

# Contemporary Economy



Contemporary Economy  
Electronic Scientific Journal  
<http://en.wspolczesnagospodarka.pl/>

Vol. 10 Issue 2 (2019) 21-30  
ISSN2082-677X  
DOI [10.26881/wg.2019.2.03](https://doi.org/10.26881/wg.2019.2.03)

## THE EXPECTED GREEN REVOLUTION BECOMES THE NEW MAIN ENGINE OF MODERN SHIPPING

Roman Woźniak

### Abstract

The purpose - the main concept of the work is to present some strong and definite influence of the world's continuously growing demand for better prevention and clear marine environment which is exerted on contemporary shipping through respective legislation. The new already implemented pro-environmental marine law forces sea transport to start making fundamental changes in the shipping business operations. Furthermore it is confirmed that innovative fuel technologies as well as their revolutionary alternatives including future electric energy as the main ship's drive described here as the green revolution become one of the most important and efficient tools leading towards modern shipping. It also marks some other revolutionary trends and ideas being developed in shipping like no-man ship operation and digitalization of majority of data. The innovation technologies will have some serious impact on sea transport cost level as well as on acceleration of scrapping of old age tonnage which will be substituted by new buildings. In the next few years demand for modern ships having various innovative technologies onboard will be continuously growing. Furthermore the new pro-ecological solutions will become some very efficient carriers' marketing tool towards environment-oriented markets and their consumers. Showing different aspects of the sulphur new regulations coming in force since 01.01.2020 recognized as a mile stone of the new marine era and what is more expected the work is to prove a direct link between the related new innovative green technologies and their impact on shipping towards its faster modernization.

Methodology: Publication research, empirical study and prospective study.

Findings: The common growing demand and respective legislation to prevent broader marine environment exert strong pressure on shipping to apply new innovative technologies.

**Keywords:** environment, MARPOL, LNG, scrubber, shipping, sulphur

**JEL classification:** N70, O44, Q42, Q53, Q55

## Introduction

2020 and the time after are considered a milestone of the new era in the present and future shipping. Here, in this article, the main interest is addressed to the globally implemented MARPOL regulation of the sulphur content of 0.5% in marine fuels which is to be enforced on 1 January 2020 and to the responses, tendencies and the most vital changes of the shipping industry. Most of the shipping world recognizes this date and the new regulations coming into force as one of the biggest steps ahead in the present marine history to preserve the marine environment and modernize the present shipping in all possible aspects, along with the beginning of a totally new and different shipping in near future, which might be even planned now with more accurate dates. Furthermore, there already are some further plans towards electric energy as the main marine power and total decarbonization of sea transport.

### 1. General issues of the world environment and climate prevention

The first signs of global interest expressed by the states and their people themselves in relation to the environmental preservation, and the first attempts to improve the environment and climate condition are related to the “Summit of the Earth” conference held in 1992 in Rio de Janeiro. The first frame United Nations Framework Convention on Climate Change was signed that time. The subsequent stages proving firm determination to tackle the climate global warming issues were confirmed by the Climate Conventions in Kyoto in 1997 (signing of the Kyoto Protocol without the USA and Canada), in 2009 in Copenhagen, in 2005 in Paris and recently, in 2018 in Katowice. Finally the more comprehensive agreement was reached in Paris with the conclusion not to exceed the global temperature by more than 2 Celsius degrees. Unfortunately the last conference in Katowice only partly managed to agree on some detailed solutions only partially. The repeated main dispute was not as expected - sufficient financial aid provided by the developed to the developing countries intended to reduce their fast pace of the economic growth in favor of more efficient environmental prevention. Both sides are reluctant to do more, neither rich countries like USA, Canada, Australia and the European Union which are not keen to offer higher compensations nor the less developed countries which are not willing to give up on their ambitions to quickly reduce the gap of their lower life standards and development (the Middle East, Africa, Pakistan, India).

Despite the understandable vital differences of interests, there are more complex pro-environmental issues being solved. They are strongly supported by the developed states which have already reached a very high life level, and their communities push for environmentally-friendly, “green” solutions leading to better health and longer life.

Most of the world’s well-developed and environmentally-friendly countries including China (probably having now the biggest number of electric cars in the world), which as been more active recently, take considerable various positive steps to have continuous improvement of the climate and environment, and these include efficient water sewage systems, garbage segregation, less plastic in common use, more electricity than fossil fuels, friendly heating systems, etc. Comparing the changes in the marine environment shipping industry appears to be ahead.

