KiteGen Venture

A better future thanks to high altitude winds…





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KiteGen

Company profile

KiteGenVenture

Founded in 2011, KiteGen Venture is the society aimed at the industrial and business development of the KiteGen technology. The natural evolution of an Italian research project, which aims at questioning all dogmas on renewable energies. Thanks to more than 40 international patents, KiteGen is ready to enter the global market, offering a unique and innovative solution to the increasing energy demand.

KGV is run by a young and qualified team, motivated to transform this project into practice and to present it to the world.

Interntional awards and recognitions:

eni award

CESI

COP15 COPENHAGEN

SEVENTH FRAMEWORK PROGRAMME

REGIONE PIEMONTE

EXPO 2010 SHANGHAI CHINA

MINISTERO DELLO SVILUPPO ECONOMICO

Board of Directors

Ing. M. Ippolito (President)

Avv. D. Baratto (CEO)

Sig.ra M. Boetti (council member)

Prof. G. Abbate (council member)

The present background

Energy is strictly connected to all human activities. The present level of well-being depends on the effective access to energy sources. However, the current scenario of global crisis proves that both the **existing resources** and our wellness will end shortly, not before causing great environmental damages.

Therefore, a **radical change of perspective** is essential and it will involve not only everyone's lifestyle, but also new energy production methods. The solution is simple: **high altitude winds** are the last energy field available to human society. They are immediately accessible, they do not require special maintenance works and they can be found all over the world.

They could represent the key for the society to escaping from economic hardships without taking advantage of others.

KiteGen technology could drill this huge resource, with no emission of CO2 and no economic impact. In other words, it could ensure a more sustainable and environmentally friendly future.

The real cost of energy

The **EROEI** is defined as the Energy Return Over the Energy Invested ratio in a plant during its operational life (Picture 1).
Oil, in the 1950's, had the highest EROEI ever recorded for any energy technology: roughly 100. In the 1970's it had already dropped below the value of 40. Today it has decreased below the value of 10, and we can assume that it will continue to decrease.
In other words, **oil is finishing its "life cycle"**, not because there is no more oil (and "by-products") to extract, but because their energetic cost of extraction is increasing and therefore the EROEI is decreasing to values not sufficient to sustain growth and progress.

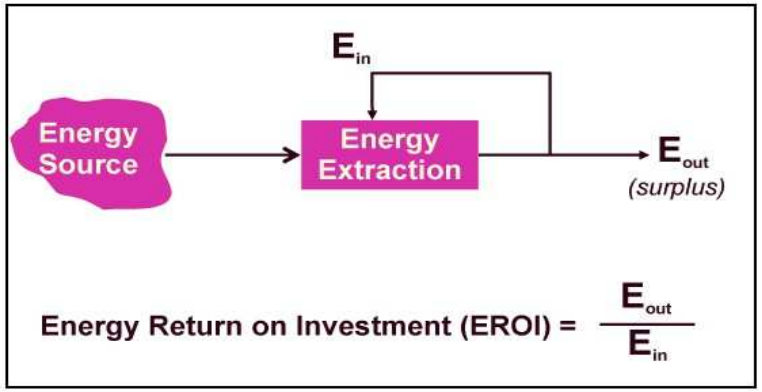
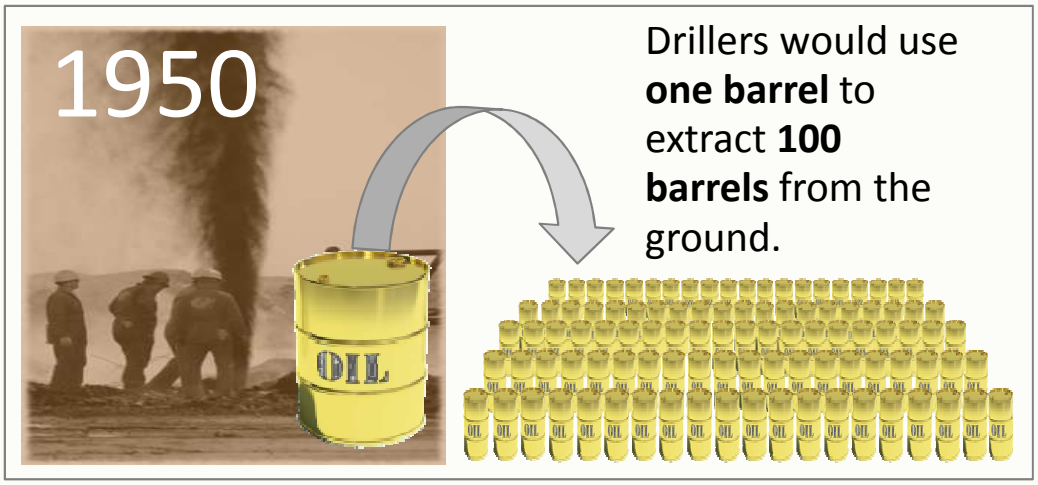
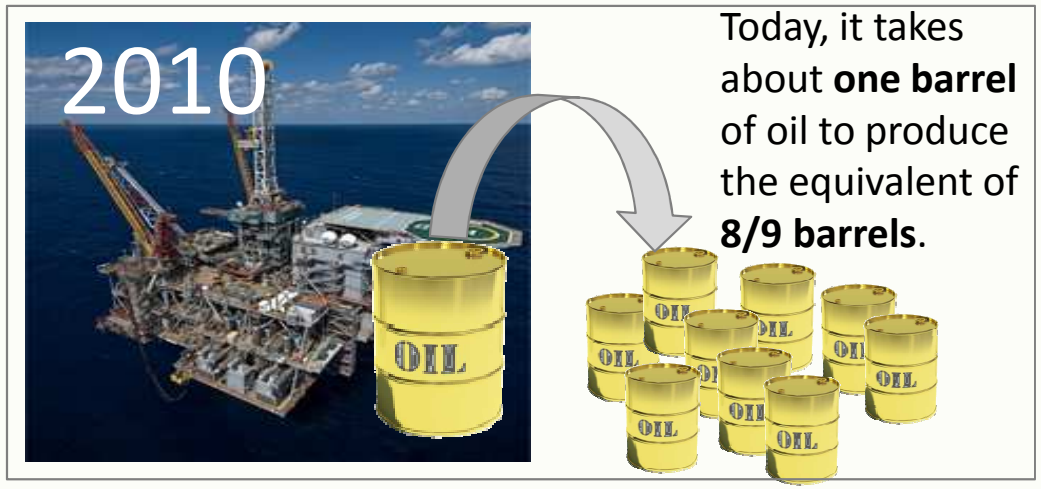


