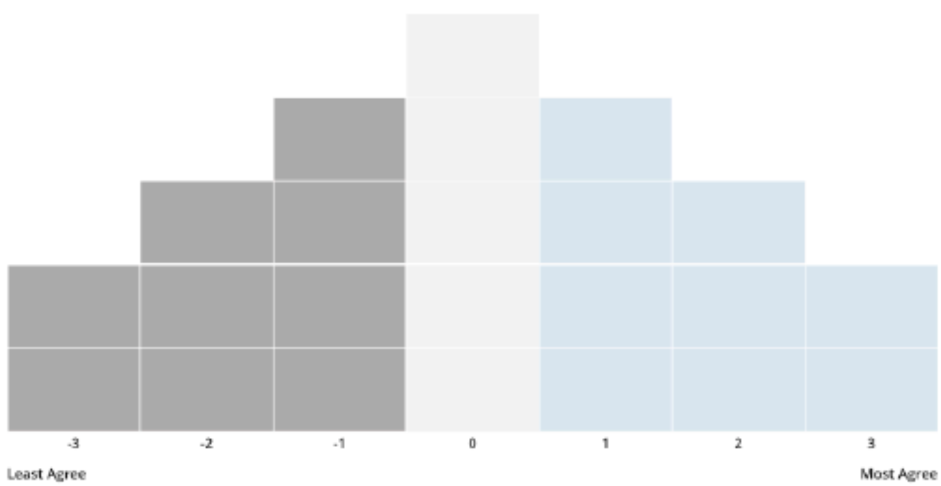
'Energy Sustainability in the Maritime Industry' August 2020

Information sheet

Dear participant,

Thank you for your willingness to contribute to this study on sustainable use of energy in the maritime industry. This industry is working hard to become more sustainable. Decision-making with regard to the use of energy is one aspect thereof. This study aims to research what standpoints are seen as most important towards energy sustainability decision-making, according to experts in the maritime industry. Your contribution to the study will be completely anonymized.

On the following pages you will see the 23 statements that you will be asked to rank according to your agreement. It might be helpful to pre-sort the statements on the pre-sort page, but you may also start with ranking right away by clicking the BEGIN SORTING button. If you do pre-sort, make use of the buttons on the statements: (least agree), (neutral) and (most agree). **Note: it is possible that you agree with all or many of the statements; it is the essence of the study to rank them anyway.** On the sorting page you will see the following pyramid to which you can drag each of the statements. All squares need to be filled; you will be able to swap the positions until you press the button to submit your sort.



As a 'thank-you' you will be informed on the findings of the study as well as its theoretical contribution with regard to the ethical side of things, when the research is finished.

Best regards,
Michiel Kamphuis

'Energy Sustainability in the Maritime Industry' **August 2020**

Statements 1 to 8 (23 in total)

[1] Alternative fuels (e.g. bio-methanol, electricity) will make up for the largest part of sustainable maritime energy developments

[2] Our company will thrive if every department has employees with knowledge of sustainable energy use

[3] Maritime corporations and society can rely on technological advancements to solve energy issues

[4] International sustainability criteria for all maritime energy sources are essential for a more sustainable industry

[5] Our company has the responsibility to cooperate with governments and the IMO to achieve a stronger global authority for sustainable maritime energy use

[6] Our company hires, or should hire, an Energy Manager with a specific energy focus in: 1) accounting and economic analysis, 2) maintenance, 3) auditing, 4) measuring and verification, 5) coordination

[7] Economic prosperity of our company is necessary to make an energy transition possible

[8] Our company should move towards reducing the total energy consumption

Statements 9 to 16 (23 in total)

[9] Our company should actively and equally put energy in environmental, social and economic prosperity

[10] Our services should not harm any of our economic, social and environmental stakeholders

[11] Our company contributes to sustainable technological progress by sharing knowledge

[12] Transparency to society about maritime energy consumption is an important part of a sustainable industry

[13] Due to direct energy savings, energy efficient ship design is essential for sustainable ship operation

[14] To evaluate sustainable use of energy our company should aim to account for all materials involved (e.g. batteries, filters, coatings, etc.)