#### 1.1. Legal prevention of seas and oceans’ environment by the UN IMO

From the perspective of the above-mentioned global environmental issues, one of the best, if not the best efficiently and consequently being improved natural wise areas have been the oceans and the seas for plenty of years. It is worth saying that comparing various initiatives of the UN in numerous fields, all the marine works are far ahead advanced with many of them already implemented in practice.

Already in 1954, newly established United Nations Agency - the International Maritime Organization (IMO), dedicated mostly to all marine issues, located in London, managed to adopt the OILPOL Convention – the International Convention for the prevention of pollution of the sea by oil. In the following years there were 51 most important legal marine laws brought by the UN IMO, 21 of which were directly related to prevention of the sea environment.

In 1973 the IMO adopted the first comprehensive International Convention for the Prevention of Pollution from Ships abbreviated to MARPOL (Marine Pollution), which in 1978 was extended by the working Protocol. Eventually, it has been in force since 1983.

In the following decades, the convention was further extended by preventive procedures against chemical and other harmful pollutions, against garbage and sewage (Annexes I-V respectively). In 1997, another Annex VI was dedicated to protect seas and oceans from air pollution from ships which finally came into force in 2005.

Other important legal measures (conventions) implemented by IMO so far are the AFS Convention – Antifouling Ships Convention, against harmful underwater ship bottom paints, the BWM - Ballast Water Management Convention, against the species' migration in ship ballast water and the Hong Kong Convention, regulating the environmentally-friendly ship scrap recycling (According to MARPOL, consolidated edition, 2017).

### **1.2. MARPOL Annex VI, 1997 (Prevention of Air pollution from Ships) – the fuel sulphur regulation and its development in 2012-2019**

In the first period of 2005-2012, Annex VI implemented global sulphur (SO<sub>x</sub> - Sulphur Oxides) cap of 4.5%, and afterwards lowered it to 3.5% from 2012. However, some states decided to implement higher limits for the fuel sulphur content lowering it to 1% in 2010 and then to 0.1% in 2015. It mainly concerns such regions like the Baltic and the North Seas, the East and the West Coast of the USA, the US Caribbean and Hawaii.

China presented a different approach deciding to use 0.5% fuel in some Chinese ports and their coastal areas.

Annex VI also applies to NO<sub>x</sub> (Nitrogen Oxides) requirements and respective limits in diesel fuel used in the marine diesel engines. This regulation was set by three Tiers - I, II, III which are based on the ship construction date and its size. Tier I and II were already (in 2000 and 2001) implemented globally, but Tier III (except the waters of the USA and Caribbean Sea as already in force since 2016) is only obligatory to the tonnage with keel-laying after 1 January 2016. The Baltic Sea and the North Sea will become NO<sub>x</sub> ECA for the ships built after 1 January 2021 according to the IMO's 70<sup>th</sup> Environment Protection Committee decision.

The above-mentioned waters observing stricter limits of SO<sub>x</sub> and NO<sub>x</sub> are described as SECA, NECA or ECA which respectively mean SO<sub>x</sub> Emission Control Area or NO<sub>x</sub> Emission Control Area or just Emission Control Areas (contains SO<sub>x</sub> and NO<sub>x</sub>).

### **1.3. Effective sulphur technological solutions used by the shipping industry to face the current and future challenges**

As the IMO regulation to lower the sulphur content cap to 0.5% from 01 January 2020 was already decided and announced in 2016, majority of the shipping industry started considering and preparing the effective ways to choose in order to meet the set limit.

Nowadays, there are three best known solutions to solve the issue of sulphur compliance.

#### **Most common fuel alternatives to be adopted by the shipping industry**

The first option is use of clean LNG (Liquid Natural Gas) fuel which becomes promoted and more common nowadays, but it is limited practically solely to fuelling the next generation of the new ship buildings.

The second option is aship scrubber system based on the concept to clean (wash) onboard exhaust gases burning marine heavy fuel oil (HFO).

The third one is the use of recently developed and already available marine fuels with low sulphur content known as ULSFO or LSFO (Ultra Low Sulphur Fuel Oil or Low Sulphur Fuel Oil).

The fourth one, however the most expensive and less economic option is to use diesel marine oil (MDO or MGO - Marine Diesel Oil or Marine Gas Oil) the price of which is much higher than prices of heavy fuel oils as well as LNG fuel.