Figura 1: ERoEI - Energy Return over Energy Investment





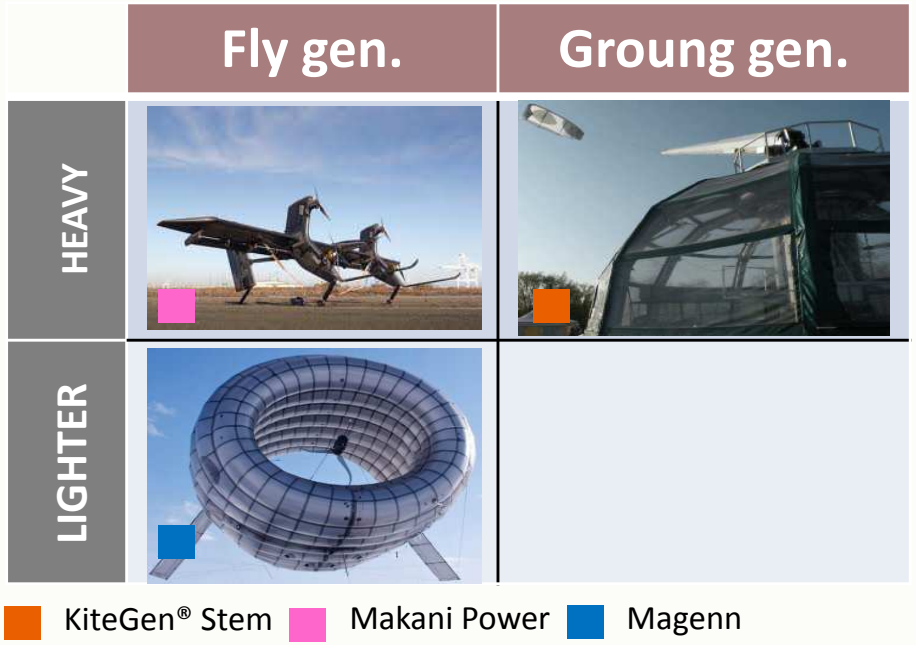
Competing methodologies

Different approaches were explored starting from first experiments in 2000. Current projects can be classified using the following categories:

1.Fly/Ground generation:
- The power generation takes place on the ground, with tethering cables that normally pull a drum rotation
- Or directly on the flying element and later transferred to ground using a power cable.

2.Heavy/Lighter than air:
Flying elements can be wings such as kites or full airplanes.
Airplanes normally integrate a fly generator used also as propeller for take-off, wings need other solutions
Lighter elements can take-off without any help.

3.Pumping/Continuous generation:
Pumping involves a cycled production later described. Used in heavy/ground gen
Continuous production is available .



Main international players

MAIN PLAYERS:

SOME INVESTORS:

Google
سابك sabic
BOEING
ALSTOM
ZEPPELIN Power Systems CAT
Oltmann Gruppe
DSM BRIGHT SCIENCE. BRIGHTER LIVING.
FESTO

The competitors

USA	GERMANY	GERMANY	NEHERLANDS	NETHERLANDS	ChINA
					
Makani Power	***Sky Sails***	***EnerKite***	***Ampyx Power***	***Kite Power***	***HA WP***
Generator (propeller turbine) on board. The tether carries energy from the kite to the grid, and connects the kite to the ground station.	Ship traction using crosswind power. Traction power-kite with flying actuators.	Inflatable kite. Traction power-kite with actuators and generators on a vehicle	PowerPlanes flying repetitive cross-wind patterns, attached with a cable to a ground-based generator.	Generator on board, rigid airfoils	Pumping parachure generators. Generator on ground.
30 kW protoype. Recently shifted from flexible to rigid airfoils.	50 kW prototype already sold to pilot customers.	30 kW protoype already working. 100 kW prototype by 2015	10 kW scale prototype with rigid airfoils	Two different ltitudes investigated: 500-1000 m and 10000 m	30 kW prototype recently shifted from flexible to rigid airfoils.

