

**Keywords:** water transport; vessel; electric propulsion; river Danube; alternative energy

**Velizara PENCHEVA\*, Asen ASENOV, Ivan BELOEV**

University of Ruse "Angel Kanchev"  
8 Studentska, Ruse, 7017, Bulgaria

**Valeri GEORGIEV**

Silistra Municipality  
33, Simeon Veliki, Silistra, 7500, Bulgaria

\*Corresponding author. E-mail: [ypencheva@uni-ruse.bg](mailto:ypencheva@uni-ruse.bg)

## STUDY OF THE USE OF ALTERNATIVE ENERGY SOURCES IN INLAND WATERWAY TRANSPORT

**Summary.** A study has been conducted on the use of alternative energy sources for propulsion of a vessel in inland waterway transport. It is clear that at this stage it is most appropriate to use a vessel designed for short-haul trips between two banks of a ferryboat for passengers and luggage or for recreation and entertainment. On this basis, research has been conducted on a newly designed and built vessel to carry up to 12 people. The drive is fully powered by 180-Ah batteries at 48 V. The batteries are charged by the sun through 5-kW solar panels. The results show that the vessel powered by two 5-kW electric motors can sail autonomously for about 1.5 hours, to travel about 13 km, at an average speed of 7.9 km/h with an average energy consumption of 71.3 kWh/100km when sailing on a linearly reversible route including sailing downstream and upstream on the Danube River.

### 1. INTRODUCTION

In 2008, a Strategic Energy Technology Plan (SET - Plan) was proposed and adopted in Europe [1]. This plan is a technological pillar in the European Union (EU) energy and climate change policy. The main initiatives that have been set are related to increasing the use of the following:

- wind energy to generate 20% of electricity in the EU in 2020 and 33% in 2030, respectively;
- solar power from photovoltaic and solar power through light sources (thermal solar power plants) to generate up to 15% of electricity in 2020;
- integration of power plants and optimization of power grids;
- sustainable biomass energy;
- capture, transport and storage of CO<sub>2</sub>;
- sustainable technologies based on atomic nucleus divisions in nuclear power and the use of fourth-generation reactors; and
- energy from fuel cells and hydrogen fuel. In this initiative, held in 2008-2013, it is envisaged that for the period 2013-2020 more and larger demonstration projects and preventive activities will be undertaken to distribute portable, stationary and transport applications, as well as research and technological developments for a long-term period to create a competitive chain for supply and charging of fuel cells and relevant hydrogen fuel infrastructure across the EU.

In 2011, in line with the Strategic Energy Technology Plan - "SET-Plan", the European Commission adopted the White Paper "Roadmap to the achievement of the European Transport Area - towards a competitive and efficient transport system resource" to 2050, in which the dependence of the transport system on oil is set for removal, without sacrificing its efficiency and without

jeopardizing mobility [2]. It is expected to improve the energy efficiency of all types of transportation by developing and deploying sustainable fuels and propulsion systems.

People working and living in cities are considering moving to a “greener” transport through integration of better approaches such as group travel and new vehicles using environmentally friendly fuels. For this purpose, the development of appropriate charging infrastructure for new transport means is envisaged.

Similarly, maritime transport is designed to improve its environmental performance through technology, better quality fuels and activities. As a whole, carbon dioxide emissions from maritime transport should be reduced by 40% (if feasible - 50%) by 2050, compared to the levels from 2005.

Following the set of initiatives in 2016, the "Clean Energy for All Europeans" package was published by the European Commission [3]. By 2030, three main objectives are planned to be implemented: putting energy efficiency as first priority, achieving global leadership in the field of renewable energy, and ensuring fair trade for consumers. To achieve them, there should be a reduction in the EU costs of importing fossil fuels, reduction in greenhouse gas emissions and increase in the use of renewable energy sources. This means the development of solar and wind technology. To this effect, to provide energy for the means of transport, it is planned to build electrical charging stations on the territory of commercial buildings with more than 10 parking spaces for the period after 2025.