### **LNG as marine fuel**

To comment briefly on the above-mentioned four options and their advantages and disadvantages, it is worth saying that nowadays LNG technology is probably the cleanest solution and cheaper (taking into consideration current pricing level) as well as characterized by relatively lower daily consumption when compared to the new low-sulphur marine fuels. Some LNG specialists evaluate that the LNG daily operating costs are lower by 7-8% when compared to other solutions based on traditional oil fuels. However, the whole aggregate account of the LNG use is not so simple if some other, additional costs are included. Moreover, there are also higher costs of new buildings - particularly a very expensive main engine running solely on LNG or on dual fuel - LNG or oil, its equipment like e.g. double-wall pipes system, more expensive safety anti-fire facilities, big-capacity gas tanks onboard required due to the gas character and for the time-being the limited number of ship filling port gas terminals (ship gas bunker terminals) around the world having negative impact on the ship's mileage autonomy.

Probably, most of the above challenges will be solved within the next few years as the number of gas terminals is on permanent increase - like the newly open in the Far East - Singapore (to be completed in 2021, Taiwan, in the Middle East - Qatar, in Europe - Poland, Swinoujscie gas terminal, nowadays the biggest in the Baltic Sea, Russia - Saint Petersburg, Lithuania - Klaipeda as well as the gas terminals in Antwerp and Hamburg ports to be built (by 2025). Other ports in different regions also start preparations to adopt the gas bunker terminals (i.e. Tangiers, Gibraltar in the Mediterranean Sea). Depending on the port there are large capacity port gas bunker terminals developed on land (Poland - Swinoujscie) or as floating gas terminals (Lithuania - Klaipeda). Some of the ports intend to convert FRSU (Floating Regasification & Storage Unit) to cooperate with the gas supply bunker feeder vessels. According to Hine, "Industry coalition SEA/LNG says nine of the world's current top 10 bunker ports will have LNG bunkering capabilities by 2020". (Hine, 2008).

Furthermore, nowadays more ship owners become interested in placing orders in shipyards for construction of new vessels run on LNG. One of the best examples is the fourth world's biggest container shipping company, CMA-CGM based in Marseille, which ordered in the Chinese shipyard for nine mega container ships of 22.500 TEU capacity each, running on dual LNG/fuel oil, being under construction and to be delivered in 2020. Hine also says "... when the first vessel of boxship owner CMA/CGM's nine, 22.000 TEU dual-fuel containership new buildings emerges in 2020, it alone will use more than the total volume consumed by all of the LNG-fuelled ships in operation today." (Hine, 2008).

Furthermore, "DNVGL (Classification Society, Ded Norske Veritas Germanischer Lloyd) believes LNG fuelling will continue to increase, albeit from a low base. Its figures show 137 ships running on LNG with a further 138 LNG-fuel new buildings on order" (Hine, 2018).

There is also growing interest in LNG tanker ships orders for new deliveries reflecting fast growing demand for more LNG supplies. Again one of the good examples is the Russian second new Arctic LNG2 export project of total value of \$25.5 bln and annual gas production HIS Markit capacity of 19.8 mln t. This project relates again to "the repeated order of the 15

Arc7 ice-class LNG carriers which were ordered for the company's first Arctic LNG project Yamal LNG" (Hine, 2018).

### **Scrubber systems as another option to meet the sulphur limits**

Scrubber systems let ship operators continue use of marine heavy fuel oil (HFO) which mean much lower operating costs. Particularly some experts like Dr Fabian Kock of the DNV GL in his case study, then Clarksons and Dir. Hedi Grati of the HIS Markit Maritim and Trade in their comments believe that after 2020 this fuel will be one of the cheapest on the market as there will be no much demand anymore and must exist as post refinery product remains (Kock, 2018) (Clarkson, 2018) (Grati, 2018). The current difference in the average price between the LSFO and HFO is around \$50-60 per mt but still no high demand for the LSFO as expected to rise at end of 2019. However again, the challenge is high investment cost around 5-8% the ship value (depending on vessel size, type and kind and brand of installed facilities), required more freespace for scrubber tower and auxiliary systems, risk of penalty (open-loop scrubbers), as well as some chemical adhesives (closed-loop scrubbers). Operators of large container vessels evaluate extra space required for scrubber installations onboard comparable to the bay of approximately 200 TEUs, which means loss of freights of such containers.