Milestones

2003. **First patenting** of the KiteGen technology.

2005. Proof of concept with a prototype of **30kW**.

2007. Development of the **second prototype** (30 kW, over 800 mt flying test). **7th EU Framework Project**: KiteGen considered as one of the best solutions in the production of clean energy.

2009. **CESI-Research** (now RSE): KG Carousel judged as the most promising solution for the exploitation of high altitude wind power.

2010. **ENI AWARD-** 1st prize to Doc. Lorenzo Fagiano: Control of Tethered Airfoils for High–Altitude Wind Energy Generation. **Expo Shanghai**: KiteGen as symbol of the Italian innovators.

Milestones

2010-2012. **KiteGen Stem**: development of the third prototype, 3 MW scale.

2011. Foundation of **KiteGen Venture** (former Soter).

2013. Cooperation agreement with SABIC (Saudi Arabian Basic Industries) for the industrialization of the technology in MENA countries.

2014. Pre-industrial phase. Second capital increase. Announcement of the installation of the first KiteGen Stem.

2015. Supply chain manufacturing development and partner scouting/evaluation. Project financing of 50 MLN for the first KiteGen Campus (50 KG Stem).

2016. Enlargement of international cooperation agreements.

The concept

The KiteGen Technology is designed to provide an answer for the increasing need of energy production, proposing a **new type of electric generation plant**, based on a renewable source, suitable for **any territory** unlike the traditional wind turbines, at costs lower than fossil fuel generation plants, in direct competition with today's conventional production (coal, oil or nuclear), and in the very near future in the GigaWatt class.

40 innernational patents

Estimated EROEI of 375

A radical change of perspective

Today

no more heavy and static structures, but lighter and more dynamic wind powered technology whose size is not affected by structural or dynamic limits as conventional turbines

Near future

High altitude winds

The first real innovation of KiteGen lies in the choice of a high-performance energy source: the **high altitude winds**, a huge, virtually endless and almost universally available energy power, but still to be explored.

High altitude winds blow all around the globe **between 500 and 10000 meters** above the surface. Compared to normal winds at ground level, those streams are **steadier**, **stronger** and almost **equally distributed** around the earth's surface. All these characteristics make the tropospheric winds a unique reservoir with a huge unexploited potential.

	TRADITIONAL TURBINES	KiteGen®
Height	80 m	800 - ~2000 m
Wind average speed	4,6 m/s	7,2 m/s
Wind presence	1550 hours/year	5000 hours/year

KiteGen Stem generator 3 MW

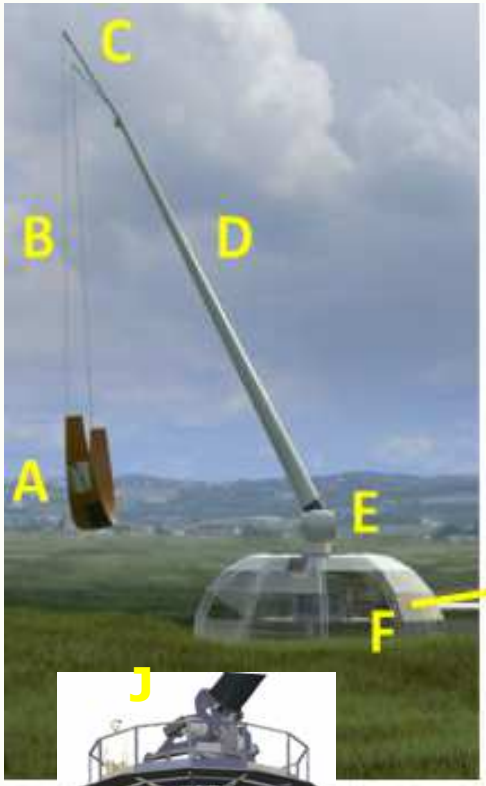
The KiteGen stem, the result of years of research and testing, now covered by 40 international patents, is based on the physical principle used by the dynamo to produce clean energy by means of a highly sophisticated, dynamic and light technology.

MAIN ADVANTAGES

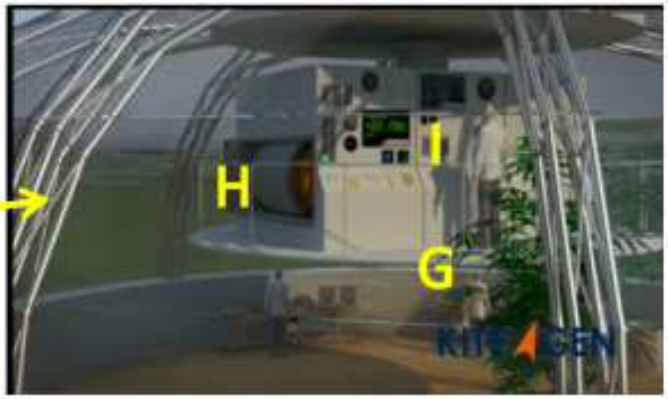
- Zero CO2 emissions
- Exploitation of an unlimited, constant and almost universally available source of energy
- Limited visual and environmental impact
- The installation of the machine does not require any special infrastructure
- Minimal energy loss
- Reduced maintenance costs: the overall management takes place on the ground, thus making the operations easier and safer
- Scalability: the farms are designed according to the local power generation needs

