SMALL-SCALE WIND TURBINE SYSTEM FOR DOMESTIC USE

AIM

The project aimed to analyse different domestic vertical wind turbines and their potentials in a domestic-urban environment.

ANALYSIS

Following an analysis and findings has been considered to build a WAWT system with a nominal power of 400 – 600 watts, using components available on a market, where the cost of a system would be considered as a crucial factor. The system to contain a generator, turbine, charge controller, battery, and stand for testing (Fig. 1).

Wide range of wind power generation systems analysed (Fig. 2). Due to aimed power output and limited costs, most suitable designs were considered – vertical wind turbines Nr. 2 (Savonius) and Nr. 6 (lantern).

Fig. 3

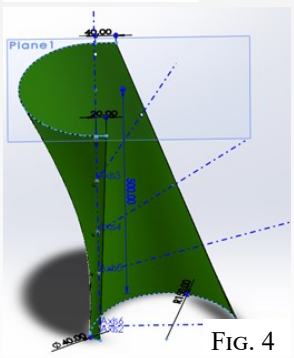

Fig. 4

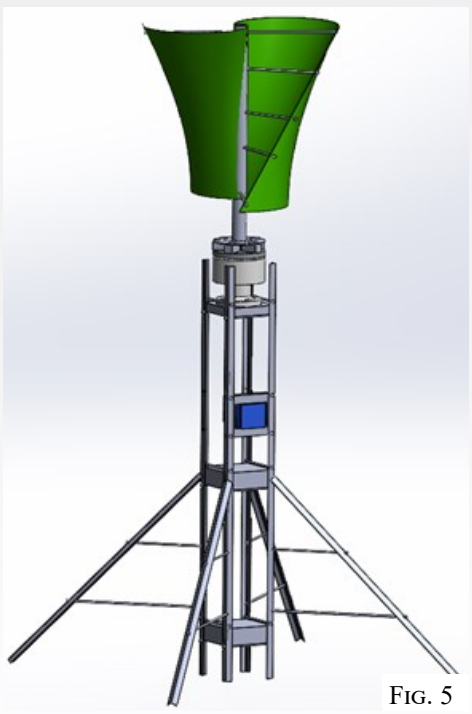

Fig. 5

DESIGNING, BUILDING, TESTING

A stand, Savonius type blades, generator and charge controller have been designed and assembled using SolidWorks software (Fig. 4 - 5).

Following the design stand and Savonius blades were built and assembled in a workshop.

1st testing has been carried out in the workshop (Fig. 11), 2nd in real-life environment (Fig. 6 - 10, 12, 13). different values were obtained and used to determine if the system is capable to meet the power requirements of one household.

Both testing results demonstrated significantly lower values than initially expected. Desired power output have not been achieved, hence power requirements for one household using the current system cannot be met.

- Minimum required power output: **208.3 Watts/hour** or 5 kWh/day
- Maximum power output at 7 m/s wind speed: **3.6W**

TESTING RESULTS			CALCULATIONS
RPM	**I**	**V**	**P (watts)**
100	0.03	10.6	0.318
150	0.15	11.6	1.74
200	0.3	12.0	3.6
300	0.4	12.4	4.96
400	0.5	12.7	6.35

Fig. 11

PURCHASED WIND TURBINE	
Wind(m/s)	Voltage(V)
6.0	10.0
6.6	10.6
7	11.2

Fig. 12

BUILT WIND TURBINE	
Wind(m/s)	Voltage(V)
6.0	10.7
6.6	11.7
7	12.0

Fig. 13

$$P_{in} = \frac{1}{2} \times 1.23 \times 0.3 \times 7^3 \times 3.5 = 221.49225\ W$$

$$C_P = \frac{P_{out}}{P_{in}} = \frac{3.6}{221.49} = 0.016 = 1.63\%$$

Fig. 14

THE BLADES	€21.57
STAND	€17.35
OTHER EQUIPMENT	€268.58
Total system price:	**€307.50**