In Bulgaria, the policy for development of clean energy obtained from renewable energy sources is also among the priorities of the National Development Program of Bulgaria 2020, starting in 2012, [4]. This is evident in the following:

- Sub-priority 7.3. Reaching 16% of renewable energy (RES) in gross final energy consumption by 2020, which includes creating a favorable environment for renewable energy (RES) production and consumption and replacing a part of the conventional car fleet with electromobility partially powered by renewable energy;
- Sub-priority 8.4. Limiting the negative effect of transport on the environment and on human health, including reducing emissions and pollution from the transport sector, as well as the adverse impacts on the climate. Using "hybrid" and electric road transport is mentioned as one of the possibilities.

To achieve the objectives of the program, socio-economic measures are envisaged. One of them includes building an educational environment that corresponds to the priority directions for the development of science in Bulgaria by 2020: energy, energy efficiency and transport, green and eco technologies development, health and quality of life, biotechnology and ecologically clean foods, new materials and technologies, cultural heritage and information and communication technologies. The mechanism of impact is the Law on Science and Higher Education and the Operational Program "Human Resources Development" with the Ministry of Education and Science as a responsible institution.

In 2017, the Integrated Transport Strategy was adopted in the period up to 2030 [5]. It has continued its policy of developing and using renewable energy and energy-efficient and environmentally friendly technologies. The transport policies of the European Union, the National Strategic Documents and the National Transport Policy are complied with. The specific targets are promoting the use of alternative fuels and reducing transport emissions and noise pollution. To achieve that, it is envisaged to promote the purchase of new cars, through tax advantages, with priority for electric cars and cars operating on alternative fuels; to encourage the use of biofuels and other renewable fuels in transport; to develop transport schemes and technologies meeting current environmental and climate requirements; to find the right formula and balance of state and municipal interests with the public need for a new and environmentally friendly urban environment; and to rethink the concept of the forms of use of the ports located within the boundaries of the city's central area.

In addition to the European and national transport development policies, other regulatory documents are available that also reflect and support the development and use of alternative fuels and environmentally friendly means of transport.

In connection with alternative fuels, major vehicle manufacturers such as Mercedes, BMW, Peugeot and Citroen, Volvo, Toyota, General Motors, BYD Company and Tesla Motors have started

to actively promote the market of electric and hybrid cars and buses, followed by manufacturers of flying objects such as "electric drones", and last but not the least, floating vessels [6-9, 17-20]. For vehicles powered by alternative fuels, a number of studies and developments have been conducted and are still being carried out. In a slide show [18] are presented the characteristics of electric road vehicles and their structure, which includes batteries, electric motors, steering, fuel cells, charging, etc., without referring to the vessels. Vessels move in an aquatic environment and their fuel loading is harder to carry out, so research on that topic is scarce and more difficult to implement. Nevertheless, a review of developments and their characteristics over the years is presented in works by Călărăși County and Skjong et al [6, 14]. The most common works study small craft vessels (boats) carrying several people and developing speed to about 6 km/h. A relatively larger project was funded in 2017 by Toyota, where the French initiative for the creation of a vessel was implemented and called "Energy Observer", powered by solar energy and hydrogen [21]. The ship has been built on a catamaran basis with an electric drive and uses a mixed system of renewable energy sources (solar panels and a hydrogen fuel cell) and a system that produces hydrogen from seawater. In connection with this, this article focuses on the research of an electric-powered vessel.

## 2. GOOD PRACTICES FOR THE USE OF ALTERNATIVE ENERGY IN VEHICLES FOR PUBLIC TRANSPORT OF PASSENGERS

Large vehicle manufacturers develop and test cars, vans, trucks, buses and other vehicles such as ships, working with alternative energy sources such as methane, LPG, biofuels, electricity, and hydrogen, [6-9, 17-22]. In recent years, vehicles and ships with electricity charged from the mains, obtained from conventional thermal, hydro and nuclear power plants, solar and wind power or a hydrogen fuel cell have attracted the interest of producers and users [16, 21, 22].

In public passenger transport, besides trains on the subway, trams and trolleybuses, which are powered by electricity, tests and trials are aiming at the deployment of buses powered only by electricity or by hybrid drive. The scheme that is available in the hybrid drive to extend the range of electricity offered by Volvo is presented in Fig. 1 [16].