The structure

Structure description
- Power wing: Composite material flexible wing structure, 150mq
- Tethering: designed for 60 ton max traction, 20 ton working conditions
- Compass (optional) + Stem: gust control within few msec, dual cable control, 24 m
- Ground structure: flexible for gust control, contain power generators, 13 x 6 m. Light Foundation to support ground structure and cable pull
- Drums: horizontal sliding to avoid cable accumulation, cooled, pulleys control tension
- Cabinet: inverter limiting power volatility supercapacitor used during wing recovery phase
- Motorized joint: gust power damping, take-off support, cable tension keeping

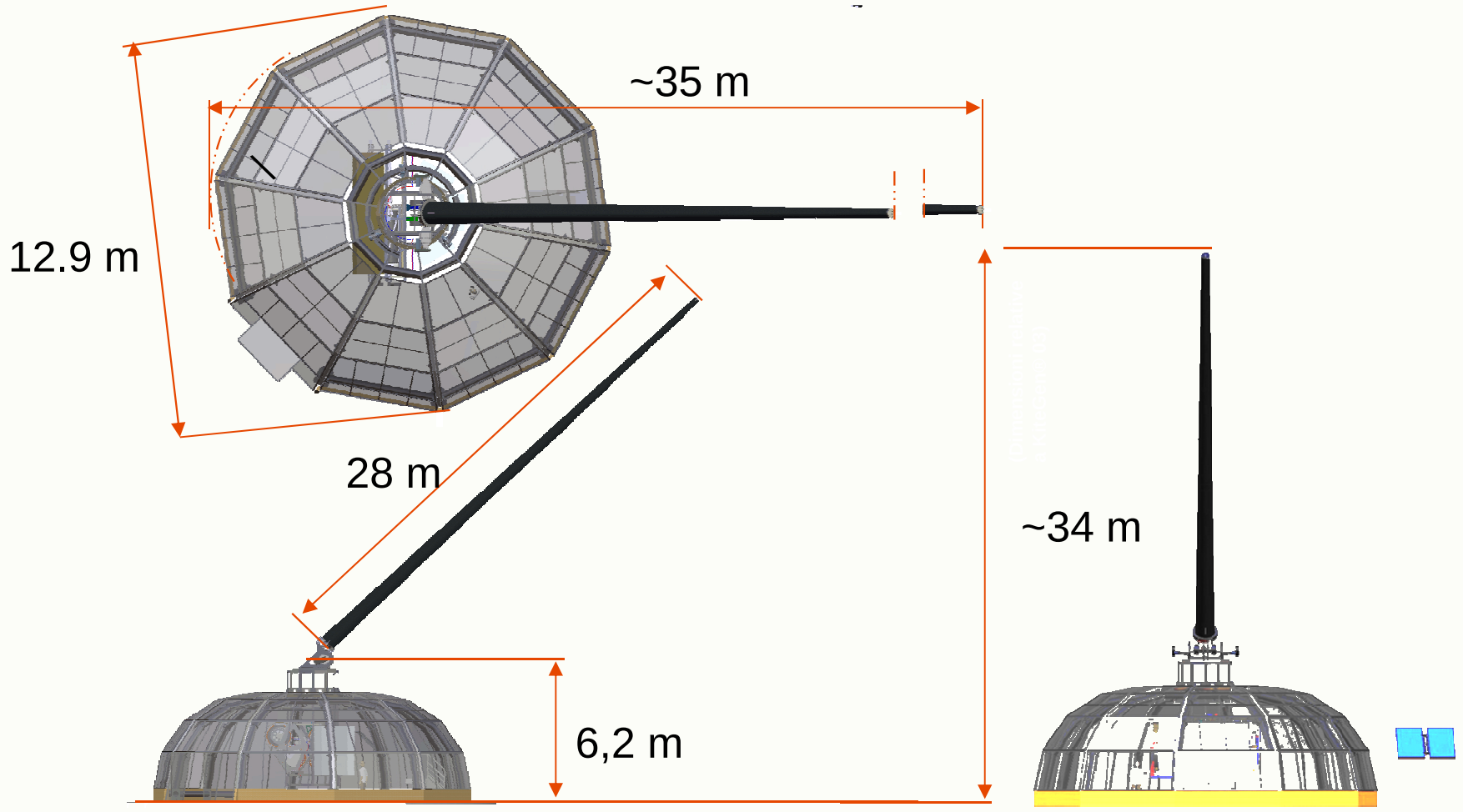


A. Power Wing
B. Dyneema® tethering
C. Compass (optional)
D. Stem
E. Powered joints
F. Ground structure
G. Suspended and rotating engine room
H. 2 power drums, 2 control pulleys, 8 motor-generators

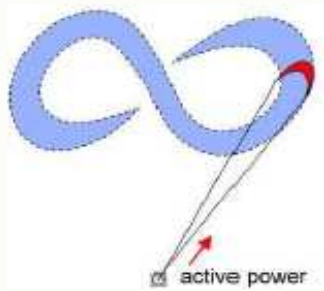


I. Cabinet and 6 actuators
J. Motorized joint
K. Drums
L. Motor drivers and control

Dimensions



Operating principles



An **automatically driven wing** flies between 600 and 2000 meters to harvest the mechanical energy of powerful winds, which is then transmitted to the ground, converted into electric power and finally injected into the grid. Two **high-strength ropes** realized in composite materials connect the wing to the base and transmit the traction of the wing thus activating the **power generators** located on the ground and producing energy. When the ropes are fully unwound and the maximum height is reached, the wind is driven to a position where it loses wind resistance. At this point, it is wound up and brought back to the minimum height. Then the cycle restarts repeatedly, just **like a yo-yo**.