[15] Since there is no absolute sustainable energy solution, it is best to install a diversity of energy technologies on board ships

[16] All crew members should receive specific energy awareness training to achieve sustainable energy use cultures on the ships

Statements 17 to 23 (23 in total)

[17] Technological advancements are essential for energy efficient ship operation

[18] Maritime officers' navigational and mechanical skills and understanding of the conditions at sea are essential for energy efficient ship operation

[19] On board our ships it is important that we measure energy use as accurately as possible for as much equipment as possible

[20] Each of our crew members are aware, or should be aware, of the amount of energy use that comes with each of their operations

[21] Our company should withdraw from a project or service if a ship will use too much energy (e.g. due to demanded speed, travel distance, or the weather conditions)

[22] Close to all energy waste (e.g. heat or emissions) should be prevented, reused or regenerated

[23] Crew's energy saving knowledge is extremely helpful to improve the energy sustainability of our fleet and the maritime industry in general

APPENDIX II: Q-SORT DATA

These z-score tables include the Q-sort results of participants A to E, separated in two groups according to their rankings. The most right columns represent how a fictive participant would have ranked the statements precisely according to the z-scores of these groups: the idealised Q-sorts.

#	Statement [anticipated factor]	Group 1			Group 2		Idealized Q-sorts	
		A	B	E	C	D	Group 1	Group 2
		Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score	Z-Score
1	Alternative fuels (e.g. bio-methanol, electricity) will make up for the largest part of sustainable maritime energy developments [1]	11.376	11.376	17.064	-11.376	-11.376	17.783	-14.594
2	Our company will thrive if every department has employees with knowledge of sustainable energy use [2]	-11.376	-17.064	-11.376	-17.064	-11.376	-14.598	-17.452
3	Maritime corporations and society can rely on technological advancements to solve energy issues [1]	-17.064	0.0000	-11.376	0.0000	-0.5688	-12.367	-0.4439
4	International sustainability criteria for all maritime energy sources are essential for a more sustainable industry [3]	-0.5688	0.0000	-0.5688	-11.376	-11.376	-0.5569	-14.594
5	Our company has the responsibility to cooperate with governments and the IMO to achieve a stronger global authority for sustainable maritime energy use [3]	0.0000	-0.5688	-17.064	0.5688	-0.5688	-14.170	-0.1582
6	Our company hires, or should hire, an Energy Manager with a specific energy focus in: 1) accounting and economic analysis, 2) maintenance, 3) auditing, 4) measuring and verification, 5) coordination [2]	-0.5688	0.0000	-0.5688	11.376	-0.5688	-0.5569	0.1276
7	Economic prosperity of our company is necessary to make an energy transition possible [1]	0.0000	17.064	11.376	-11.376	-0.5688	12.139	-10.155
8	Our company should move towards reducing the total energy consumption [3]	17.064	-0.5688	0.0000	-0.5688	0.0000	0.2536	-0.2858
9	Our company should actively and equally put energy in environmental, social and economic prosperity [3]	17.064	0.5688	-0.5688	-0.5688	0.0000	0.0504	-0.2858
10	Our services should not harm any of our economic, social and environmental stakeholders [3]	11.376	0.0000	17.064	0.0000	0.0000	15.476	0.0000
11	Our company contributes to sustainable technological progress by sharing knowledge [1]	0.5688	-11.376	0.0000	-0.5688	0.0000	-0.1078	-0.2858
12	Transparency to society about maritime energy consumption is an important part of a sustainable industry [2]	0.0000	0.0000	0.5688	-0.5688	0.0000	0.4339	-0.2858

