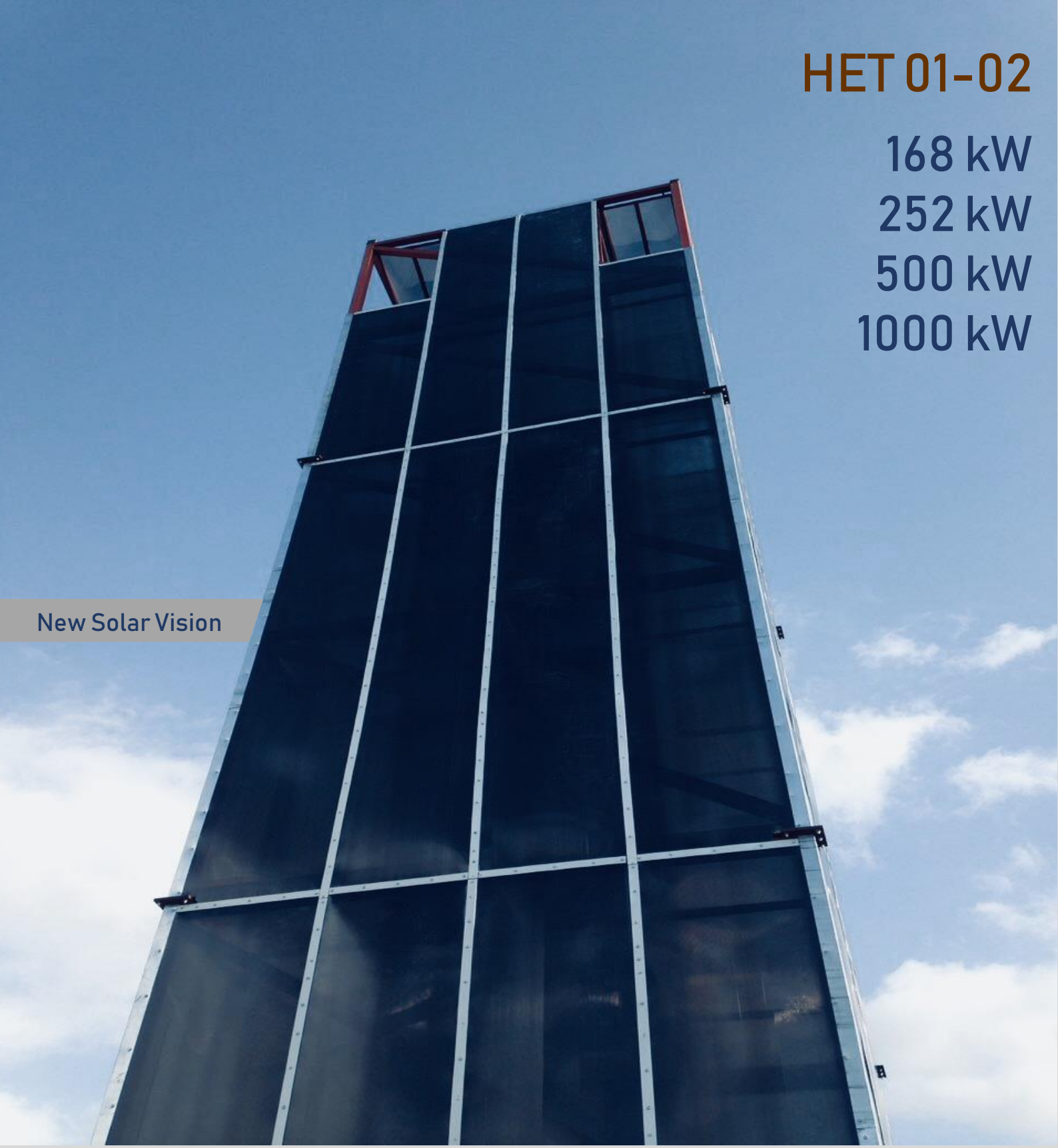
HET 01-02

168 kW
252 kW
500 kW
1000 kW



New Solar Vision

HET

The Solar Chimney. Reimagined.

Trakya University – Edirne, Turkey

Ensure green profits for 30 years

The Solar Chimney. Reimagined.

HET, the hybrid energy tower is a brand-new concept combining two separate energy tower systems normally operating in **updraft and downdraft methods in a single structure**. Protected by international and national patents, hybrid energy tower system not only ensures increased efficiency by utilizing down- and updraft mechanisms together, but also provides substantial decrease in the system dimensions compared to conventional energy towers.