According to the author's own business contacts some RO-PAX ferry vessel operators evaluate their scrubber investments for 4-5 mln Euro comparing to the approximate vessel's value of 60 mln Euro. In comparison installations cost approximately 150.000 US\$ when it comes to the approved ballast water management systems. In Europe, the biggest Ro-Ro operator, Danish DFDS, decided to install scrubbers on all their vessels. Probably, the scrubber costs will be continuously dropping as the demand is growing as expected. According to different sources, at the end of 2018 the number of vessels having scrubbers installed was up to 1850 units. This figure was published by DNVGL but the S&P Global Platts shows 1509 vessels. Anyway, the approximate figures given by the DNVGL, S&P Global Analytics, Clarksons by 2020 say about 2278-2700 vessels which will have scrubbers already installed or ordered (Lipsith, 2018) (Ship & Bunker News Team, 2018) (S&P Global Platts, 2018). Then according to the above analytics further demand will grow to reach a greater number of 3000-4000 vessels firmly interested to install scrubber facilities onboard. The new, open production site of Wartsila (the Finish, world's leading engines and its equipment manufacturer) in Vietnam, following increasing demand, offers more scrubbers supplies to several Far East destinations, mostly to the Chinese shipyards for the new constructions as well as tonnage already in operations, but of younger age. On the other hand, there is growing concern about the scrubber open-loop systems, which are suspected that they do not clean water completely (after exhaust gases washing) which is afterwards discharged into the sea. The close-loop systems are more expensive and require more tank storage space onboard to carry and discharge waste water into port facility. They also limit autonomy of vessel's mileage. Costs of the port discharge are still unknown as no port has such a facility.

Common doubts expressed by some European countries push IMO to review the regulations implemented so far when it comes to the discharged waste water issue. On the other hand, ship owners which have already installed scrubbers with open loop are totally against any change of regulations in force. For the time being, IMO decided to delay its decision of the new scrubbers' standards by another one year.

### **Low sulphur fuel oil the most popular solution expected**

There is not much time till the end of 2019 for the operators who have not managed to install (or because of their other preferable option or not enough financial strength) scrubbers yet, and having in mind the full portfolio of shipyards working with the scrubbers, virtually the only solution now is to prepare themselves to use the low sulphur fuel oil. However, some owners choose LSFO intentionally like the MSC, the world wide mega container carrier (Mediterranean Shipping Company).

ranean Shipping Company set in Geneva) which ordered an order new buildings of six container ships of 22.500 TEU just run on LSHO (opposite to the CMA-CGM new ships) from Chinese shipyards.

### **Low sulphur fuel oil as risk of contamination**

Due to the already implemented SO<sub>x</sub> limits (0,1%) in the ECA zones, such fuel is already available on the market, much more types of fuel with requested parameters appeared on the market especially in 2018 with different quality effects. The refining industry expecting high increase of demand for 0.5% fuel from the fourth quarter of 2019 carries out several tests adopting various chemical additives added to heavy fuel to meet the imposed limits. These attempts taken in 2018 had adverse effect on ship operators causing very severe damages in some extreme cases. It appears that some main types of engines are too sensitive to different, new blends of fuels being suddenly supplied to the market these days. The present MARPOL regulations based on Annex VI and the International Marine Fuel Standards 8217, clause 5 and the respective norms, ISO 8217:2005, ISO 8217:2010, ISO 8217:2012, ISO 8217:2017 unfortunately do not fully secure vessels against unexpected fuel quality risks, damages and high costs of repair. In 2017 and 2018, due to bad quality fuels supplied by Houston, Panama and Singapore (three, world's biggest bunker ports) more than 100 ships were badly affected. In those extreme cases, few of them suffered serious accidents and collisions. The example is the P&O ro-ro passenger vessel "Pride of Kent" which in 2017 in Calais struck a jetty and afterwards was grounded due to the breakdown of a bow thruster caused by bad quality fuel. In 2018, another case is m/v Thorco Lineage (Danish shipping company) claim of 10 mln US\$ as their ship was grounded due to the contaminated bunker fuel oil. "Contaminated bunker may have caused Thorco accident" (Krigslund, 2018).

The most recent Lloyd Fobas Team report says "... with the upcoming sulphur limit for outside ECA-Sox from 1 January 2020, it is anticipated that a much broader range of fuel blends will become available. Bearing that in mind, the risk of incompatibility between two different fuel types can become more pronounced than that faced today. Typical problems include sludging at tank bottoms and blockage of pipe work, filters and centrifuges" (Lloyd Fobas Team, 2019). The bad quality fuel issues are also closely monitored by BIMCO as well as the US State Environment Agency.