#	Statement [anticipated factor]	Group 1			Group 2			Idealized Q-sorts	
		A	B	E	C	D		Group 1	Group 2
		Z-Score	Z-Score	Z-Score	Z-Score	Z-Score		Z-Score	Z-Score
13	Due to direct energy savings, energy efficient ship design is essential for sustainable ship operation [1]	-0.5688	0.5688	0.0000	0.0000	17.064		-0.0076	13.318
14	To evaluate sustainable use of energy our company should aim to account for all materials involved (e.g. batteries, filters, coatings, etc.) [3]	0.5688	-0.5688	0.5688	0.0000	0.5688		0.4415	0.4439
15	Since there is no absolute sustainable energy solution, it is best to install a diversity of energy technologies on board ships [1]	0.0000	17.064	11.376	0.5688	-17.064		12.139	-10.461
16	All crew members should receive specific energy awareness training to achieve sustainable energy use cultures on the ships [2]	0.0000	-11.376	0.0000	0.5688	11.376		-0.2307	11.737
17	Technological advancements are essential for energy efficient ship operation [1]	0.5688	11.376	-0.5688	0.5688	17.064		-0.0802	16.176
18	Maritime officers' navigational and mechanical skills and understanding of the conditions at sea are essential for energy efficient ship operation [2]	-11.376	0.5688	0.5688	11.376	11.376		0.3033	14.594
19	On board our ships it is important that we measure energy use as accurately as possible for as much equipment as possible [3]	-17.064	-0.5688	-11.376	11.376	0.5688		-13.520	10.155
20	Each of our crew members are aware, or should be aware, of the amount of energy use that comes with each of their operations [2]	-0.5688	0.5688	0.0000	17.064	-17.064		-0.0076	-0.4745
21	Our company should withdraw from a project or service if a ship will use too much energy (e.g. due to demanded speed, travel distance, or the weather conditions) [3]	-11.376	-11.376	-17.064	-17.064	0.5688		-17.783	-0.4134
22	Close to all energy waste (e.g. heat or emissions) should be prevented, reused or regenerated [3]	0.5688	11.376	11.376	0.0000	11.376		12.215	0.8879
23	Crew's energy saving knowledge is extremely helpful to improve the energy sustainability of our fleet and the maritime industry in general	11.376	-17.064	0.5688	17.064	0.5688		0.3337	13.013

Factor characteristic	A	B
Average Reliability Coefficient	0.8	0.8
Number of loading Q-Sorts	3	2
Eigenvals	1.771	11.839
Total explained variance	3	2
Composite Reliability	0.9231	0.8889
Standard Error of Factor Scores	0.2774	0.3333

Standard error of differences		
Factors	A	B
A	0.3922	0.4336
B	0.4336	0.4714

Correlation between Z-factors		
Factors	A	B
A	1	-0.0047
B	-0.0047	1

Participant E, Dutch firm 1

How long did it take you to sort the statements?

"About 15 minutes."

What was your overall opinion on the selection of statements?

"I believe it was an interesting selection. Sometimes I thought it could be stated sharper, or more focused on a part of the spectrum."

Would you say there were certain statements or directions missing?

"In general, with regard to the maritime industry, I believe it was a comprehensive selection of statements."

Do you have supplementing thoughts on the statements you most agreed with?

[1] *(Alternative fuels)*: "This one I found difficult as one could think differently about the distinct examples. In our program toward sustainability, biofuels and batteries make up for almost half of the solution. From the perspective of a shipowner, it is also the most straightforward idea: use another fuel, which is also circular, and then you're actually already there."

[10] *(Our services should not harm)*: "That one was easily placed. Eventually that's the balance, that's what you do it for, and it is also what is stated in our policy. The reason why I placed statement 9 (doing actively good) at -1 was mainly because I agree with actively putting energy in that, but not equally. I rather had it placed at neutral, but there was no place anymore. I believe that - in these times - we need to emphasise more on the economic, then the social and then the environmental aspects."

Do you have supplementing thoughts on the statements you least agreed with?

[5] *(responsibility to cooperate with authorities)*: "I do it, and I believe we should, but morally speaking the corporation does not have responsibility for this. The responsibilities of the government end at some point and you could question where the responsibility of one stakeholder ends and the responsibility of the other starts. We do not have the moral responsibility, but we do cooperate anyway. However, we can't be prosecuted because we are not sustainable enough. Not yet."