All the heavy machinery for power generation and the management of the entire system is on the ground, consisting of an **igloo-shaped base** and a 20 meters long **stem**, connected to the wing through the ropes. The base hosts the hearth of the machine: the software, which controls all the operations on the bases of the data received from on-board avionic sensors. In this way the wing flight paths can be controlled and directed to maximize the energy production, in compliance with the working principles of the machine and in conditions of complete safety.

THE PRODUCTION CYCLE

1. **Production phase**: the kite gains height and unwinds the ropes, thus causing the rotation of the drums and generating electricity.

2. **Passive phase**: when ropes are entirely unwound, the wing is driven to a position where it loses its wind resistance and the cables are wound in. Then the cycle restarts. Energy consumption during the winding phase is a minor fraction of the energy generated during the unwinding phase.

Comparison: KiteGen Stem Vs conventional turbines

Overview of relevant factors

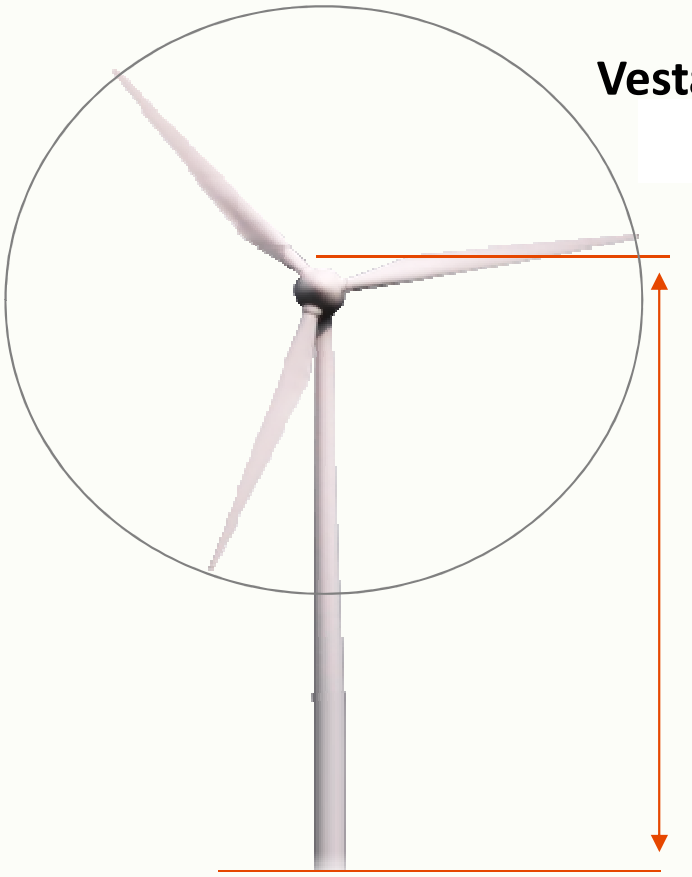
Among other factors, the relevant ones are dimensions, masses, logistics, disposal, environmental impact, capacity factor, territorial energy density, site properties, levelized costs of energy, intermittence and EROEI, as shown in the table below:

	KiteGen Stem	Wind turbines
Equivalent working hours at nominal power	6800*	1550
Weight including foundations (tons)	20	1400
Min. distance between generators (m)	100	800 (7-9 x diametro pala)
Average ground machine height (m)	30	80
Nominal power	3 MW	3 MW
Territorial energy density (MW/km^2)	363	18
Produced energy cost (€/MWh, Italy)	<20**	90-150

* Advanced technology learning curve

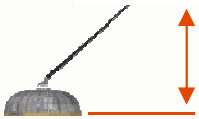
** Advanced economical learning curve

Dimensions



Vestas V90 3MW
~ 80 m

KiteGen® Stem 3MW
~34 m



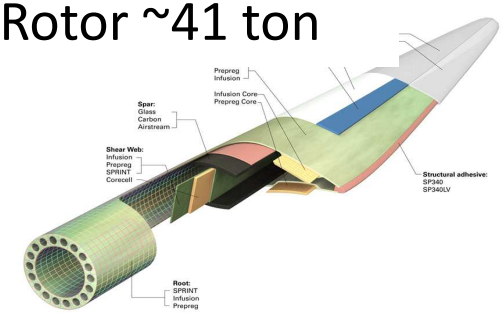
- High altitude wind remains out of the reach of current and the future's aero-generating towers, already more than 100m high. Above a certain height the structure that holds up the rotors becomes exponentially heavier, more unstable, and above all more costly
- The relatively higher wind availability at lower altitudes at open sea still does not make traditional windmills economically feasible. The high thrust and moment generated by the windmill on the platform during operations require heavy, complex (and costly) platform and mooring systems in deep water.

