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KEY FACTORS AND BARRIERS TO THE ADOPTION OF COLD IRONING IN EUROPE

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Abstract

The first cases of successful implementation of cold ironing can be found in Alaska about twenty years ago. In that case, the energy cost was lower than in Europe where cold ironing has been developed only in the latest years at few ports.

The present paper investigates the innovative process of cold ironing at European level. Firstly, its recent development in Europe is documented as well as the main concern of its corresponding legislation. Then, the adoption of this initiative by the “green ports” concept is discussed. Secondly, the technical barriers, such as lack of standardization of electricity parameters are mentioned. And given that port electrical infrastructure needed onshore represents a huge investment that not all ports are financially able to do, the financial problematic is treated explicitly taking into account the cost of energy at ports (directly provided by electric centrals or converted) against the energy cost onboard. Finally, conclusions are drawn covering the main barriers confronted by this technology and the future premises of cold ironing at European ports considering the social and environmental benefits in terms of air and noise pollution.

Keywords: cold ironing, energy cost, technology barrier, European ports, environmental

1. Introduction

Cold ironing is a process enabling a ship to turn off its engines while berthed and to plug into an onshore power source. The ship’s power load is transferred to the shore-side power supply without a disruption of onboard services. This process allows emergency equipment, refrigeration, cooling, heating, lighting, and other equipment to receive continuous electrical power while the ship loads or unloads its cargo. Cold Ironing is also known as Shore Connection, On Shore Power Supply, Alternative Maritime Power Supply (AMP).

Cold ironing has been adopted in some ports around the world as a measure belonging to the “Green Ports” concept. This concept refers to a set of several measures aimed to achieve sustainability at ports, considering that a port not only meets all the environmental standards in its daily operations, but also has a long-term plan for continuously improving its environmental performance.

Auxiliary engines run by ships in ports generate SOx, NOx, CO_2 and particle discharge as well as noise and vibration. These pollutants cause negative health and environmental impact on the surrounding communities. Independent studies have found that cold ironing generates many environmental and social benefits, by reducing emissions from vessels docked in ports, so it can be considered a relevant part of "green ports".

Cold ironing can be considered a technological innovation as it is a relatively new technology providing electricity for large sea-going vessels and since there is only a limited amount of information available, this concept requires a full investigation. Moreover, it can be defined as a 'not yet a successful inititative' in terms of innovation. This is due to its recent development in Europe linked with a recent legislation, as well as the recent spread of the "green ports" concept in many EU ports. Therefore, cold ironing has been implemented only in few European ports, even if other port cities are currently planning to install shore power supply systems. In the next paragraphs there is a detailed explanation of the genesis of this innovation, its development in the EU, its current progress and trend, and the lessons to be learned.

The background of this innovation is examined, including the reasons for launching it, and its development since twenty years ago. The current system of cold ironing in Europe will then be summarised, followed by an analysis of the development process, including its impact and spread across the maritime transport sector at international level. The penultimate section of this paper provides the lessons that may be learned from the analysis of this innovative case. In the final part there is a section including the discussion and the last section draw some general conclusions.

2. Background and Development

Cold ironing is a shipping industry term that first came into use when all ships were equipped with coal-fired engines. When a ship tied up at port there was no necessity to continue to feed the fire and the iron engines would literally cool down, eventually going completely cold. From here derives the term "cold ironing".

Historically, ships were not submitted to emission controls and regulation and diesel engines were their main source of power. However, in the last 10 to 15 years the growing attention to sustainability at ports and protection of marine environment began to increase importance. Then, several studies demonstrated the contribution of ships to the total global emissions. Ships produce 2% of CO_2, 10 to15% of nitrous oxides (NO_x) and 6% of sulphur oxides (SO_x) (ABB Marine, 2010). Further research indicates that 60,000 cardio-pulmonary mortalities are due to particulate matter from ship emissions (Corbett et al. 2007).

As a consequence, new environmental regulations were set-up by the International Maritime Organization (IMO) at a global level. In 2004, the MARPOL Convention (73/78) has placed limits on sulphur oxide (requiring use of <4.5% sulphur fuel by 2010, and its target is to reduce world maritime sulphur output to <0.5% by 2020) and nitrogen oxide emissions from ship exhaust and prohibited deliberate emissions of ozone-depleting substances. In 2005, EU Directive 2005/33/EC has limited the amount of sulphur to 0.1% in all marine fuel used while at berth for more than 2 hours in European ports, since 2010. In 2006 a new environmental EU recommendation came into: it is the EU Recommendation 2006/339/EG, destined to member countries to promote shore-side electricity facilities. The EC recommendation also called for the development of harmonized international standards and provided guidance on costs and benefits of connecting ships to the electricity grid.