Not-fully-clear fuel sample test standards (legislatively not promptly updated) lay in the background of the rapidly-changing fuel market, put ship operators in less favorite position, through legal proceedings against fuel suppliers and having difficulties to prove the bad quality fuel.

Furthermore, the few worldwide laboratories having experience in such specialist tests are overcharged due to the massive suspected cases now and offer long testing time which does not comply with the contract bar time clause. The suppliers are not interested to extend time of such a contract clause as it is counterproductive to their interests. The bunker port states maritime administrations also do not show more interest to follow such bad practices of the fuel supplying chain, despite regular, on-spot information offered by the shipping industry, probably due to the legal difficulties to find a responsible party.

Looking at the current fuel quality problems, they will also affect the marine main engine producers which already now must take into consideration more resistant engines compatible with the kind of fuels which appear and will appear on the bunker market. There is some news on the market that the Wartsila is not having so many orders like before for the "flex" type (fuel costs saving) engine as considered too much sensitive for the fuels offered now. New engine generations must be improved and designed to meet less known quality fuels, at least until the quality issue is definitely determined and solved. Taking into consideration all of the above concerns, at beginning of 2019 the IMO agreed that after 1 January 2020, vessels

will be still permitted to use the HFO provided being able to prove their concerns about quality of the compliant fuel offered to them and which put vessel's safety at risk.

Another practical issue for ship operators is the necessity to clean ship fuel tanks already in third quarter of 2019 and start bunkering 0.5% sulphur. The USA state maritime administration warns the shipping industry that there will be „no mercy” after 01.01.2020 and heavy fines will be imposed if even a slight violation of the set limit is discovered.

Furthermore, there are more concerns of the shipping industry about the sea ports being still unprepared to receive discharge of the scrubber's wash water or having no facilities to dispose of the non-compliant fuels or even there being no IMO conclusions on the key technical issues of the emissions regulation which are still to be completed.

The latest concern is related to the attempts of the biggest world's oil producers like Shell and ExxonMobil to patent their newly invented low sulphur fuels, which might have some serious impact on access to the market for smaller oil companies, and will limit the free market price competition.

## **2. Possible scenarios and key elements of the future shipping developments**

### **2.1. Advantages and concerns regarding the marine sulphur prevention solutions and prediction of the shipping markets' response**

Presenting above the advantages and the challenges of the different solutions chosen by several ship operators and some serious uncertainties expressed by the markets, it must be added that some companies believe that still the best device is “wait and see”. The first 2-3 years from 2020 will show clearer tendencies of firm directions which shipping will proceed with. However, trying to make some predictions for the future, it looks that the first commonly chosen option will probably be the low sulphur fuel. The majority of operators provided that their presently operated tonnage/engines can run on the LSFO, and that they will just simply use that solution. They believe that LSFO prices will be going down gradually as a result of the growing demand and more supplies of the petrochemical industry as well as its competition. It does not require any new expensive equipment onboard and no periodic, regular maintenance which the scrubbers and the LNG probably need and extra costs concerned. In general, the shipping market expects that the marine oil prices will start increasing in the second half of 2019 and first half of 2020, but will afterwards slowly stabilize with later tendency to go down. There is another factor, having stronger influence on the fossil fuels market causing its constantly increasing share of the renewable energy in the global world energy balance.

Polish ship operators belong to the group which will run on the LSFO as so far no firm steps have been taken to have any new buildings run on scrubbers or on LNG or convert the existing tonnage.

The second commonly used solution will probably be the scrubber systems, however still minor. Considering more expensive and space-consuming scrubbers with closed loop and extra cost of wash water discharge at port, the interesting advantage is low cost of high sulphur heavy fuel and its wide availability. It is only a question of the rate of return on investment, depending on the fuel price. The higher price means quicker return, but higher operational costs and the case is opposite with the lower price. It always means some advantages. Taking into account the growing demand and more scrubbers supplies, their prices will be dropping and these solutions will become more affordable for many owners who are still not enough financially strong to order them now. There is also a firm chance that some state administrations considering scrubbers as a pro-ecological option and having strong support of their na-

tional green environment will offer some subsidies for their own shipping provided under a national flag (like few Scandinavian states did).

