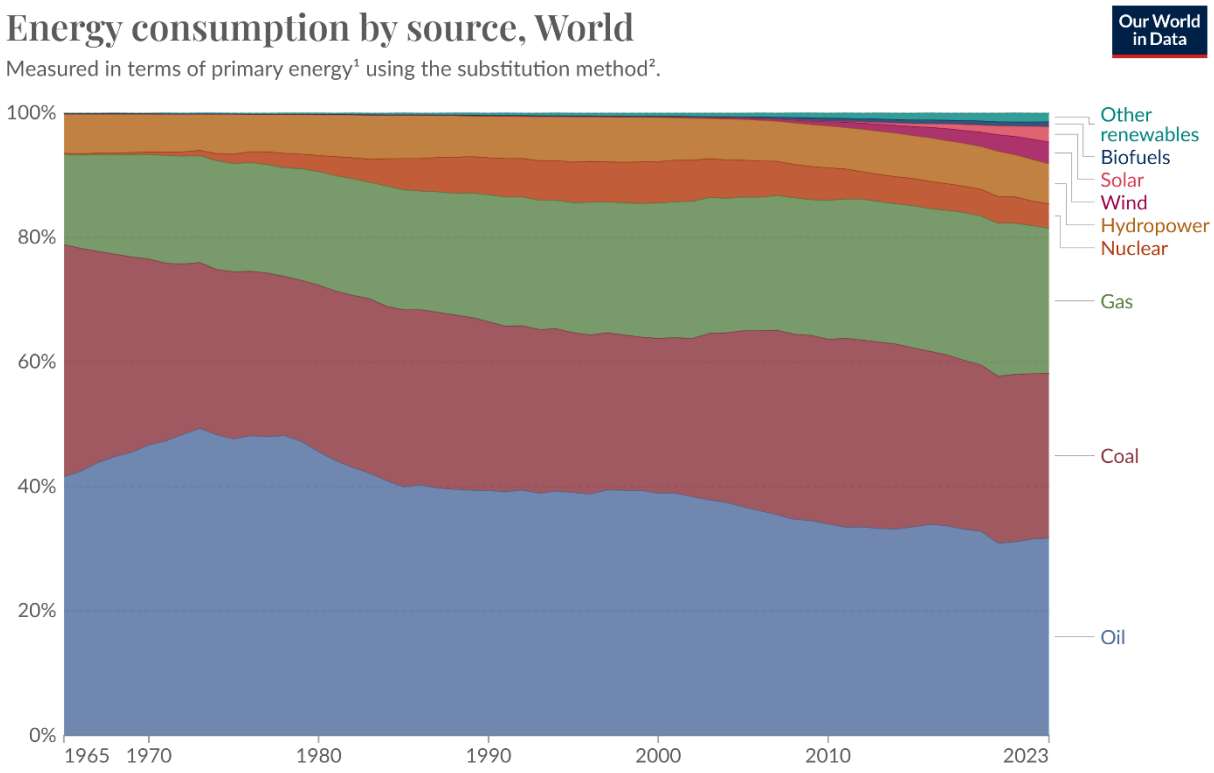
A project to create a layout of a vertical wind turbine for marine use
“Njord”
Sverdlik Sophie, Yengalychev Ilya, Lazovskaya Vasilisa, Karpov Alexander
Curators of the project: Svirelkin Georgiy Maksimovich, Kobzev Anton Andreevich

1. Introduction

At the moment, the world's population is continuously growing, and at the same time more and more energy is being consumed. According to data for 2022, oil accounts for 31% of the total amount of fuel consumed, coal – 27% and gas - 23%, while wind energy accounts for only 3%.



Source: https://ourworldindata.org/grapher/energy-consumption-by-source-and-country

The dominant energy sources – oil, coal and gas – cause great damage to the environment, both in use and in production.

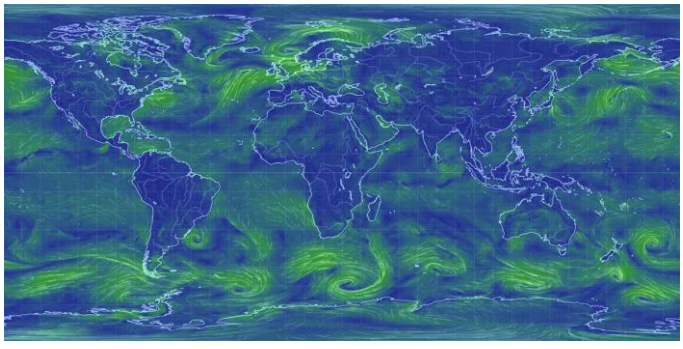
For example, when these products are burned, large amounts of carbon dioxide, various sulfur compounds, nitrogen oxides, etc. are released into the atmosphere.

Wind energy is an excellent substitute for the fuel used, as wind is an environmentally friendly and renewable energy source. If humanity uses only 5% of all possible wind energy, this will be enough to meet all current global needs. [https://en.wikipedia.org/wiki/Wind_power]

Wind energy is obtained through the operation of wind generators – devices that convert the kinetic energy of the wind flow into the mechanical energy of rotation of the rotor, followed by its conversion into electrical energy.