Masses

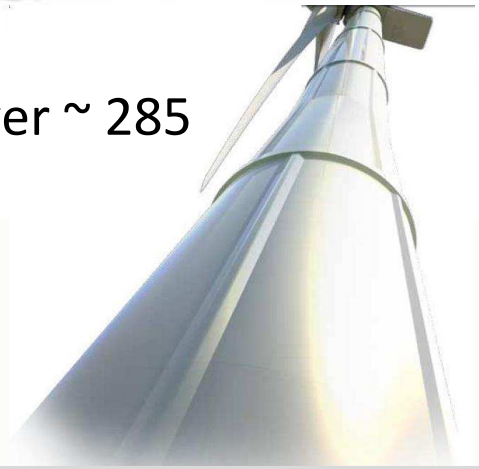
Conventional turbines

Nacelle ~70 ton

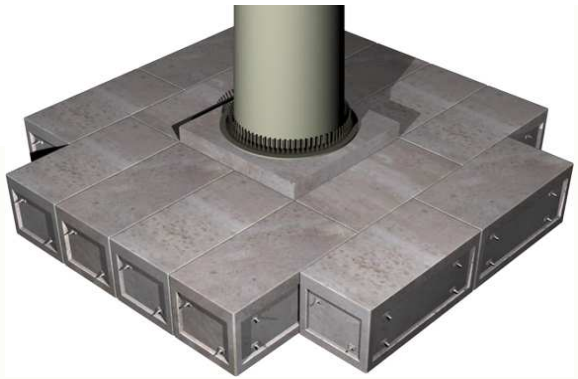
Rotor ~41 ton



Tower ~ 285 ton



Foundation ~1000 ton



TOT ~ 1400 ton

KiteGen Stem 3MW

The small size and reduced wieght makes the generator easy to carry and install

Igloo + Stem ~12 ton

Foundation < 10 ton

TOT ~ 20 ton

Logistics, assembly and decommissioning

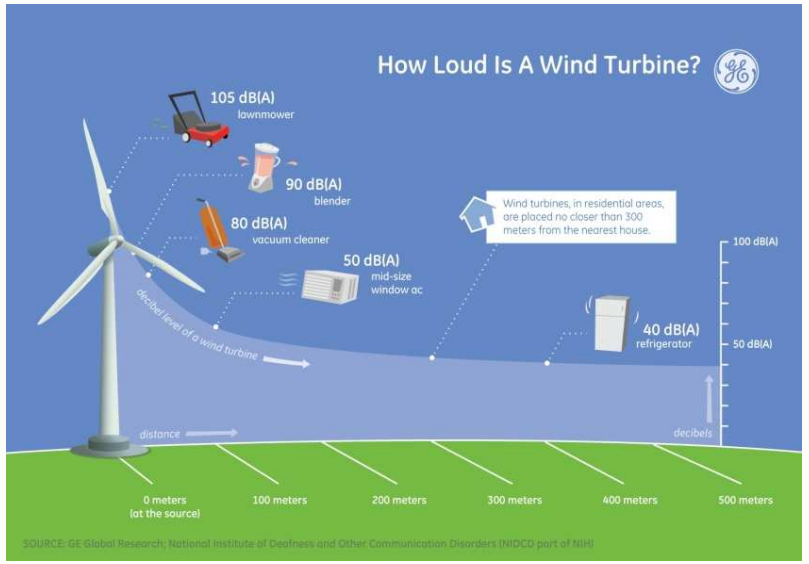
Conventional turbines

KiteGen Stem 3MW

- No component with a height exceeding 120 kg
- Shipment in 3 containers 40"
- It does not require special equipment for assembly
- Easily removable and installation site easily restorable (use of micro-piles for foundations)

Environmental impact

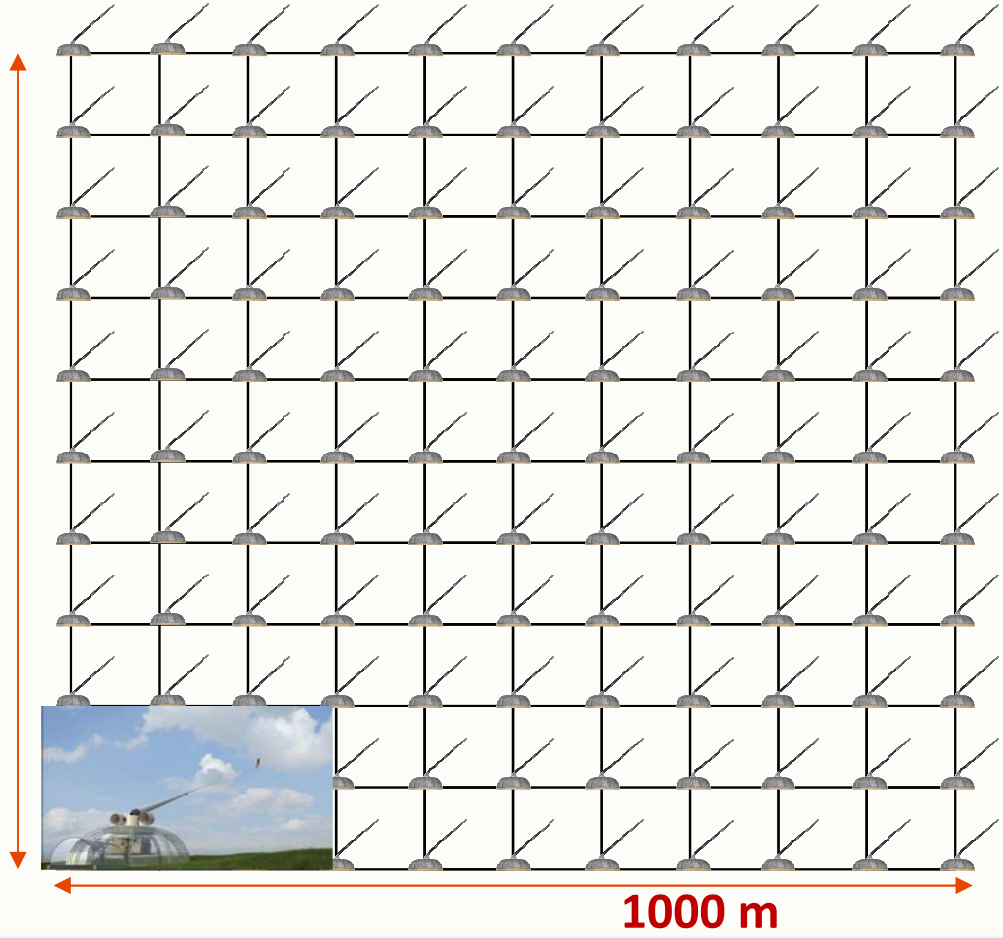
- Modest visual impact of the generator
- Virtually no visual impact of cables and wings (no shadow projected)
- Low noise to the ground, no reduction systems alternators
- Low noise of wings and cables in relation to the working distance
- Reduced impact on the ground (use of micropiles) and limited use of the same
- No infrastructural work required for transport and assembly
- No emission of CO2 or other gases
- Negligible impact with birds (normally under the operational portion of the wing)