LNG, nowadays the cleanest fuel, taking all costs into consideration, will probably be developed slower than it is expected now as it is the most expensive concept comparing the scrubbers and the LSFO. Moreover, there is a concern about the costs of renewal and intermediate service of the LNG ships which is unknown now, but will probably be much higher than the tonnage run on the LSFO. Certainly the LNG concept will be more competitive for the new buildings than the potential conversions of the tonnage in operations, but analyzing the other tonnage figures still look not to be immediate future going solution.

Comparing the criteria of the lowest costs of transport and the freight related, it looks like the scrubber concept might be the cheapest one, but the LNG as the cleanest energy, even most expensive, will have a strong market chance to reach the high technology inventive products, which can afford higher costs provided that it is widely based on “the green” and demanded by final consumer who is ready to pay more for such a solution. Probably in the short perspective the new regulations leading to the new technologies, more expensive fuels will have some impact on the freights increase. However, in far future there will be more factors usually having influence on freights level like ship size, automatization and related crew costs, technical maintenance costs, tonnage supplies, trade exchange, etc.

## **2.2. Changes in tonnage supply towards more new buildings versus more scrap of old age vessels**

In general, the above expectations will have some influence on the tonnage supply to the market. After 2020 there will be no waters in the world where the old tonnage could be transferred. At the beginning of the time, the change most of shipping will continue running on the existing tonnage, but then there will be more old age tonnage to scrap and to be substituted by newly modern one shipyard built. Furthermore, comparing the low value of the old tonnage and limited time of her further use with expensive scrubber investment makes it unprofitable. Probably the new ship building demand will start increasing from 2021/2022.

All of the above considerations are based on the annual world trade increase by 2-3% and the current oil price level. Particularly the oil market is very sensitive for influence of different factors including political climate like the US sanctions imposed on Iran, or the Venezuela crisis. The sudden, violent and unpredicted causes, for example risk of closing the Ormuz Strait, might destabilize this market totally.

## **3. New, innovative, non-fossil marine power technologies**

Despite of some logic concerns and still the practical issues to be concluded in respect of the regulations coming into force in 2020, other works on the revolutionary solutions will be applied after 2050. They lead to the total decarbonization, which will mean zero carbon ships in the shipping industry. The world’s biggest container carrier, Maersk’ CEO says “We will have to abandon fossil fuels. We will find a different type of fuel or different way to power our assets. This is not just another costs-cutting exercise. It’s far from that. It’s an existential exercise, where we as a company need to set ourselves apart. We’ve been able to absorb the last 10 year’s growth without adding to CO2 emissions. It’s good starting point but it’s not enough... Not just governments and countries, but also companies and industries need to make a change. The maritime industry and Maersk need to take their responsibility,” (Weintraub, 2018).

On the present fuel market, the only carbon-free fossil fuel is LNG. Regardless, the world turns more toward electric energy to be commonly used in shipping in the future. One of the



testing ways is liquid hydrogen and methanol which the fuel cells convert into electrical and thermal energy used to run electric motors. The even farer going innovative solutions develop combined systems of efficient solar photovoltaic, wind mills onboard and energy water propellers charging efficient batteries to store electric renewable energy sea voyage and run vessel's engines.

This concept is being developed now by the GNVL in cooperation with Schenker, a world-wide leading logistic company on the inland waters of Germany as autonomous electrically run container barge commanded remotely without any crew onboard. Another option being studied are more effectively advanced sail systems as ship's main drive.

Besides the new technologies, there are some new routes to be used by merchant shipping known as the Arctic Circles (Russia) and the North West Passage (Canada). Navigating arctic, north waters, the voyage time between Far East and North Europe as well as around Canada shortens by about 14 days which means lower running costs and particularly lower fuel consumption and less emission into the air. Paradoxically, this navigation looks to be possible now because of the global warming effect, which humanity fights on. It is hard to say if in the case of successful reduction of globe average temperature this route will be accessible.