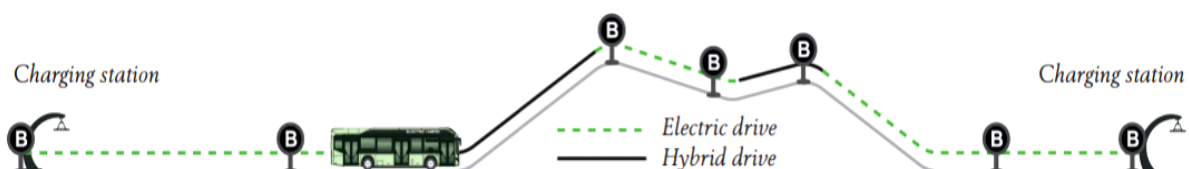


Fig. 1. Scheme for using hybrid buses on different routes

Driving on flat terrain and downhill is to be carried out only by electric drive, and ascending on sloped terrains is to be executed by hybrid or internal combustion drive. Moreover, according to the length of the route, charging stations are also planned to be easily accessible. The Volvo 7900 Electric bus is 12-m long, 2.55-m wide, 3.28-m high for 83 passengers, 35 of which are seated with the driver. The drive is executed by a 160-kW electric motor, with a torque of 400 Nm, using lithium-ion 4x19 kWh batteries or a total of 76 kWh; the gearbox has two gears. Charging is fully automated, with the charger on the roof of the bus and takes only 6 minutes to charge. The current is in the range of 200 to 400 A at a voltage of 500-750 V. The bus has two axles and is available in electric and hybrid versions. A hybrid variant is used in Stockholm, Sweden, in an 8-km-long route. Since 2015, more than 2200 buses of the same type have been put into service in Europe, Asia, America and Australia.

In 2015, the "Strategy for Development of Sustainable Transport System in the Calarasi - Silistra Cross - border Area" was established under Clean Access Project in the Calarasi - Silistra cross - border area / Clean Access in Calarasi - Silistra Cross - Border Area "- Clea / Ref. No 2 (3 i) -1.1-7

MIS - ETC CODE: 118, financed under the Romania - Bulgaria Cross Border Cooperation Program 2007-2013 with a leading partner, The Institute of Electrical Engineering / INCDIE ICPE - CA / Bucharest, and partners, Angel Kanchev University of Ruse, National Institute for Research and Development of Gas Turbines in Romania, municipality of Silistra and municipality of Calarasi, [6]. It presents test results of the BYD bus K9 of the Chinese company BYD Company Ltd, powered by electricity. In 2013, in Timisoara, Romania, a bus has been tested with a 200-km run on a single charge. The bus has the following characteristics: autonomy of 250 km with one charge in urban traffic; dimensions (L/B/H): 12m/2,55m/3,36m; seats: up to 72 passengers (31 seats), with a maximum authorized mass of 18 000 kg; cost per 100 km is approximately 130 kWh, acceleration: 0-50 km/h in 20 seconds; maximum speed: 70 km/h; charging: full charging 6 h, fast charging 3 h; battery capacity: 324 kWh/ (600 Ah - 200 Ah x 3) with battery life expectancy of about 4000 charges; and standard charging duration: 5 h - 60 kW (30 kW x 2, 480 V, alternating three-phase current).

Another variant of a proposed electric bus for which technical data from testing and operation is known is the YTP-1 model, produced by the Dutch company Ebusco. In 2015, the bus was tested between Munich and Berlin on a 450-km route. A new type of battery with a capacity of 3000 charging cycles was used and a power rating of 1:3.5 kWh/kg. In 2013, the Dutch Organization for Applied Scientific Research (TNO) researched and published a report (TNO 2013, R10212) on test results of this type of bus on battery autonomy using the SORT (Standardized On-Road Cycles) procedure.

According to the procedure, the tests were carried out over a period of three test cycles: SORT 1: busy urban route; SORT 2: low-loaded urban route with moderate traffic flow; and SORT 3: easy surrounding route, Fig. 2, [8].