Fig. 15

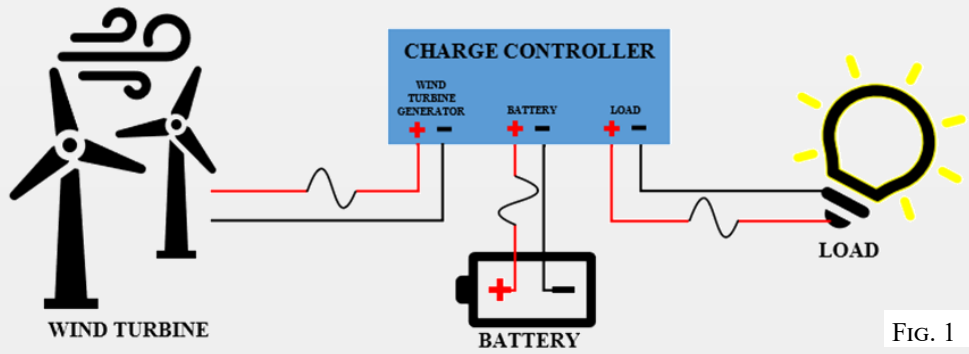

Fig. 1

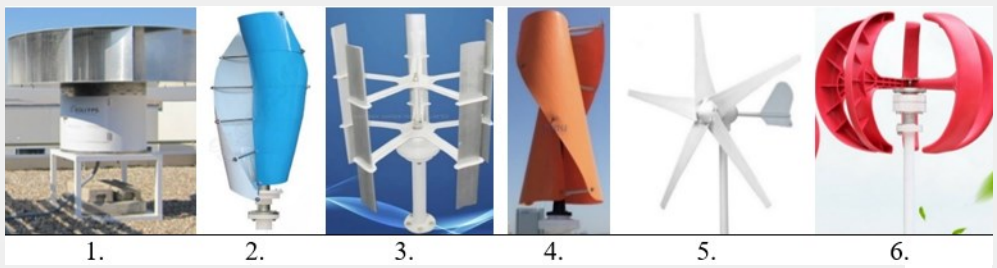

Fig. 2

IMPLEMENTATION

Following the research has been considered, that most suitable components for the system are:

- Permanent magnet generator with maximum power of 600 Watts.
- PWM charge controller.
- Second hand automotive 12 V battery.
- Four pod stand.

Market research led to wind turbine Nr. 6 which has been sold with permanent magnet generator and pwm charge controller. Price to power output considered as outstanding. Turbine has been purchased.

For further investigation and potential system improvements, has been considered to purchase wind turbine Nr. 6 and build blades like wind turbine Nr. 2 (Savonius type, helical, Fig. 3), attaching them to the acquired generator and other components from the turbine Nr. 6.

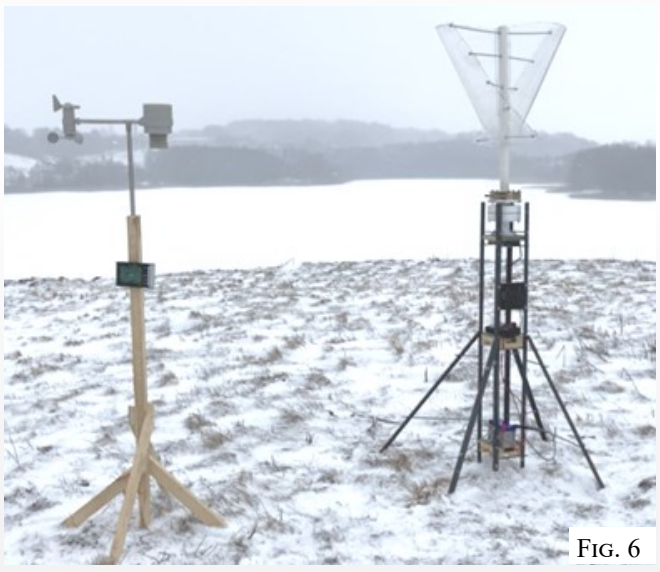

Fig. 6

Fig. 7

Fig. 8

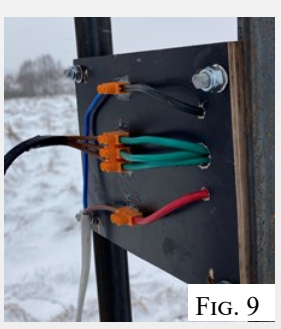

Fig. 9

Fig. 10

CONCLUSION

Considered that the core issue resulting in very low power output is the faulty generator or misleading generator specification.

Calculations for system efficiency additionally proves that the system is very inefficient, hence defects in core components are highly likely (Fig. 14).

Work has been completed including analysis and implementation of the system, accurately following the initial proposal and aims.

positive discoveries were made during the building and testing stages with the built wind turbine – the turbine itself is very cheap (Fig. 15) and easy to make, it is also can be easily scaled. During the test, the built turbine is showed better results than the purchased one.

reference for fig. 2: cordis.europa.eu/article/id/244881-wind-turbine-for-city-rooftops; ebay.com; aliexpress.com