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Identifying the unique challenges of installing cold ironing at small and medium ports – The case of aberdeen

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ABSTRACT

Emissions from shipping contribute significantly to both climate change and local air pollution. Cold ironing (onshore power supply) reduces emissions while ships are berthed in port by providing power from shore-side electricity rather than onboard auxiliary generators. Previous research has focused on installing the technology in large ports but if policy goals (particularly in the EU) are to be achieved then smaller ports must also install the technology. Therefore, this study examines the feasibility of installing cold ironing in a medium sized port with several small berths, based on the case of Aberdeen.

Vessel call data were analysed to calculate energy demand and a cold ironing system was designed, including separate OPS units for numerous small berths. The total capital cost was £6.6 m (€7.4 m) and the system could save annual emissions of 108 tonnes of NOx, 2.7 tonnes of PM and 4,767 tonnes of CO_2 emissions worth £1.3 m (€1.4 m). Payback scenarios were examined via SCBA, based on the external costs of potential emission savings. In the best case scenario, the substantial external cost benefits would return the system capital and operating costs in only 7.0 years, or 3.5 years if subsidised 50% by the EU. Challenges result from several small berths needing individual OPS units, long cables and cable reel storage, as well as the need for several vessels to install the onboard technology, which must be overcome if ports besides the large cruise and container ports are to install cold ironing.

1. Introduction

The transport sector is responsible for almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities. The EU has set a target for 2050 of reducing greenhouse gas emissions from transport to a level at least 60% lower than in 1990. Emissions from shipping already account for 2.8% of global GHG emissions, which is double the level produced by air travel and expected to equal those from road transport by 2020 (Smith et al., 2014). Therefore, it is necessary for the maritime industry to focus on reducing emissions from shipping in an effort to reduce the sector's impact on air pollution.

Over the last decade, much research has focused on reducing emissions from ships at sea, mostly as a result of IMO regulations on cleaner fuel, which have focused on SOx (first through SECA limits of 0.1% sulphur and more recently through a global sulphur limit of 0.5% by 2020), and more recently on NOx. Despite the large contribution of shipping to global GHG emissions, CO_2 targets remain absent. Other methods to reduce shipping emissions include some vessel design improvements also mandated to some extent by the IMO, such as EEDI and SEEMP (Cullinane and Bergqvist, 2014; Lister et al., 2015) and fuel reduction through slow steaming (Cariou, 2011; Zis et al., 2015).

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Table 1
Ports using cold ironing (WPCI, 2017).

Introduced	Port	Country	Introduced	Port	Country
2000	Gothenburg	Sweden	2010	Verko, Karlskrona	Sweden
2000	Zeebrugge	Belgium	2010	Amsterdam	Netherlands
2001	Juneau	USA	2011	Long Beach	USA
2004	Los Angeles	USA	2011	Oslo	Norway
2005	Seattle	USA	2011	Prince Rupert	Canada
2006	Kemi	Finland	2012	Rotterdam	Netherlands
2006	Kotka	Finland	2012	Oakland	USA
2006	Oulu	Finland	2012	Ystad	Sweden
2006	Stockholm	Sweden	2012	Helsinki	Finland
2008	Antwerp	Belgium	2013	Trelleborg	Sweden
2008	Lubeck	Germany	2014	Riga	Latvia
2009	Vancouver	Canada	2015	Bergen	Norway
2010	San Diego	USA	2015	Hamburg	Germany
2010	San Francisco	USA	2015	Civitavecchia	Italy

Vessel emissions in ports are increasingly of concern, especially for SOx, NOx and PM rather than CO_2. The former affect local populations directly while the amount of CO_2 produced in ports is a very small portion of global shipping CO_2. The World Health Organization (WHO) considers air pollution a major environmental risk to health estimating that it results in three million deaths per year (World Health Organisation, 2016). Shipping contributes a significant amount to this, especially in coastal areas. Shipping accounts for approximately 15% of NOx and 5–8% of SOx emissions worldwide (Zis et al. 2016) which both cause serious harm to human health and the environment. Air pollution kills 40,000 people every year in the UK alone and leads to long term illness and death from asthma and other chronic diseases, a significant contributor to which is the shipping sector (Royal College of Physicians, 2016).

Vessel emissions in ports are addressed by methods such as cold ironing, use of LNG and vessel speed reduction in the port (Winkel et al., 2016; Sciberras et al., 2015; Styhre et al., 2017; Winnes et al., 2015). LNG is cheaper than HFO and MGO, has no SOx or PM and much lower NOx but only produces a small CO_2 reduction compared to other fuel. It is a particularly attractive solution to city centre ports with populations nearby. As Winnes et al. (2015: 81) point out: “since the share of total GHG emissions in port areas are low compared to emissions during voyage, a port city might be more benefited from prioritising local issues before global.”

Cold ironing (or onshore power supply (OPS) or shore-side electricity (SSE)) is the process of ships connecting to shore side electricity rather than running their auxiliary generators in order to provide power for hoteling. It has been shown to be effective in reducing emissions contributing to air pollution and climate change in countries with a high concentration of renewable energy generation. According to the WPCI (2017), there are only 28 ports in the world with cold ironing installed, which represents how low the takeup has been so far (Table 1). With the exception of Bergen, all are large ports with high total energy demand, which is also in most cases concentrated in a small number of berths, such as a specialised cruise or container terminal, particularly the former as they have higher hoteling requirements than other vessels due to the number of passengers staying on board. Moreover, all of these projects have been completed with external support in countries where ambitious environmental targets have meant that funding has been available.

The technology still has many operational challenges, especially for ports with several small berths and a wide variety of vessel types which may be reluctant to install the required connections on their vessels. If this technology is to have a significant role in decarbonising the maritime industry it must also be installed in smaller ports and used by many different vessels. The Scottish Government has pledged to support Scottish port authorities in implementing emission abatement technologies including cold ironing. This study aims to set out the level of support required in order to implement this, as well as identifying the unique challenges faced by small and medium ports.

Some high level studies have determined the overall potential for cold ironing, but these must be complemented by case studies in order to understand the practical challenges of designing the systems. There have been a small number so far, with only one on small ports. This paper will examine not just the total energy demand, system costs and emission savings, but will also examine the practical challenges of system design, based on several small berths and a variation of vessel type. The following section reviews the literature regarding policy and regulation for cold ironing and then identifies and discusses the system design issues raised in previous studies. Section 3 presents the Social Cost Benefit Analysis (SCBA) methodology. Section 4 analyses the data on energy demand, presents the system design, calculates costs and finally develops several scenarios for analysis. Section 5 concludes with generalisations to other small and medium ports.

2. Literature review

2.1. National and international policy and regulation for cold ironing

The International Maritime Organization (IMO) is the maritime branch of the United Nations with the “Responsibility for the safety and security of shipping and the prevention of marine pollution by ships.” (International Maritime Organisation, 2017). The

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