The battery of the bus had a mass of 2 400 kg and provided a range of up to 250 km. The total mass of the bus with a load was 14,410 kg. In the tests, the following data were obtained: for SORT 1: busy urban route: where for a mileage of 5,395 km was spent 6,21 kWh, which is 1.15 kWh/100 km; SORT 2: a slightly busy urban route with a moderate traffic flow at 8,386 km where 9,57 kWh was used, which is 114 kWh/100 km; and SORT 3: an easy roundabout route for a mileage of 11,181 km, using 12,87 kWh, which is 115 kWh/100 km. For a distance of 177 km covered in 7.5 hours, an average of 210,85 kWh was charged, which is an average of 119 kWh/100 km.

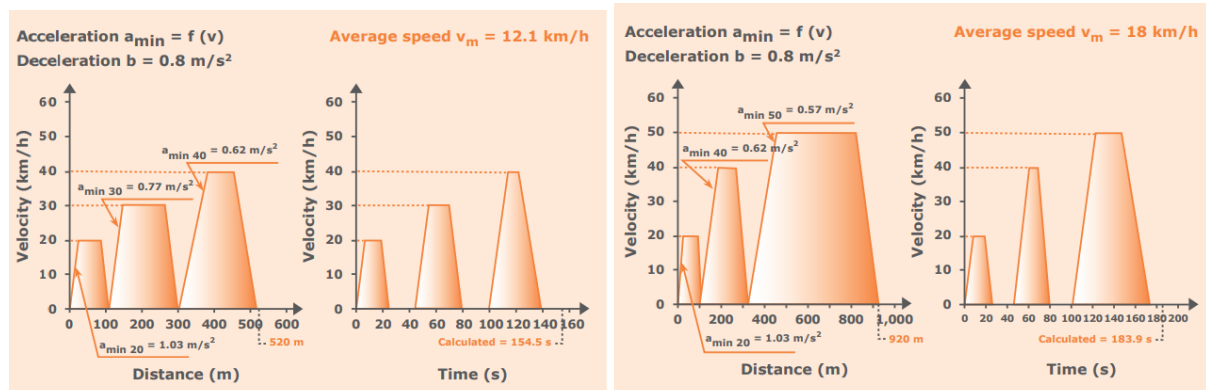
From the review of good practices in road passenger transport, it has been found that there are ready solutions, implementations and test methods that have been developed, with results available.

### **3. VESSEL OPERATED BY ELECTRIC POWER**

#### **3.1. Selection of a vessel**

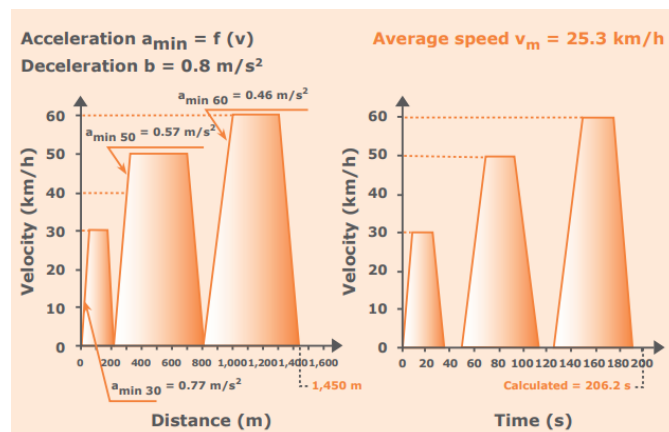
When choosing a vessel to be equipped and propelled with electricity, it is necessary to analyze the regulations in the country and the constructions of the known vessels. In the Republic of Bulgaria according to the normative documents Ordinance No. 11 of 26 April 2004 on ship and ship-owners inspections, [15] inland waterway vessels on inland waterways in Europe and ships sailing between ports and facilities in the Republic of Bulgaria, fishing vessels, as well as non-commercial vessels are not subject to compliance assessments in respect of shipboard living and working conditions under the Maritime Labor Convention, 2006. Besides, according to Ordinance 22 of 11 October 2018 for the requirements for inland waterway vessels, [14] vessels less than 20 meters in length and ferries are not subject to control. Furthermore, the vessel need not be registered for commercial activity. This shows that a vessel that can be designed to operate using electricity and tested in real conditions on the Danube River must meet the specified requirements. Such a vessel was constructed under the project "Pure access to the border area Calarasi - Silistra", [6]. This is a prototype vessel "trimarane" powered by electricity (Fig. 3). The vessel is 8.5-m long, 4.5-m wide and 2.5-m high. The drive consists of two electric motors of 5 kW each, operating with a voltage of 48 V. The power supply consists of two lithium batteries at 180 Ah. Solar panels with power of 5 kW are used to charge the batteries. The panels are laid over the entire surface of the vessel and are made of poly-silicon (Poly - Si). Each panel