## **Conclusion**

2020 sets new standards of the present and future pro-ecological shipping. Despite of the current practical new regulations implementation concerns and difficulties it will definitely give exert impact on the shipping market for the new innovative technologies to be applied. There is growing worldwide determination demanding more efforts to have clean marine environment which mean continuous pressure for further ecological legislation. In turn, it will create a friendly climate for more far-going technical solutions including electric energy and total decarbonization of the shipping industry. Certainly, due to high costs of the innovations in a few-years perspective it will make sea transport more expensive even expecting that part of the costs increase will be absorbed by the market competition. Considering long period of 20-30 years perspective the today's revolutionary technologies will become more competitive and cheaper for common use by the majority of the sea carriers. On the other hand, the fossil fuels did not say their last word showing strong confidence in the refining and chemical industry and its abilities to supply clean green friendly fuel still based on fossils. Today being in the eve of the vital technologies changes coming in force it is really hard to say which way will appear to be most successful. Probably in a long run it will be electric energy. But even now there are few clear and realistic conclusions. The first one is that final market consumers should expect some general transport costs (freights) increase to finance green friendly shipping solutions. The second one as costwise at sea carriers side means that they should prepare themselves for some general costs increase of shipping business doing. In order to rationalize their costs and implement new expensive pro-environmental technologies carriers will more look for corporate merges and market alliances as well as states support. The green revolution will push shipping towards other technologies like digitalization and remote ship operations having no crew onboard anymore. Having in mind the new trends and the ideas, a certainly revolutionary time for shipping is coming very soon. Looking into the past behind us nobody in XIX and first half of XX century supposed that maritime steam era based exclusively on coal will disappear but.... it happened...

Presently there is growing confidence that electric energy in XXI century as main power including shipping will become true.

## **References**

- Clarksons (30 August 2018), *A quarter of ships on order to be fitted with scrubbers*, <https://worldmaritimenews.com/archives/259806/clarksons-a-quarter-of-ships-on-order-to-be-fitted-with-scrubbers/>, accessed on 16.03.2019.
- Grati, H. (24 May 2018), *Interest in ship's scrubbers is growing steadily, but still falling short of tipping the IMO balance*, <https://ihsmarkit.com/research-analysis/interest-ships-scrubbers-growing-steadily.html>, accessed on 16.03.2019.
- Hine, L. (2018), LNG Fuelling Proves a Slow Burner, *Trade Winds*, December 14, 2018, pp. 27.
- Hine, L. (2018), Shipowners called up for Arctic LNG2's planned newbuildings, *Trade Winds*, October 5, 2018, pp. 17.
- Hine, L. (2018), Transition choices emerge to meet the IMO's 2030 target, *Trade Winds*, December 14, 2018, pp. 29.
- International Maritime Organization (2017) , *MARPOL CONSOLIDATED EDITION , Articles, Protocols, Annexes and Unified Interpretations of the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the 1978 and 1997 Protocols, Incorporating all amendments in force on 01 January 2017*, IMO, London.
- Kock, F. (2018) *Global Sulphur cap*, DNV GL, Germany, 23.05.2018, pp. 11-13, 24-25.
- Krigslund, N. (2018), Contaminated bunker may have caused Thorco accident, *Shipping Watch*, August 14, 2018 , pp. 1.
- Lipsith, G. (21 February 2019), *Scrubber uptake grows six-fold in 2018*,[https://www.mpropulsion.com/news/view,scrubber-uptake-grows-sixfold-in-2018\\_56921.htm](https://www.mpropulsion.com/news/view,scrubber-uptake-grows-sixfold-in-2018_56921.htm), accessed on 16.03.2019.
- Lloyd Register FOBAS Team (2019), *Compatibility of fuels in view of IMO2020*, Lloyd Register FOBAS Bulletin, March 1<sup>st</sup> 2019.
- Shea, J. (2019), Plastic pollution found in deepest sea, *China Daily Business*, March 2-3, 2019, pp. 7.
- Ship & Bunker News Team (15 October 2018), *IMO 2020: number of vessels with scrubbers installed or ordered jumps to 1,850*,<https://shipandbunker.com/news/world/706953-imo-2020-number-of-vessels-with-scrubbers-installed-or-ordered-jumps-to-1850>, accessed on 16.03.2019.
- S&P Global Platts (12 December 2018), *Scrubbers under scrutiny by maritime industry as IMO 2020 nears*,<https://blogs.platts.com/2018/12/12/scrubbers-scrutiny-maritime-industry-imo-2020/>, accessed on 16.03.2019.
- Weintraub, S. (2018), World's largest container shipping group Maersk pledges to cut all carbon emissions... by 2050, *Electrek*, December 6, 2018, pp. 1.

Roman Woźniak

Shipping Director of the Chinese-Polish Joint Stock Shipping Company, Shanghai, China

55 Yan An Road (E.) Shanghai, China, 200002

rwozniak@chipolbrok.com.cn