[21} *(we should withdraw when using too much energy)*: "This one was also easily placed. I just do not agree with that. Imagine, all used energy is renewable, then you could use as much of it as you wish. Besides, it is not only a matter of what you do, but also how you do it."

Follow-up question: would you rank this differently when it would be stated as "We should pause a project when..."? "No, that wouldn't make a change. It is not about the energy; it is about the environmental footprint. When it would say 'if the environmental footprint is too high', then it would make a change indeed. Imagine that you are running a project that would make everyone in the world somewhat happier, but you would have to use all barrels of oil in the world for that, then it would be a hard question. In the end, energy is not the issue, the sun is providing more than enough, the question is how we make use of it."

Participant A, Dutch firm 2

How long did it take you to sort the statements?

"About 5 to 10 minutes."

What was your overall opinion on the selection of statements?

"In general, it seems broad and complete with regard to the topic. I would have agreed with practically all of the statements. Some statements or wordings could be arguable and therefore might have been sorted differently accordingly."

Would you say there were certain statements or directions missing?

"I would have expected some more statements in relation to policy and regulation. For example, if we would like to operate our ships with different fuels, then regulation will have to go along. In that sense, we would need to take risks. This counts for economic reasons as well, for which we need to communicate with our clients: 'We invest in these developments, therefore we hope you will recognise this in being our client.' It is not included in these statements, but it is possible it costs money. It is in our advantage that we have a lot of clients in the wind industry, who reward us for using more sustainable equipment."

Do you have supplementing thoughts on the statements you most agreed with?

[8] *(Total energy reduction):* "Businesses should take their responsibility in this sense."

[9] *(Actively and equally put energy in three sustainability pillars):* "We have to act responsibly in every aspect. Momentarily it is still an accepted opinion if coral is ruined at one side, when at the other side something very good is done economically or societally. In the long run this is not tenable, however. Statement 10 [not doing harm] could even be sort a bit more to the left [less agreeing] in that regard."

Do you have supplementing thoughts on the statements you least agreed with?

[3] *(Relying on technological advancements):* "This one I ranked low, because you could be passive and wait for technological advancements, but then transitions will take a lot longer I believe. We have to actively participate, e.g., by cooperating with pilots and making a vessel available. Another strategy could be to wait for competitors to develop things and then jump in. Waiting will go slower, especially in a conservative sector like ours. It is important to participate for competitive reasons. The technological advancements are essential to solve the environmental

issues. However, behaviour is important as well. We could gain extreme amounts in that part, not everyone thinks alike in that sense yet."

Side question: How does that work in the company, is it hard to convince people to go along with sustainable thinking? "That feels like a mission."

[19] *(measuring as accurately as possible):* "The wording of this statement, 'measuring' and 'as accurately as possible', those things are nice-to-haves but less important than most of the other issues. In that sense it is at odds with statement 22 [prevent, reuse, regenerate energy waste], for which it is necessary to measure as well of course. On the other hand, it is easy to question whether we sail with maximum speed from Brazil, but that would also mean that crew members might have to stay on board for a longer period of time, which costs financially. The statement could become more important in a later stage of developments when more has been achieved."

Participant C, Dutch firm 3

How long did it take you to sort the statements?

"About 5 minutes."

What was your overall opinion on the selection of statements?

"Recognizable."

Would you say there were certain statements or directions missing?

"Not directly, I believe it was quite complete."

Do you have supplementing thoughts on the statements you most agreed with?

[23] *(Crew's energy saving knowledge is extremely helpful)* "I very much agreed with this statement. There are numerous ships in the world, also ships that have not been built recently. Operating these ships in an environmentally friendly way completely depends on how well and effectively crew deals with it. We are a shipping management corporation, it all hinges on the crew for us. We are able to manage people well and the crew members are good in managing the ships. We work with experienced Dutch officers and captains from which some sail for already 20 to 30 years.

My understanding of 'crew's energy saving knowledge' refers to the bridge and the captain's knowledge and skills in relation to speed, pitch settings and economic sailing. It also refers to the engine room, which needs to be in good technological state in order to have the desired output and nothing will get lost. They should also switch off equipment when they're not needed. Crew is being tested through special audits. I can also analyse the use of fuel and when I see a deviation, then I will ask questions about it. Not only to be critical but also to learn."