has a power of 250 watts. The vessel has a total weight of 1500 kg and is built to be able to carry 10 people plus a 2-person crew. The planned speed is 10 km/h. In the calculation of resistance and the necessary power of the vessel the forces of resistance from the weight of the container, the river on which it will sail, the water resistance of the draft, which cannot be greater than 0.5 m (planned 0.42 m) etc., are taken into account according to Călărași County [6].



a) Heavy urban traffic

b) Easy Urban



c) Easy Suburban

Fig. 2. Test cycles for electric buses, [8]

The vessel's equipment includes a hybrid inverter / charger with ON / OFF operation grid; LED lighting for navigation and lighting on deck with a total installed power of 200 W; electric outboard motors complete with controllers and lever system for simultaneous remote control and own software for adjustment, monitoring and control; AIS / GPS transmitter for traffic control and positioning; a grid link between AC and DC consumers with protection and management; tablet docking station with a GPRS connection and the ability to supply free WIFI, equipped with software programs ONLINE / INTIME monitoring, measurements of energy consumption, operating time, distance, recording of data, setup and management of individual systems. The vessel is suitable for non-commercial purposes, such as amusement rides along the Danube and other navigable rivers, other inland waterways such as lakes and dams. When used for commercial purposes, it can replace a ferry between the two banks of the river Danube, which is about 1 kilometer in the Bulgarian-Romanian section or another necessity where the distances between the sites are shorter.