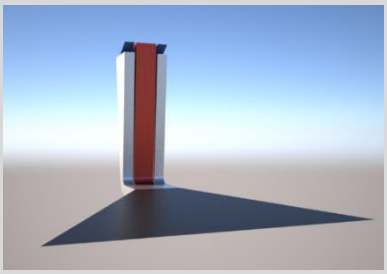
Basic components of hybrid energy tower system are:

1. One updraft chimney
2. Two downdraft chimneys with wind catchers
3. Vertical turbines
4. Transpired solar air collectors

Hybrid energy tower configuration has three different tower systems compared to the conventional solar chimneys. The single tower located in the center of the three-chimney system is the updraft tower and ensures that the hot air is drafted upwards and discharged to the external environment. By means of this tower, while the hot air provided by the collector moves towards the tower, it is accelerated by the absorption effect of the tower and ensures that the vertical turbines rotate and generate power by passing through **the vertical turbine group located at the tower inlet.** The external towers positioned adjacent to this tower on both sides of the updraft tower are the downdraft towers and ensure that the external air is accelerated and transmitted to the vertical turbine group located at the bottom of the towers. Thanks to this flow regulation, the most important innovation of the invention, the flow regulations of the updraft and downdraft systems, which normally operate as separate mechanisms, are now “combined”.

The main element ensuring that the updraft and downdraft mechanisms are combined in a system is **the turbine arrangement in the system configuration**. In this new turbine arrangement, the vertical turbine group and the vertical turbines in the group are positioned at the tower inlet where the bases of the updraft tower and downdraft tower meet instead of being positioned inside the chimney as in the conventional application. **The turbines used in the turbine group are vertical-axis turbines instead of the horizontal-axis turbines** used in the conventional energy towers. Thus, it is ensured that the vertical turbine blades benefit from the “bidirectional” air flow provided by the downdraft and updraft towers. Therefore, **the electric power is generated by simultaneously using two different air flows moving both up and downwards.**

Technical Specifications



HET01

HET01 is a mid-scale base system for the powerful commercial version of the hybrid energy tower, which performs energy production with solar thermal method and wind catchers. As a configuration, HET1 operates with multiple small-scale Savonius turbines and a high capacity factor thanks to the bi-directional airflow and low-speed startup of turbines.

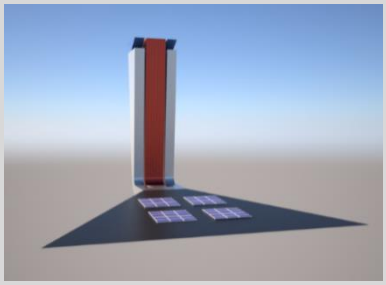
Specifications	
Nominal Power	Up to 252 kW (depending on region)
Energy production	750.000 kWh/year (depending on region)
Tower number	3 units
Collector area	7500 m2
Rotor number	24 units, 6 units per tower
Capacity factor	0.34 (depending on region)

Components	
Collector	Transpired solar collector
Tower	3 tower units per system
Rotor unit	Savonius type, two-stage rotor, 6 units per tower
Max capacity	14 kW per rotor, 84 kW per tower, total capacity 252 kW
On/Off grid	Grid tied, or smart grid capable, micro grid, off grid (battery system compatible)

Collector	
Collector type	Metal absorber-transpired solar collector
Thermal capacity	1000 W/m2
Temperature rise	Up to 41°C
Air flow	18-180 m3/h/m2
Collector area	2500 m2 per tower, 7500 m2 in total

Tower	
Construction	Steel construction
Dimensions	8 m length, 5 m width, 15 m height
Tower type	Rectangular diffuser shape, 2 downdraft section, 1 updraft section
Cover material	Galvanized sheet metal and/or polycarbonate panel (depending on region)
Tower velocity	Max. downdraft 25 m/s, max. updraft 25 m/s

Turbine	
Turbine type	Vertical axis turbine, two-stage Savonius turbine with modified blades
Dimensions	3 m diameter, 3 m height
Nominal power	10 kW (@16.5 m/s) (optional, more power is available)
Maximum power	14 kW (@18.5 m/s)
Startup air speed	1,2 m/s
Working principle	Bidirectional air flow
Swept area	9 m2
Power coefficient	Up to 0.5 (theoretical value not measured)

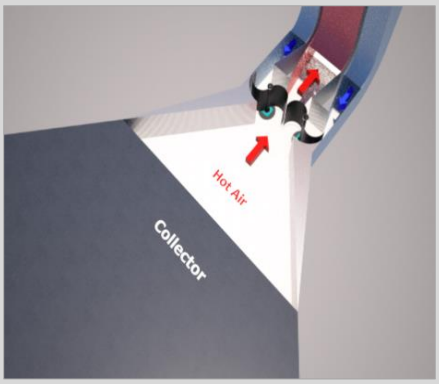


HET02

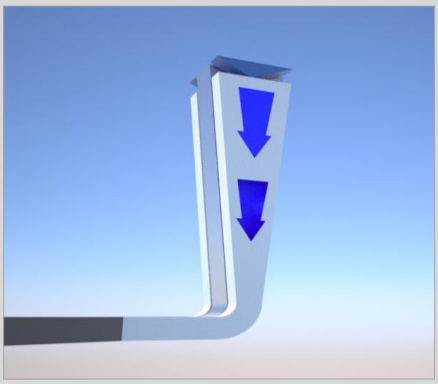
In addition to HET1 features, HET02 includes photovoltaic panels integrated to transpired solar air collectors. Therefore, in this version, the hot air is produced by photovoltaic thermal method; air flow provides cooling effect on the photovoltaic panels and it increases the photovoltaic efficiency. Thanks to the use of two different technologies in the one area, the available solar field is efficiently used.

