



**9 ICREPS**

# TULIP-SHAPED WIND TURBINES

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## Abstract

Wind turbines have been used long for the production of electrical energy from renewable sources.

The aspirations of their designers are to improve the performance of such energy systems.

One of the new solutions for small wind farms, adapted to populated areas, are tulip-shaped wind turbines, manufactured by company Flower Turbines from the Netherlands and which are presented in the paper.

They implement more technological innovations, because innovative aerodynamic solutions and adaptive design are used for turbines.

Constructively, they contain two special blades, and are currently produced in three different blade heights, namely 1 m, 3 m and 6 m.

They do not disturb the appearance of urban environments, do not make more noise from the wind that drives them, they start to produce electricity at wind speeds of 1.2 m/s, and grouping more of them increases their efficiency by 20 % – 50 %.

## Abstract (continued)

There are configurations of 2 kW, 3.5 kW and 5 kW, no vibration and are long lasting. In addition, birds are not endangered as with classic wind turbines because they are clearly visible, the materials from which they are made are steel or aluminum (recyclable), while the return on investment is 2 to 10 years (depending on wind speed, number of turbines, electricity grid price).

The paper presents the results of experimental tests and numerical simulations of the flow around the turbine blade.

One power plant, made of these wind turbines, can produce more electricity per m<sup>2</sup> than competing solar panels.

Tulip-shaped wind turbines are being installed at various locations in the Netherlands and Germany.

The listed systems for the production of green and clean energy, which are also not expensive, are an important contribution to the sustainable development.

- Introduction
- Flower turbine models
- Tests and results
- Conclusions
- Literature

## Content

# Introduction

- Renewable energy sources:
  - Wind,
  - Hydropower,
  - Solar,
  - Geothermal.

- Renewable vs/and Sustainable energy sources

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

There are many definitions of sustainable energy.

The use of energy is considered sustainable if it meets the needs of the present without compromising the needs of future generations.

- Production of electrical energy

# Introduction (continued)

- Wind as important energy source now and in the future

Environmental impact of wind power – relatively minor compared to the environmental impact of traditional energy sources.

Wind power consumes no fuel, and emits no air pollution, unlike fossil fuel power sources.

- Wind turbines (WTs):
  - Horizontal-axes type - HAWTs,
  - Vertical-axes type - VAWTs:
    - Darrieus wind turbine, or "Egg-beater":
      - Giromill or H-barr or H-rotor WT,
      - Cycloturbines,
      - Helical blades,
      - Active lift turbines.
    - Savonius wind turbine,
    - Parallel WTs,
    - Unconventional wind turbines.
- Wind farms

# Flower wind turbines

- Design, made by Flower Turbines:

**”The wind turbine you want to live and work next to.**

We make the most beautiful and efficient small wind turbines advanced aerodynamics combined with low noise, a pleasure to live next to and look at.”

- Properties
- Types of flower models – tulip-shaped wind turbines:
  - little
  - middle
  - large

## Little model

- Measuring 1 meter, this compact and light model is ideal for off-grid projects, installations, and campers
- Flower Turbines:  
”Despite being our smallest model, it bears our patented design that ensures unrivalled efficiency.”



Little model

## Middle model

- Perfect match between cost-efficiency and productivity
- The turbine can be installed on the ground or on strong enough flat roofs
- Its blades are made of fiberglass; it comes with a powerful generator, a charge controller, battery (extra charge), and a grid inverter