Territorial energy density

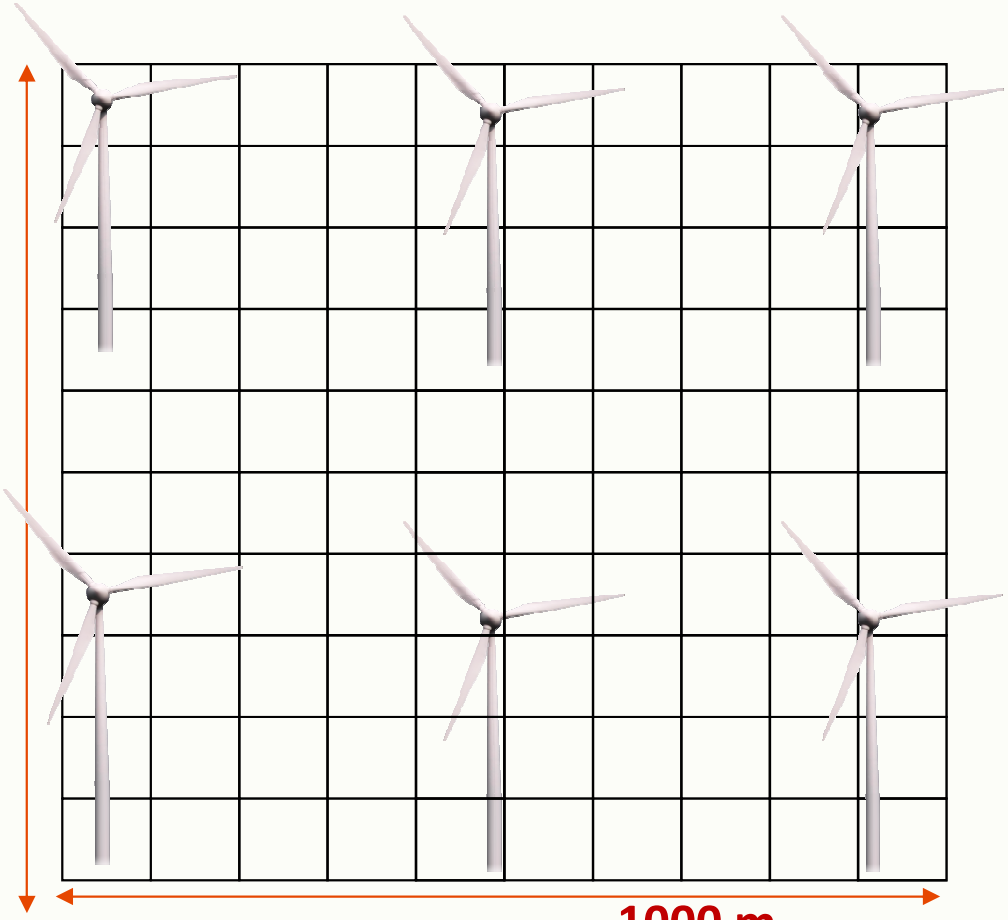
121 KiteGen STEM x 3MW

density: 363 MW/Km^2



6 conventional turbines x 3 MW

density: 18 MW/Km^2



KiteGen® configurations

KiteGen Farm

Wind farm configuration consists of a series of generators with a nominal power of 3 MW each grouped together. Thanks to its small size (base diameter of 13 meters) and reduced weight (6 tons per MW), the machine installation is simple and inexpensive. Their spatial distribution guarantees a **high energy density per Sq. km** and a reduced land use. This solution ensures a high scalability: a wind farm can produce from 3 to 300 MW, according the power generation needs and to the characteristics of the territory.