3. State of the Art

From a technical and operational viewpoint, cold ironing is a complex technological system made by the following elements. Electrical infrastructure at ports (engineered and integrated systems are required to fit all types of ports); electrical infrastructure on ships (retrofits or new builds); connection and control solutions to ensure personnel safety and seamless power transfer. In particular, a complete onboard system solution should include all power equipment necessary to connect the ship to a shore-side power point; all control equipment necessary to secure seamless automated power transfer of the ship load from the onboard power plant to the shore-side source and back. Furthermore, this integrated system needs to comply to new international standards including: High Voltage Shore Connection (HVSC) by IEC, ISO and IEEE, IEC 60092-510 edition1 IEC/ISO PAS.

Considering economic and financial aspects, it is important to underline that cold ironing is most effective and convenient for those vessels that call frequently at the same port and operate on dedicated routes, and for those that consume huge amounts of power and emit high levels of air pollutants when berthed. Typical vessel typologies include: ferries, cruise ships, containerships, LNG carriers and tankers.

Several ports around the world have already implemented shore-to-ship power including: Antwerp, Gothenburg, Lübeck, Zeebrugge, and Oulu in Europe; Los Angeles, Long Beach, Juneau, Vancouver and Seattle in the rest of the world. If considering the case of the Finnish port of Oulu, with a ship consuming 2000 kW, 7hrs each day, it has been calculated the following estimated annual cost savings with Shore Connection versus on-board electric power production (Fig. 1).

Other cities are currently planning to install shore power supply systems at their ports, such as Barcelona, Bremen, Busan, Copenhagen, Marseille, Civitavecchia, Rotterdam, Stockholm and Venice.

Among the most successful cases, there are the Ports of Los Angeles and Long Beach where cold ironing is a key element of the Clean Air Action Plan (CAAP) adopted by the two ports since 2005. As explained in a CAAP fact sheet, the plan indicates that “all major container cargo and cruise ship terminals at the ports would be equipped with shore-side electricity within five to ten years so that vessels can shut down their diesel-powered engines while at berth.” Under this program, a shipping company has agreed to utilize shore power at the port for at least five years as part of its lease agreement. The port of Los Angeles has added an incentive program and will provide up to $810,000 to defray the cost of adding shore-power to a ship.

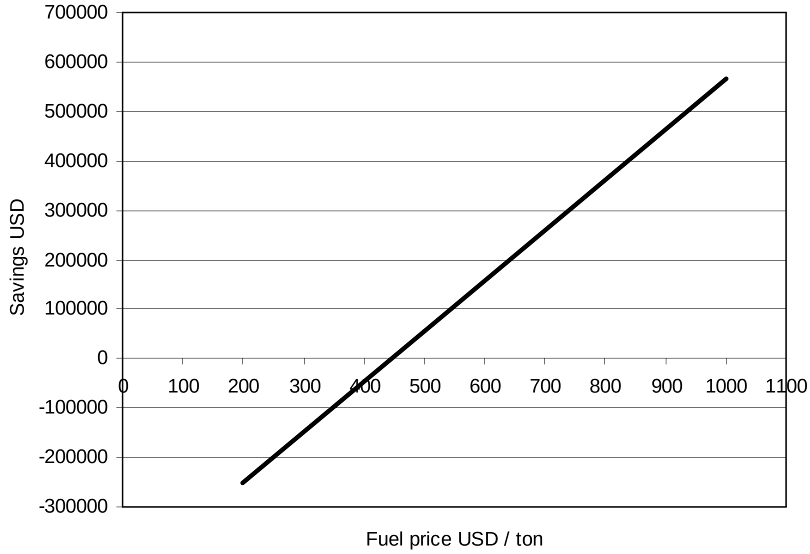

Fig. 1: Annual operational cost savings using cold ironing at Oulu.

Source: ABB Marine, 2010.

The main benefits generated by the application of cold ironing are social and environmental. Firstly, if this innovative technology is implemented properly, it can contribute to air quality improvement. The use of cold ironing could lead to a significant reduction in CO2 emissions, most notably in Japan, UK, and Italy (Hall 2010). Indeed cold ironing system, due to the higher efficiency and to the “limiting emissions facilities” in lower plants, permits to save more than 30% of CO2 emissions and more than 95% of nitrogen oxygen and particulate. It has been demonstrated that, in 10 hours of stop of a cruise ship, its emissions drop from 72.2 to 50.1 tonnes of CO2, from 1.47 to 0.04 tonnes of nitrogen oxide, and from 1.23 to 0.04 tonnes of sulphur oxide. This system also allows to reduce noise pollution. Other positive impacts are better onboard comfort while in port, green profiling for ship owners and customers, and also reduced lifecycle cost by reduced fuel consumption and maintenance cost.

4. Analysis/Discussion

The first case of successful implementation of cold ironing can be found in Alaska about twenty years ago. The success here is mainly due to an economic factor: the cost of energy. In contrast to the price of fuel, quite consistent worldwide, the price of electricity can vary a lot accordingly to local circumstances. In Alaska the energy cost is lower than in Europe due to the huge availability of energy. It amounts about to USD 0.05 per kilowatt-hour (Sassi 2010). Also in California the energy cost is lower than in Europe, equal to USD 0.11 per kW-hr (Sisson and Mc Bride 2010).