Middle model

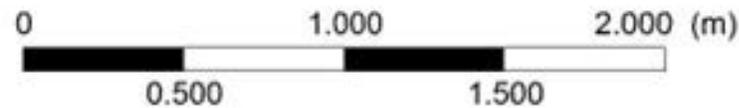
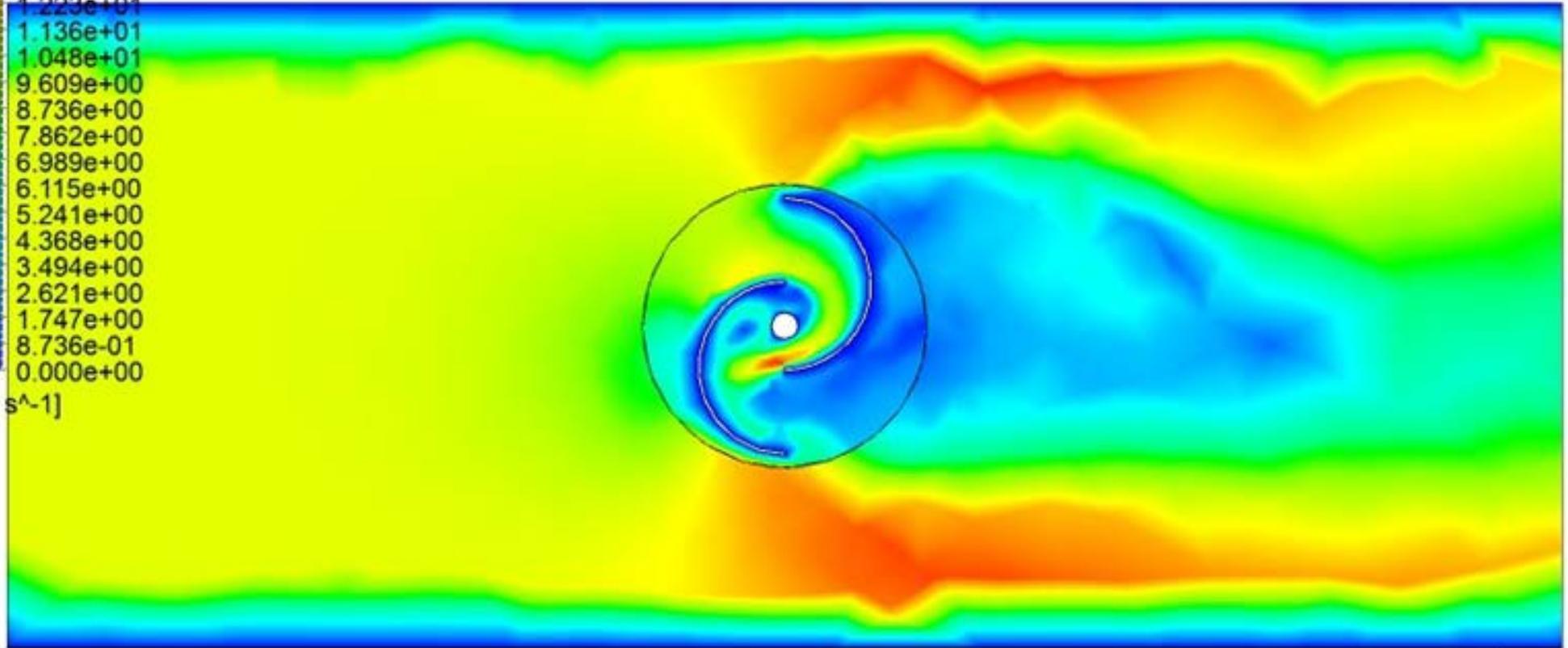
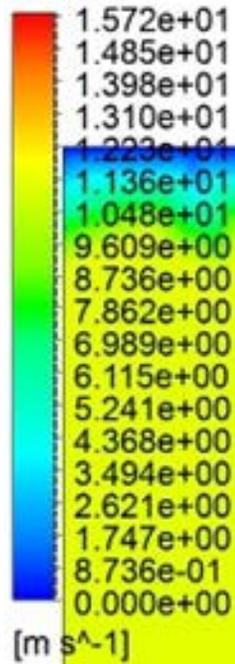
## Large model

- A 6 meters model is a serious option for the large-scale production of electricity because placing them in groups close to each other increases their productivity
- Especially relevant for corporations with strong roofs or along parking lots and otherwise unused areas
- Currently only available in fiberglass blades
- The wind turbine comes with a 5 kW generator