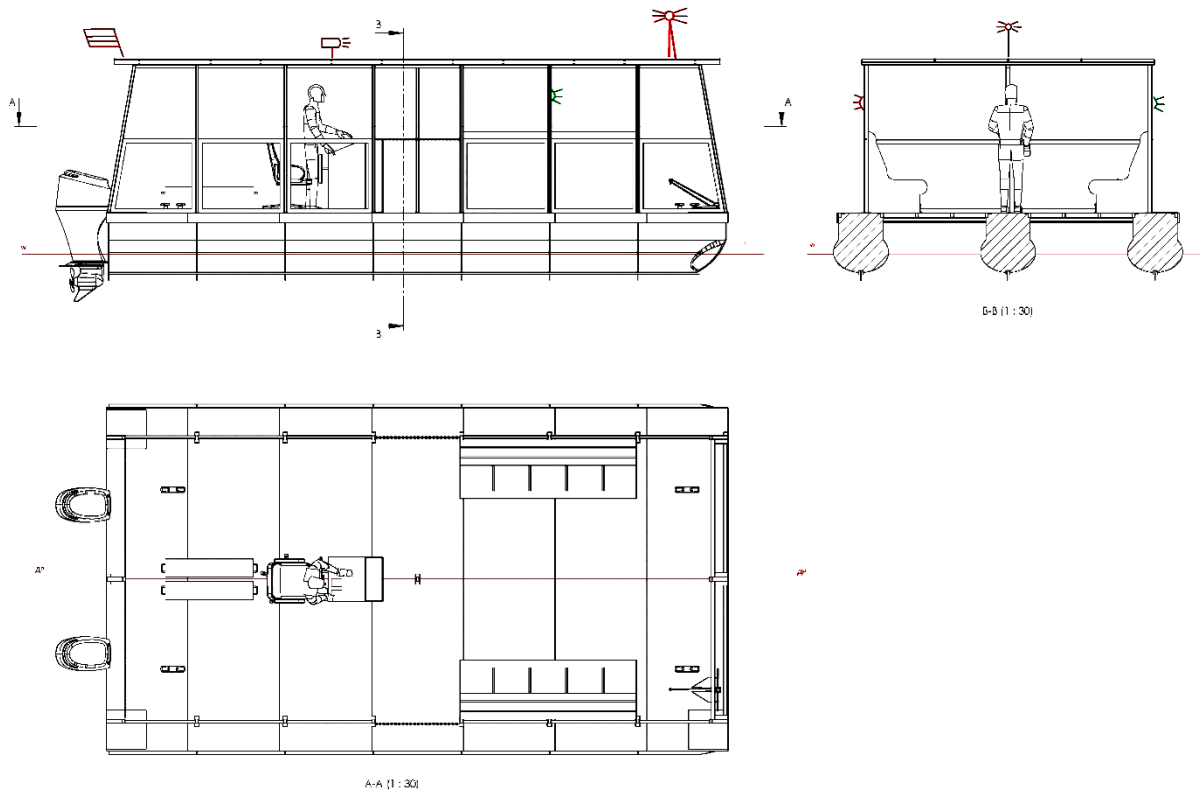


Fig. 3. General appearance of the vessel powered by electric power

### 3.2. Methodology of the study

The study was conducted in the Lower Danube area around the town of Silistra. The research was conducted during the summer season (July and August) of 2018 when the sun is high, because battery charging is done only by solar panels. Three routes were selected for the research: route I - a 1.3-km-long section in the Silistra-Kichu section; route II – average length of 5 km in the region of Silistra - Danube Park; and route III - relatively 13-km long in the Silistra - Chatepee area. The test was made on all three routes downstream and upstream. Typically the average velocity of flow of the River Danube in the area around Silistra is about 3.6 km/h, varying in the range of 2-6 km/h. The depth of draft of the vessel is around 0.37 m.

The tests were conducted with charged batteries. For this study, the data are recorded with index 1 for sailing upstream and with index 2 for sailing downstream: routes I, II or III; travel time  $t_{1,2}$ , min; distance traveled  $L_{1,2}$ , km; the energy consumed  $E_{1,2}$ , kWh; maximum speed  $v_{max}$ , km/h; maximum engine load, where the average speed on the route  $v_{1,2}$ , km/h, using method by Atanasova-Petrova et al [15]; and the energy consumption per 100 km distance traveled  $Q_{1,2}$ , kWh/100km. Energy consumption for 100 km route is determined by dependence:

$$Q_{1,2} = 100 * E_{1,2} / L_{1,2}, \text{ kWh/100km}, \quad (1)$$

where index 1 shows values for movement upstream, and index 2 - downstream.

The vessel's hardware and control equipment is used for measuring and recording of the data.

The management of the vessel is carried out by a qualified captain and one assistant (fig. 4). In the research, the total number of passengers is 5 people. The vessel is not loaded with other passengers and additional cargo.

The purpose of the research is to determine in real terms what the actual electricity consumption when traveling up and downstream is.



Fig. 4. Testing of the electric vessel on the Danube River

#### 4. EXPERIMENTAL STUDIES ON THE DANUBE RIVER

During the tests with the vessel on the Danube River, the data were measured by the system embedded in Hybrid Solar Dispatcher HSD-5K-48V MPPT and Voltronics for recording data. Recording the measured values is every 60 sec. The measurement accuracy is as follows: electric current  $\pm 1A$ ; voltage  $\pm 1\%$ ; power  $\pm 1kW$ ; the distance covered and velocity are measured and specified by the GPS installed. It has next technical specifications: accuracy: 0.1 km/h; update rate: 20 Hz, minimum velocity: 0.1 km/h, resolution: 0.01 km/h, latency:  $<41.5$  ms, distance accuracy: 0.05 % ( $<50$  cm per km), 2D position  $\pm 2.5m$ .

The data for the distance covered are recorded simultaneously also by the mandatory ship's Automatic identification system (AIS) installed. It allows the presentation of the route on the river map later, in order to visualize it when the direction of sailing is determined.

To determine the energy consumption, 20 attempts on three routes have been made. These results are presented in Tab.1 for the upstream movement and table. 2 for the downstream movement. In the tables, 19 attempts are presented, because one of the 20 attempts is to determine the maximum flow rate of the vessel downstream. The maximum speed that is obtained when driving downstream is 14 km/h. When driving the trimarane on the selected routes, the engine load on the upstream movement is maintained within a current range of about 80 A at a maximum value of 100A. In the downstream movement, current values are about 30A; the goal for this experiment is not to reach maximum speed at maximum load but to maintain speeds close to the set speed of 8-9 km/h and possibly lower energy consumption and longer mileage with one battery charge.