Therefore, the cost of electric energy represents a first barrier to the spread of cold ironing in Europe. However, cold ironing could represent a cheaper solution in certain cases if compared with vessels switching to marine distillate (MDO) while in port as required by many local regulations (MDO burns cleaner than bunker fuel, but it is about twice expensive). If a vessel calling in California is charged at the commercial rate of USD 0.11 per kW-hr, the bill for a 24-hour call drawing 1,600 kW will be USD 4,200, less than half the price of burning MDO onboard (Sisson and Mc Bride 2010).

One other barrier can be found in cold ironing infrastructure at marine terminals. They require extra electrical capacity, conduits, and the “plug” infrastructure that will accept power cables from a vessel. A large container ship usually requires approximately 1,600 kilowatts (kW) of power while at berth, but the power requirements can differ substantially, depending on the size of the vessel and the number of refrigerated containers on board (Sisson and Mc Bride 2010). Port electrical infrastructure equipped for cold ironing costs more than a conventional terminal, and it represents an investment that not all ports are disposal or able to do. A possible solution to incentive ports to invest in this new technology could be the use of emission reduction credits: they could help offset this expense and provide short term incentives.

Initially cold ironing for containerships at the port of Los Angeles was realised using a barge to deliver the power, while in the last years new permanent shore-side power has been built. The total cost of constructing the shore-side infrastructure, and the cost of retrofitting the vessels calling at the berth have been estimated for LA ports by Sisson and Mc Bride in 2010. These extra costs will differ considerably by location; their analysis uses US$1.5 million per berth for the shore-side infrastructure (based on recent documented costs for a cruise ship installation in Seattle). Assuming a 30-year design life and applying a six per cent interest rate, this translates into a shore-side construction cost equivalent to US$110,000 per year per berth. The vessels calling at the berth will also need to be equipped with the required electrical infrastructure. Assuming that five vessels are required to provide a weekly trans-Pacific service, at a cost of US$400,000 per vessel, or US$ 2 million for the fleet of five. With a 20-year vessel design life and six per cent interest, this equates to an annual cost of US$170,000 for vessel modifications to a fleet of five vessels. Adding this to the shore-side infrastructure cost, yields a total annual construction cost per berth of US$280,000.

A further barrier is represented by some technical problems concerning lack of standardisation. This concerns compatibility of electricity parameters: ships, built in different international yards, have no uniform voltage and frequency requirement. Some ships use 220 volts at 50 Hz, some at 60 Hz, others use 110 volts. Primary distribution voltage can vary from 440 volts to 11 kilovolts. Load requirement varies from ship to ship – ranges from a few hundred kW in case of car carriers to a dozen or more MW in case of passenger ships or reefer ships. Connectors and cables are not internationally standardised, though work has progressed in this direction. There are other legal implications to outsourcing primary power source (Pawanexh 2009).

One further barrier may be found in the lack of legislation and regulations: the spread of cold ironing at the ports of Los Angeles and Long Beach is a consequence of a stricter legislation (in comparison to Europe), including the MEPC 59/6/5, a joint proposal from USA and Canada to IMO to designate an Emission Control Area (ECA) for specific portions of U.S. and Canadian coastal waters.

Finally, a possible barrier to the spread of cold ironing systems may derive from the adoption of innovative engines and innovative fueling systems such as the LNG propelled ships.

5. Lessons to be Learned

Cold ironing can be evaluated as “not yet a success” due to its recent development in Europe and to its recent legislation environmentally oriented. However, this technology has been successfully implemented outside Europe, in Alaska and California, meaning that there is the possibility that cold ironing would become a practice concerning also European ports.

The presence of many barriers limits the spread of cold ironing at European ports. Barriers are mainly financial and economics, related to the energy cost and infrastructure cost at terminals.

Cold ironing could be implemented with success if European legislation will lead towards the compulsory adoption of new standardized technologies as measures of Green Ports (such as cold ironing, LNG, etc.) in order to achieve emission reductions at ports.

6. Summary and Conclusions

The analysis reveals that the new technology called cold ironing has been successfully implemented in Alaska and California ports. However, it could be not classified as a success in Europe due to its scarce implementation. Indeed there is still the presence of several barriers such as the costs (energy cost and infrastructure cost), the lack of standardisation for the equipment, and the lack of European legislation.

There are three main conclusions that may be drawn from the analysis and discussion of cold ironing, an innovative technology come into force about 20 years ago and still in the phase of growth and development worldwide.

First, it is clear the role played by legislation in California in the spread of this innovation, as its main ports have been obliged to adopt new measures such as cold ironing to reduce air and noise emissions at ports.

Second, another relevant element contributing to the development of cold ironing is the cost of electricity that in Europe is higher than in Alaska and California. Also the cost of port infrastructure represents a strong barrier to the adoption of cold ironing.

Third, the current level of pollution in Europe should incentive the spread of Green Ports and cold ironing if considering their environmental benefits. If nothing will be done, air pollutants emitted from ships in the EU will exceed all combined land-based sources by 2020.

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