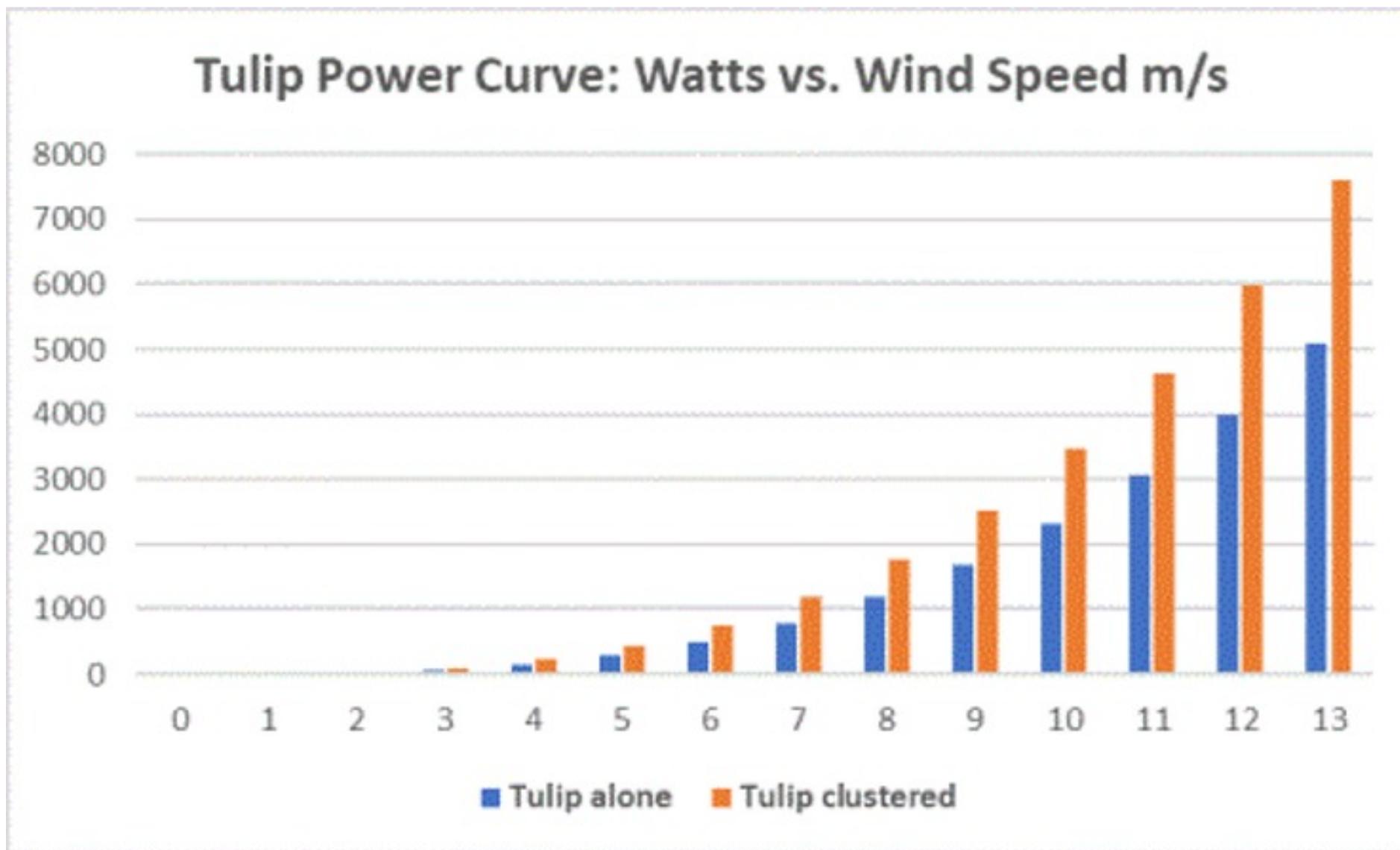


Large model

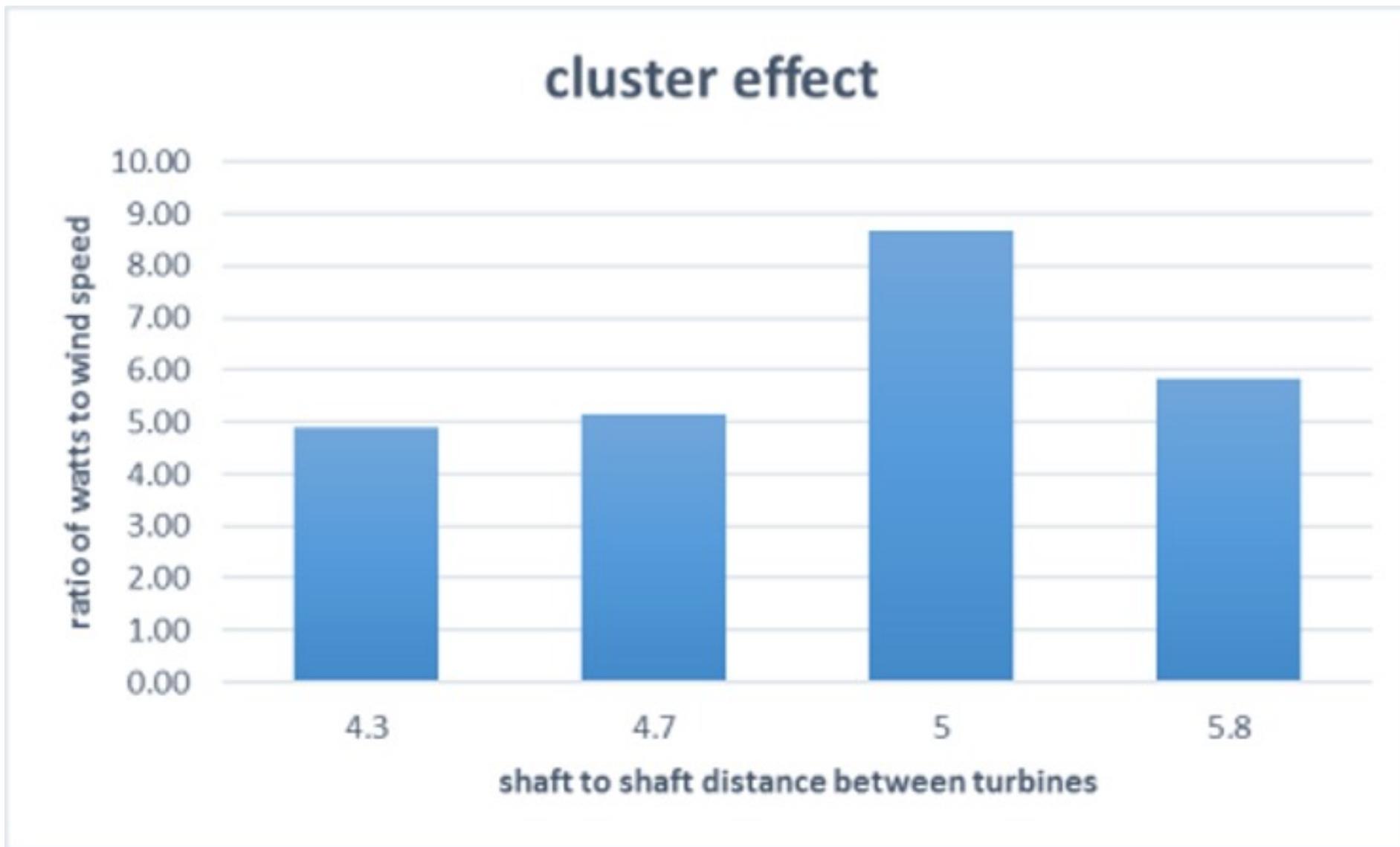
Velocity in Stn Frame  
Contour 1



Simulation of the wind speed around the wind turbine blade when the position of the turbine is well centered with respect to the wind direction



Power produced by the wind turbines, installed individually or in a cluster, as a function of wind speed



Dependence of the ratio of produced power and wind speed on the distance between the axes of tulip-shaped wind turbines, when they are placed in a group (cluster effect)

Table of the results of Flower Turbine innovations  
Source: <https://flowerturbines.com/technology/>

Drag wind turbines	Flower Turbines
Drag wind turbine efficiency 7-10%	Increased to over 40%
Most Turbines degrade performance of neighbors by 20-50%	Flower Turbines increase production of neighbors by 20-50%
Most turbines start at 3 m/s	Flower Turbines start at around 1 m/s

# Conclusions

- Wind turbines have been used long for the production of electrical energy from renewable sources
- The aspirations of their designers are to improve the performance of such energy systems
- One of the new solutions for small wind farms, adapted to populated areas, are tulip-shaped wind turbines, manufactured by company Flower Turbines from the Netherlands and which are presented in the paper
- They implement more technological innovations, because innovative aerodynamic solutions and adaptive design are used for turbines

## Conclusions (continued)

- Constructively, the tulip-shaped turbines contain two special blades, and are currently produced in three different blade heights, namely 1 m, 3 m and 6 m
- They do not disturb the appearance of urban environments, do not make more noise from the wind that drives them, they start to produce electricity at wind speeds of 1.2 m/s, and grouping more of them increases their efficiency by 20%–50 %
- In addition, birds are not endangered as with classic wind turbines because they are clearly visible, the materials from which they are made are steel or aluminum (recyclable) or fiberglass, while the return on investment is 2 to 10 years (depending on wind speed, number of turbines, electricity grid price)

## Conclusions (continued)

- There are configurations of tulip-shaped turbine clusters producing 2 kW, 3.5 kW and 5 kW, with no vibration and are long lasting
- The paper presents the results of experimental tests and numerical simulations of the flow around the turbine blade
- One power plant, made of these wind turbines, can produce more electricity per m<sup>2</sup> than competing solar panels
- Tulip-shaped wind turbines are being installed at various locations in the Netherlands and Germany
- The listed systems for the production of green and clean energy, which are also not expensive, are an important contribution to the sustainable development

# Literature

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**THANK YOU FOR ATTENTION.**

**ANY QUESTIONS?**

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