[20] *(Each of our crew members are aware, or should be...):* "Five new ships were built for us in China where an employee of ours was present during the process. Before delivery we send crew members to get to know the ships. Ships are built with a certain philosophy, but each crew member has own experiences and they should learn to deal with the new ship. There is no point in building a frugal and efficient vessel if you do not pay attention to the crew."

Do you have supplementing thoughts on the statements you least agreed with?

[2] *(Our company will thrive if every department has):* "I agreed less with this statement because I believe that everyone has their own background. I am part of the technical department as the dedicated environmental person. I believe you can separate that from each other. I don't

think everyone is interested in the environment and that's fine; others are more interested in making sure things run smoothly. Slowly people are becoming more environmentally aware though, for example through media attention, but I believe it is a separate branch of expertise. I do believe that each organisation should do something in some sense.

Our clients are Scandinavian corporations that might be more environmentally aware or, rather, aimed at sustainability in a broader sense as in 'how can we do this in 100 years still' and 'how can we build our ships so that they may be operational for the longest period of time?'"

[21] *(Our company should withdraw ...):* "From an environmental perspective this would be desirable, but it seems least realistic for us. The cleanest ship is the one that doesn't sail and is laid up. Charterers sometimes ask to speed up a little bit due to scheduling reasons, that belongs to the maritime industry as well. Holding on to certain standards and reject solutions would make it more difficult to innovate as well."

Follow-up question: If withdrawing were a matter of safety, would that make a difference? "In that case I would agree with it, as everyone would be involved. Captains communicate with the operational corporation and is instructed on the time of arrival at the next port. The captain then needs to communicate the fuel it would cost. It would be great if that could be turned around, but it seems economically difficult. Safety is easier to incorporate in that sense. Often, arriving just-in-time at ports is not rewarded and not in the hands of the crew either. Not listening and arriving late has great consequences. I am often criticised for all the reporting that needs to be done, but the crew can't do anything about the demands to sail full speed. The one who pays is the one that decides. We may want to do best for the planet, but economic interests are given priority. The environment is getting more attention however; more regulation as well. The EU plans to set an emission cap and trading system. That might be a good idea, although it would mostly be in favour of larger corporations who have the finances to buy off their environmental obligations and to innovate. Moreover, now the transportation performances are important, and it is looked at the emissions made per goods' weight per transported mile. Solving that can be done by building larger and larger ships. However, eventually that will only lead to more transportation and more energy use. In the end the knowledge of the public is important. [This refers to statement 12, which this participant ranked at -1]."

Designing Maritime CSR for Sustainability:

Considerations on Energy

A master's thesis by Michiel Kamphuis for the programmes *MSc Business Administration* and *MSc Philosophy of Science, Technology and Society.* Michiel Kamphuis has a background in maritime *Electrical Engineering*.

Abstract

Shipping is an important aspect of economic, social and human development, but the maritime industry has to contend with significant sustainability issues. The carbon emissions of the maritime industry amount to 3% of the global greenhouse emissions, which compares to the 6th largest CO_2 emitting country worldwide, ahead of Brazil and Germany. Moreover, the environmental issues appear to be interconnected with problems of economic and societal nature. The difficulty of solving the issues make it likely that maritime energy management will be confronted with - increasingly - morally conflicting strategic and operational choices. To improve on energy sustainability, the maritime industry needs to attain social innovation alongside the technological innovations. One candidate for such innovation for shipping firms is maritime Corporate Social Responsibility (CSR). In this thesis I argue that maritime CSR should be (re-)designed from a new starting point, namely by considerations on energy itself. In the assumption that values of energy sustainability can be addressed through organisational design, I investigate these by the hand of Value Sensitive Design (VSD) and subsequently make propositions for the design of maritime CSR. A holistic approach to energy is grounded in energy's circular - not ending - movement through the biophysical (and thus societal) system and recognises that energy use both establishes and challenges sustainable development.

UNIVERSITY OF TWENTE.