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Increased energy efficiency in short sea shipping through decreased time in port

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ABSTRACT

According to a range of assessments, there exists a large cost-effective potential to increase energy efficiency in shipping through reduced speed at sea enabled by shorter time in port. This means that the energy needed can be reduced whilst maintaining the same transport service. However, the fact that a large cost-effective potential has been identified that is not being harnessed by decision-makers in practice suggests that there is more to this potential to understand. In this paper, the possibilities for increasing energy efficiency by reducing waiting time in port are explored and problematised through a case study of a short sea bulk shipping company transporting dry bulk goods mainly in the North and Baltic seas. Operational data from two ships in the company's fleet for one year showed that the ships spent more than 40% of their time in ports and that half of the time in port was not productive. The two most important reasons for the large share of unproductive time were that ports were closed on nights and weekends and that ships arrived too early before the stevedores were ready to load or unload the cargo. Reducing all of the unproductive time may be difficult, but the results also show that even a conservative estimate of one to four hours of reduced time per port call would lead to a reduction in energy use of 2–8%. From in-depth interviews with employees of the shipping company, ports and ship agencies, a complex picture is painted when attempting to understand how this potential arises. Aspects such as a lack of effective ship-shore-port communication, little time for ship operators, an absence of means for accurately predicting energy use of voyages as a function of speed, perceived risk of arriving too late, and relationships with third-party technical management may all play a role.

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1. Introduction

Shipping contributes to a growing share of global CO_2 emissions. In a report to the International Maritime Organization (IMO), Buhaug et al. (2009) estimated that these emissions were approximately 3% of global emissions in 2007 and that emissions may double or even triple by 2050 in a business-as-usual scenario. Increased energy efficiency[1] through better operational practices, new technologies and improved logistic systems have been noted as key strategies in abating CO_2

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[1] Energy efficiency in shipping is often defined as energy used per transported goods and distance, e.g., kg of fuel per tonne cargo and nautical mile. A related figure is CO_2 efficiency, which is defined as grams of CO_2 emissions per tonne cargo and nautical mile.

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emissions from shipping. Buhaug et al. (2009) argued that CO_2 efficiency in shipping could increase by 25–75 per cent, with the largest share of the measures directed toward increased energy efficiency. It has also been noted that this potential should be attainable at little cost. Eide et al. (2011), for example, found that an increase in CO_2 efficiency of more than 33% by 2030 could be achievable by implementing measures with a marginal cost below zero. Hoffmann et al. (2012) showed that improving efficiency by more than 50% by 2030 could be possible at zero *net* costs for society; i.e., savings accrued through cost-effective measures pay for measures that involve a higher cost. These findings suggest that, similar to other sectors, there exists a so-called energy efficiency gap in shipping; a gap between what is actually achieved and what appears to be economically optimal (Johnson and Andersson, 2011; Rehmatulla and Smith, 2012; MaddoxConsulting, 2012; Acciaro et al., 2013; Jafarzadeh and Utne, 2014; Balland et al., 2014).

Speed reduction due to increased port efficiency[2] is one of the measures—explored in academic literature and in reports to political bodies—deemed to contribute to large reductions in emissions at limited costs. Lavon and Shneerson (1981) were among the first to discuss this in the wake of the oil crises of the 1970s. More recently, Faber et al. (2009) estimated that up to 10% improvement in energy efficiency could be feasible. Bazari and Longva (2011) determined that the potential ranged from approximately 10 to 20%, depending on ship size and type. Although Eide et al. (2011) do not disclose details of costs and savings in their assessment of the potential for increased energy efficiency in shipping, speed reduction due to increased port efficiency is among the measures with the greatest total savings potential, as well as one of the most cost-efficient. However, following Shove (1998, p. 1110), who argued that "technical potential which cannot be realised for a range of perfectly explicable sociotechnical reasons is not really technical potential, or at least it is not technical potential which is of any relevance in the race to reduce CO_2 emissions", an important gap exists in understanding this measure *in terms of* its apparent high cost-effectiveness. The fact that a large cost-effective potential has been identified but is not being harnessed by decision-makers in practice suggests that there is more to this potential to understand.

The purpose of this paper is to explore the possibilities of reducing speed at sea by decreasing unproductive waiting time in port, and how this can affect a ship's energy needs. A study of a short sea dry bulk shipping company that mainly operates in the Sulphur Emission Control Area (SECA) in the North and Baltic Seas is presented and discussed. The study originates from an action research project aiming at understanding and improving shipping company practices in terms of working to increase energy efficiency (Johnson, 2013; Johnson et al., 2014). In this study, additional quantitative data from the shipping companies' operations was gathered and was complemented with a range of interviews.

We believe that a case study examining how a short sea bulk shipping company could improve energy efficiency through addressing port efficiency could be interesting for a number of reasons. First, the main portion of research on ports and logistics has used quantitative methods, while qualitative and interpretative research has been called for to generate a better understanding of empirical phenomena (Woo et al., 2011). Paixão and Marlow (2003) argue that most research conducted on port performance is based on quantitative methods and focuses mainly on container terminals, while bulk cargo ports have rarely been investigated. Case studies are less prevalent in logistics research in general and have been recommended to bring in new perspectives (Näslund, 2002; Ellram, 1996). Second, in addition to the CO_2 discussion, shipping companies operating in Northern Europe are subject to more strict environmental requirements in terms of sulphur content in fuel, which is expected to lead to less environmental impact but also to increased costs (Bengtsson et al., 2014). An on-going discussion amongst researchers, policy-makers and industry concerns to what extent these additional costs will drive goods from sea- to land-based transportation (Notteboom et al., 2010; Holmgren et al., 2014). Speed reduction due to increased port efficiency may also be a way to alleviate such a development. The aim of this paper, however, is not to generalise across all shipping sectors, or even all short sea shipping companies in Northern Europe, but to initiate a discussion on how shipping companies could achieve reduced time in port and use that time to decrease speed and increase energy efficiency.

The paper is constructed as follows: Section 2 provides a theoretical overview of short sea shipping, energy efficiency, ship speed, and port efficiency. Section 3 discusses methodological issues. Section 4 contains the empirical outcome of the case study, both from the interviews and from the quantitative data, while Section 5 explores the potential for increased energy efficiency for the studied short sea shipping company. Section 6 problematises this potential. A discussion of the method and results in relation to previous and future research are included in Section 7, followed by conclusions in Section 8.

2. Short sea shipping, port operations and energy efficiency

Short sea shipping (SSS) can be defined as the movement of cargo and passengers by sea between ports that does not involve an ocean crossing. Short sea shipping currently accounts for nearly 40% of all cargo moved in Europe, and the volumes have increased over the years while the market share has been stable (EC, 2012). In 2012, total short sea shipping in the EU-28 accounted for close to 1.8 billion tonnes of freight and represented 60 per cent of the EU-28 maritime transport of goods (Eurostat, 2014). Bulk shipping is the distribution of unpacked or large parcels of raw material and bulk cargo, and can be divided into *liquid bulk*, such as crude oil, and *dry bulk*, such as grains, coal and ore. The former accounted for nearly half (46%) of total short sea shipping of goods to and from the EU-28. Dry bulk is the second largest type of cargo with 20 per cent. Bulk shipping is thus a very important part of European waterborne transportation.

[2] Increased port efficiency relates to reduced turnaround time in this paper. Energy used in ports, both in ship auxiliary engines to produce electricity for the ship (so-called "cold ironing") and in port operations, is outside the scope of this study. The role of ports in this context has been explored recently by, e.g., Acciaro et al. (2014) and Gibbs et al. (2014).

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