The problem is that most of all winds are located in the seas and oceans, where the only surface on which wind turbines can be installed are ships. It is also important to mention that the fuel mainly used by ships is diesel. This fuel, like its combustion products, is very harmful to the environment: diesel engine emissions contribute to the formation of ground-level ozone, which harms crops, trees and other vegetation. Acid rain also falls, which adversely affects the soil, lakes, streams and enters the human food chain through water, food, meat and fish. (https://www.epa.gov/dera/learn-about-impacts-diesel-exhaust-and-diesel-emissions-reduction-act-dera# .) We propose to solve the problem of using non-environmentally friendly fuels, and in particular, the consumption of diesel fuel by ships, by designing and installing wind turbines on ships.

The most suitable ship for this is a bulk carrier. All goods transported by him are located directly inside the ship, and the deck remains free. The ship carries only the crew, which minimizes the risk of any inconvenience or accidents associated with the installation of wind turbines.



A map of the distribution of winds across the planet, https://earth.nullschool.net/#current/wind/surface/level/orthographic=-264.71,10.87,311/loc=-59.206,17.819

The project that we describe in this article is aimed at developing and creating a layout of a vertical wind generator designed to work on the deck of a dry bulk carrier, solving the problem of generating energy on sea surfaces and reducing environmental damage from the use of diesel fuel.

The uniqueness of the project lies in the fact that the use of the “Njord” will cover the entire marine space, because the installation of wind turbines will not be tied at a distance to the shores and the depth of the bottom. Also, the blades of the wind turbine are designed in such a way that their rotation will not create a significant “Magnus effect” and slow down the ship.

The advantage of our project is that it solves two environmental problems at once.

Target audience

Looking at the market, it is clear that our project will be useful for many industries.

1. International trading companies - have a great benefit from our product. Wind turbines installed on ships will help in saving raw materials and raising the level of trust in the company.
2. Logistics companies are engaged in the transportation of objects, respectively, their benefits will be approximately the same as those of companies that trade across the ocean. This is due to a reduction in the amount of fuel used to transport goods.
3. The government of the coastal regions is probably also interested in saving resources spent on ships. Our future idea for the development, transmission system, sale of energy storage facilities will be relevant and profitable for them.
4. Energy companies will be able to set up a market for the sale of electricity generated by wind turbines on ships.

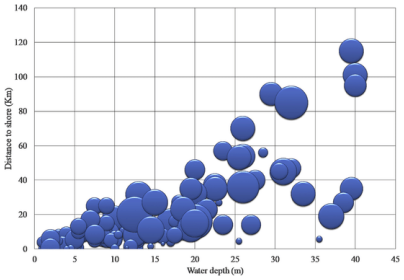
2. Analogues

1.Damen Shipyards Works

The company that commissioned the SOV 7017 Electric ship, designed for convenient maintenance of wind turbines and charging from them during maintenance, uses technology that differs from ours. This technology is tied to changes inside the ship itself, and not to the improvement and installation of wind turbines on the ship. The ship does not have an autonomous energy source, does not transport energy and does not have the ability to give it away, it only works from it. Also, the radius of operation of the vessel is limited by the size of the offshore wind farm, while ships with our version of the wind generator are able to move freely over the entire surface of the water.

2. Wind turbines at sea

Some companies, such as Three Gorges Energy, RWE and others, have already built wind turbines at sea. However, the maximum distance from the shore for such wind turbines is 120 km, and the maximum depth is about 40 m. Such restrictions do not allow the full coverage of the entire maritime space.



The average water depth and distance to the shore of operating offshore wind farms.

https://www.researchgate.net/figure/Average-water-depth-and-distance-to-shore-of-operational-offshore-wind-farms-The-circle_fig4_342040498

3. The process of project implementation

1. At the first stage, after studying the structure and application of wind turbines, as well as analyzing existing alternatives, we designed and created a drawing of the blades and fasteners of Njord. His uniqueness and strengths were revealed.

2. Then, we transferred the final sketch of the blades, screw, mast, frame for screws, gears, housing, as well as the layout of the house, clearly showing energy production, to 3D, working in the NX program. After that, the models were printed on a 3D printer.

3. After printing, we assembled the finished components into a single structure, and we soldered the electrical components responsible for the illumination and operation of the blades. In the end, we put the structure together and checked its operability.

4. Final project and development prospects

The final version of the layout is a vertical wind generator consisting of screws located inside the frame and attached to a shaft that rotates gears connected to the generator. The rotation of the gears causes the generator to generate energy, which flows through the mast through the wires into the housing. From the housing, energy can flow both into the battery, where energy is stored, and go directly to the energy consumer, which is represented on the layout in the form of a lamp located inside the house.

Regarding further research within the framework of this project, we see the following development prospects:

The development of special ships designed to work from energy generated by a wind turbine.

Creating living spaces inside wind turbines in which engineers or part of the ship's crew could live. For sound insulation, you can borrow technologies from China, which were used in the construction of residential buildings through which trains run.

The introduction of a new trading system for the sale of energy from ships to ports.