Test results were processed in Microsoft Excel with the Descriptive module Statistics and are presented in Tab. 3.

After processing the data, the average energy consumption per 100 km traveled distance along route I upstream is 102.04 kWh/100km at an average speed of 7.84 km/h. Route II has a corresponding energy consumption of 103.23 kWh/100km at an average speed of 7.78 km/h. On route III, the value is only one corresponding power consumption of 93.97 kWh/100km at an average speed of 8.51 km/h. Overall, the average cost of energy is 103 kWh/100km when sailing upstream, except route III, which is mainly owing to the lower flow velocity and more favorable conditions of sailing owing to the greater length of the minutes route.

After processing the results in Excel, the average energy consumption per 100 km traveled distance along route I is 42.68 kWh/100 km at an average speed of 7.61 km/h. Route II has an energy consumption of 39.34 kWh/100 km at an average speed of 8.24 km/h. On Route III, the value of energy consumption is 39.05 kWh/100km at an average speed of 7.73 km/h. Overall, the average cost of energy is 40 kWh/100 km at an average speed of 8 km/h for downstream movement.

When processing all of the results from the routes, we conclude that the average energy consumption when travelling upstream is 102.49 kWh/100 km at an average speed of 7.8 km/h (Tab. 3). The average power consumption when travelling downstream is 40.03 kWh/100km at an average speed of 8.08 km/h.



Table 1

## Test results for upstream movement

№ of experiment	Travelled distance, $L_i$ , [km]	Travelled time, $t_i$ , [min]	Travelling speed, $v_i$ , [km/h]	Energy consumed, $E_i$ , [kWh]	Energy consumed per 100 km, $Q_i$ , [kWh/100km]
Route I. Silistra - Kichu section					
1	1,35	10,32	7,85	1,376	101,93
2	1,3	9,66	8,07	1,288	99,08
3	1,29	9,9	7,82	1,32	102,33
4	1,32	10,38	7,63	1,384	104,85
Route II. Silistra - Danube Park region					
5	5	41,46	7,24	5,528	110,56
6	4,9	40,8	7,21	5,44	111,02
7	5,1	40,2	7,61	5,36	105,10
8	5,2	37,8	8,25	5,04	96,92
9	5,1	41,16	7,43	5,488	107,61
10	4,9	35,88	8,19	4,784	97,63
11	5,1	40,68	7,52	5,424	106,35
12	4,9	34,98	8,40	4,664	95,18
13	5,1	36,18	8,46	4,824	94,59
14	5	35,58	8,43	4,744	94,88
15	5	38,88	7,72	5,184	103,68
16	4,9	36,12	8,14	4,816	98,29
17	4,8	40,26	7,15	5,368	111,83
18	4,9	40,98	7,17	5,464	111,51
Route III. Silistra - Chatepee area.					
19	12,83	90,42	8,51	12,056	93,97

In linear reversible routes, which include sail in both directions of the current, the average power consumption is obtained for route I – 71,9 kWh/100 km, for route II – 71 kWh/100 km and route III – 66,5 kWh/100 km. For all the results, the average energy consumption is 71.3 kWh/100 km at an average speed of 7.95 km/h (Tab. 3). This shows that with increasing distance travelled, energy consumption reduces. It means that options for conservation and creation of energy for the vessel so that it can travel longer distances for longer periods of time without stopping should be sought. The decision to increase the number of batteries is not desirable because it costs a lot and increases the weight of the container. The option of using solar energy is good, but only under certain conditions, which does not allow a complete solution to the issue. A suitable option is the use of a hydrogen fuel cell power generation system and a hydrogen generation system on board of the vessel from pure water, similarly to the vessel in [21]. Therefore, the results of the survey, as well as the created vessel, will be used for improvement purposes, with the addition of a hydrogen fuel system to increase the length of the voyage.

In the case of distances up to 15 km, the trimaran and any other similar vessel requiring electricity are quite suitable for recreation and development. People who sail with trimaran have the opportunity to fish, race, etc. In the case the vessel is used for commercial purposes, it is well put to be used as a ferry boat for transportation from one river shore to the other.