KiteGen Carousel

This configuration combines a series of KiteGen generators connected together to form a carousel. The kites' flight makes the entire system rotate at the desired speed, thus activating the alternators. A single carousel can harness a **huge amount of wind power**.

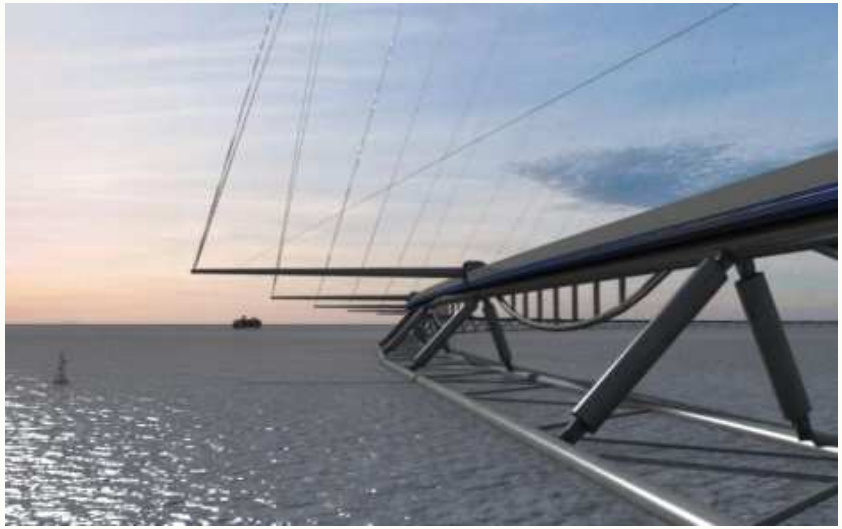
KiteGen Carousel generators represent the last step of the project and will be developed once the Stem generators reach a widespread diffusion.

KiteGen® Configurations

KiteGen Offshore

A single stem is installed on **floating platforms**, in order to exploits high altitude winds energy at deep sea, where wind availability is generally higher in terms of both speed and hours.

As **no rigid infrastructures** are required, most of the technical and economic difficulties of the traditional offshore turbines are overcome. This solution can be applied to the carousel configuration also.



K-Bus

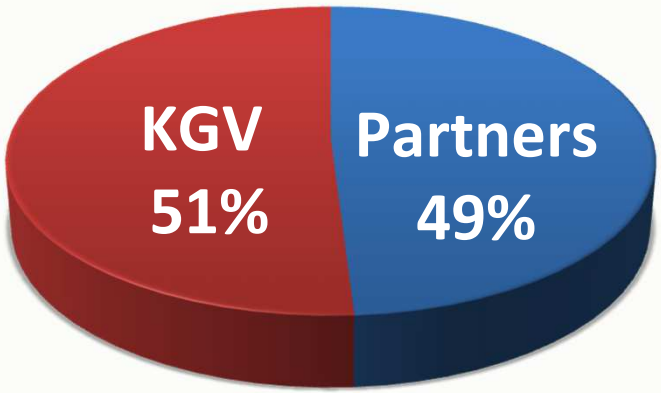
Electric bus with an internal ultra-fast recharging system integrated with the road infrastructure.

The K-bus employs **super-capacitors** instead of normal batteries, thus obtaining advantages in terms of costs, dimensions, consumes, logistics and disposal. The bus is **fully recharged at the bus stop**, during the normal pick-up and drop-off time.

Market strategies

KiteGen Campus

The main outlined strategy of KiteGen Venture is the so-called Campus Project. KGV conceives the Campus as a wide area with 50 KiteGen Stems, for a **total installed power of 150 MW**. As it is a project with considerable industrial and economic implications, KiteGen Venture will develop it in cooperation with venture capital companies and institutional counterparts. The KiteGen Campus will be used both as an R&D site and as a production site to sustain the growth of the company.



NEWCO

Wind Farm

Each operating area will be designed taking into consideration the outlined energy supply requirements and, consequently, the specific number of KiteGen Stems needed. Each Stem will automatically transfers the produced energy power to the local grid, thus enabling the shareholders to obtain a steady economic return. For each Farm, KiteGen Venture will found a new dedicated society, named **NEWCO**, devoted to the management of the operative site. KGV will own 51% of the NEWCO, while both private and institutional investors will share the remaining 49%, thus benefiting from the distribution of the profits.

New KGV branches

Thirdly, KiteGen Venture has established to focus its efforts on the **internationalization** of its brand, opening new branches all around the world. All new branches will have to deal with local representatives and institutions in order to support the installation of productive Farms. Their opening will be subjected to the deposit of an agreed minimum investment.

International and local partners

As one of the most useful application of the KiteGen technology concerns factories in need of a huge amount of power supply, KGV has developed a specific profitable cooperation program for entrepreneurs and industrialists. In fact, by gathering in the purchase of a KiteGen Stem, not only could they fulfill their energy demand, but they could also obtain an extra profit by selling the exceeding production to the power distribution network.

Investors & Partners

KiteGen can engage each individual in the accomplishment of its important project, with the commitment to make the world a greener and cleaner place.

Find out how to take active part into the KiteGen project and support the deployment of this innovative technology. Our company has an optimistic vision on the future and is open to each individual contribution. For any information, please feel free to contact us.

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