Specifications	
Nominal Power	1000 kW (252 kW rotor + 750 kW photovoltaic panels)
Energy production	2.000.000 kWh/year (depending on region)
Tower number	3 unit
Collector area	7500 m2
Rotor number	24 units, 6 units per tower
Capacity factor	Up to 0,23 (depending on region)
Components	
Collector	Transpired solar collector
Tower	3 tower units per system
Rotor unit	Savonius type, two-stage rotor, 6 units per tower
Max. capacity	14 kW per rotor, 84 kW per tower, total capacity 252 kW
On/Off grid	Grid tied, or smart grid capable, micro grid, off grid (battery system compatible)
Collector	
Collector type	Metal absorber-transpired solar collector
Thermal capacity	1000 W/m2
Temperature rise	Up to 41°C
Air flow	18-180 m3/h/m2
Collector area	2500 m2 per tower, 7500 m2 in total
Tower	
Construction	Steel construction
Dimensions	8 m length, 5 m width, 15 m height
Tower type	Rectangular diffuser shape, 2 downdraft sections, 1 updraft section
Cover material	Galvanized sheet metal and/or polycarbonate panel (depending on region)
Tower velocity	Max. downdraft 25 m/s, max. updraft 25 m/s
Turbine	
Turbine type	Vertical axis turbine, two-stage Savonius turbine with modified blades
Dimensions	3 m diameter, 3 m height
Nominal power	10 kW (@16.5 m/s) (optional, more power is available)
Maximum power	14 kW (@18.5 m/s)
Startup air speed	1,2 m/s
Working principle	Bidirectional air flow
Swept area	9 m2
Power coefficient	Up to 0.50 (theoretical value, not measured)
Photovoltaic	
Panel type	Poli or mono crystal (depending on project)
Nominal power	260 W/panel (depending on project)
Dimensions	1650×992×40mm (depending on project)
Photovoltaic area	Total 4784 m2 (depending on project)

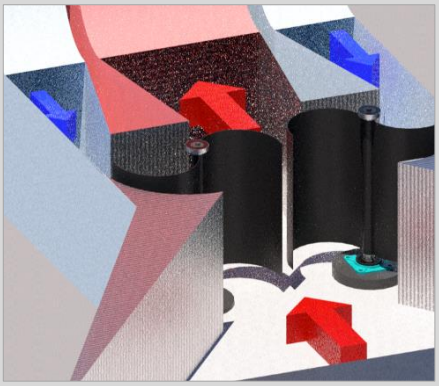
Working Principle



Hot air moves from the solar collector towards the turbines thanks to lower density, and operates the turbines.



Wind catchers positioned on the top of the side towers draw the atmospheric air down the towers in diffuser form and accelerate it.



Vertical turbines located on the base and connected to the updraft and downdraft towers generate power by operating both air flows.

Advantages

Hybrid energy tower combines the Solar Updraft Tower and Downdraft Energy Tower systems, each normally used as a separate energy generation technique, in a single structure, and simultaneously utilizes the functions of both techniques. Thanks to this combined technique, HET offers more advantages compared to the conventional energy towers:

- HET has smaller tower dimensions compared to the conventional energy towers.
- Offers high capacity energy generation with downdraft and updraft functions in the same system.
- HET wind catchers catch the wind and draw it down; drawn air is accelerated up to 3 folds and powers up the turbines thanks to the diffuser structure.
- Diffuser shaped updraft tower substantially increases the updraft efficiency compared to the regular fixed section towers and ensures that the tower length is shortened.
- HET wind catchers are designed to catch the wind from all directions; therefore, system efficiency is improved.
- Metal transpired solar collectors of the system are more durable compared to glazed collectors the conventional Solar Updraft Tower, and up to 3 times more efficient. Thus, the actual cost of system is decreased.
- The vertical-axis turbines located at the center of the HET are operated with bidirectional effect of both downdraft and updraft air flows achieving higher power coefficients. Thus, turbine dimensions are smaller, and the efficiency is improved.
- Multiple small-scaled turbines of the system are activated depending on the air flow power, and thus, efficient use of turbines is ensured.
- HET can be integrated with photovoltaic systems. While the air collectors convert the waste heat of photovoltaic panels to electricity, increased efficiency is achieved by cooling the panels.
- HET runs on various energy sources; for example, it is possible to use geothermal or waste heat in the system. Thus, the system continuity is improved.
- HET takes up less space compared to conventional solar power systems and generates more energy.
- It is possible to add humidifier to downdraft part of the HET system if necessary, and thus, additional increased performance is achieved in arid climates.

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HET test facility with photovoltaics, Trakya University – Edirne, Turkey

HET

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