Table 2

Test results for downstream movement

№ of experiment	Travelled distance, $L_i$ , [km]	Travelled time, $t_i$ , [min]	Travelling speed, $v_i$ , [km/h]	Energy consumed, $E_i$ , [kWh]	Energy consumed per 100 km, $Q_i$ , [kWh/100km]
Route I. Silistra - Kichu section					
1	1,35	10,80	7,50	0,58	42,67
2	1,31	11,00	7,15	0,57	43,72
3	1,33	10,30	7,75	0,57	43,91
4	1,34	10,00	8,04	0,53	40,40
Route II. Silistra - Danube Park region					
5	5,03	34,20	8,82	1,82	36,48
6	5,05	38,60	7,85	2,06	42,01
7	5,02	40,40	7,46	2,15	42,25
8	5,28	39,30	8,06	2,10	40,31
9	4,92	33,70	8,76	1,80	35,24
10	5	34,50	8,70	1,84	37,55
11	5,03	37,80	7,98	2,02	39,53
12	5,1	33,70	9,08	1,80	36,68
13	5,02	39,80	7,57	2,12	41,62
14	4,89	34,20	8,58	1,82	36,48
15	5,07	35,50	8,57	1,89	37,87
16	4,96	36,00	8,27	1,92	39,18
17	5,07	40,50	7,51	2,16	45,00
18	5,03	37,30	8,09	1,99	40,60
Route III. Silistra - Chatepee area					
19	12,91	100,20	7,73	5,01	39,05

## 5. CONCLUSION

The report presents a new prototype of a vessel for transportation of up to 10 people on the inland waterways. The planned vessel is in line with the modern European and national programs and strategies for environmentally friendly transportation, which offers 100% of electricity from solar panels with a power of 5 kW. The vessel does not pollute the environment and, above all, the water that is used for shipping.

From the experiments performed on the created electric powered vessel with weight 1.5 t and 5 persons on the board, the energy consumption is on average about 102.5 kWh/100 km when floating upstream and 40 kWh/100 km when floating downstream at speeds between 7.8 and 8.1 km/h. When travelling in both directions, the power consumption averages 71.3 kWh/100km at an average speed of 7.95 km/h. To realize voyages of 100 km and longer distances, it is necessary to provide a greater amount of electrical energy stored, because at this stage the amount of energy stored in the batteries and charging from the sun is enough to sail around 1.5 h, which is a fairly short distance - less than 15 km.

Table 3

Characteristics values of the surveyed route metrics

Value	Metrics					
Tested indicators	$v_1$ , [km/h]	$Q_1$ , [kWh/ 100km]	$v_2$ , [km/h]	$Q_2$ , [kWh/ 100km]	$v_{12}$ , [km/h]	$Q_{12}$ , [kWh/ 100km]
Mean	7,8316	102,49	8,0768	40,029	7,954	71,260
Standard Error	0,108	1,4225	0,1257	0,6497	0,084	5,192
Median	7,82	102,33	8,0400	40,3077	7,917	69,485
Mode	#N/A	#N/A	#N/A	36,48	#N/A	36,480
Standard Deviation	0,4709	6,2003	0,5478	2,8321	0,519	32,005
Sample Variance	0,2217	38,4441	0,3001	8,021	0,269	1024,303
Kurtosis	-1,3975	-1,363	-0,9665	-0,9825	-0,816	-2,012
Skewness	-0,0287	0,1497	0,2246	0,0256	0,217	0,045
Range	1,36	17,86	1,9347	9,7582	1,935	76,588
Minimum	7,15	93,97	7,1455	35,2418	7,145	35,242
Maximum	8,51	111,83	9,0801	45	9,080	111,830
Sum	148,8	1947,31	153,4587	760,5546	302,259	2707,865
Count	19	19	19	19	38	38

The results show that the electric-powered vessel is very suitable for short distances of up to 15 km, and can be used for recreation and entertaining purposes such as fishing, sporting activities, as well as trips from one coast to the other, fulfilling the role of a ferry boat.

## ACKNOWLEDGMENTS

*This work was supported by the Bulgarian Ministry of Education and Science under the National Research Programme E+: Low Carbon Energy for the Transport and Households, grant agreement D01-214/2018.*

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Received 28.04.2018; accepted in revised form 27.08.2019