MAY 2021

Cleantech Group

KiteGen

The 'magic' energy solution





KiteGenVenture [Holding Company]

[Patents holder] KiteGen

Company profile

KiteGen

KiteGenVenture

Interntional awards and recognitions:

eni award

CESI

COP15 COPENHAGEN

SEVENTH FRAMEWORK PROGRAMME

Cleantech Group

REGIONE PIEMONTE

EXPO 2010 SHANGHAI CHINA

MINISTERO DELLO SVILUPPO ECONOMICO

KiteGen® is the evolution of **wind energy exploitation.**

The novelty is that the KiteGen® technology can reach an unexploited, abundant, virtually endless, suitable for baseload operations and almost universally available power source: **high altitude wind.**

Thanks to 10 years of continuous research, a strong know how, five prototypes approaching the industrial scale and more than 40 international patents, KiteGen is finally ready to drive and support the industrialization and the deployment stage, sharing the know-how with qualified partners.

KiteGenVenture (KGV) is the Italian based sustainable energy company engaged in the design and manufacture of equipment that extracts kinetic energy from high altitude winds (500 to 2000m high) and converts this to electrical energy

Executive summary (1)

KiteGenVenture is based in Turin, Italy where for over a decade the company has investigated ways of harnessing kinetic energy from high altitude winds to convert this to electricity. The company is currently developing its 6th prototype and is progressing through TRL 8 performing field trials and to then progress to full-scale manufacturing. The company has 40 patents registered in about 50 countries covering the key elements of its technology and considers itself to be about 5 years ahead of nearest competitors.

The entry product is the KiteGenStem that employs an aerodynamic efficent semi-rigid PowerWing kite that flies cross wind at altitudes over 600 m. The kite is attached to a compact ground-based generator via two very strong Dyneema ropes. The **aerodynamic lift** of the PowerWing exerts enormous force on the ropes that in turn drives the generator making electricity. The KiteGenStem will be followed by the KitegenCarousel suitable to achieve the Gigawatt scale.

Key features of the KiteGen stem that offer substantial competitive advantage over sustainable energy peers are 1) LCOE < €20 / MWh that will enable subsidy free generation, 2) less intermittent than wind turbines since high altitude winds are more constant, 3) very high energy return on energy invested. This is based on the machine's low cost and light weight construction.

Executive summary (2)

The company already has an order for 200 machines from Saudi Arabia that is subject to achieving TRL 9.

The company has established an almost complete supply chain for components that come together to make the 14 sub-systems of the KiteGen Stem. The future of KiteGenVenture lies in assembling these components into the full system, field deployment, set up and servicing. The company also plans to take contolling interest in subsidiary KiteGen electricity generating companies.

This presentation is arranged into 8 sections:

1) Corporate preamble
2) The Energy Problem
3) Some basic principles of high altitude wind power
4) The KiteGen Stem, prototype history and technical details
5) Energy return of KiteGen, wind turbines and solar PV
6) Competitors
7) Business plan and Economics
8) KiteGen Patents

Please note:
The following slides contents are marked with coloured stars indicating the audience they are directed:
GENERAL FACTS ★
ENGINEERING FACTS ★
ECONOMICS & FINANCIAL ★

Corporate preamble

[Holding Company]

[Patents holder]

Corporate structure

Board of Directors

Ing. Massimo Ippolito (President)
Dott.Ing Eugenio Saraceno (council member)

KiteGen Venture, through which most of KiteGen's daily business is conducted, holds controlling interests in KiteGen, the patent holder.

Interntional awards and recognitions:

KiteGenVenture

Holding company

KiteGen

Patent holder

KiteGen people: Massimo Ippolito

1975: Developed the first free broadcast transmitters in Turin
1978: Intense training in logi-mechanical design and control of machines
1983: Formation of Sequoia Automation. The company has over its life worked on over 100 projects including: human voice print recognition, detection of leaks in Pipings on vibrational signals, artificial vision for quality control, industrial acoustic selections, control and realization of robotic parallel kinematics, EHV grids service robots, Turbo-gas generators control, autonomous energy systems and vehicles.
1985: Awarded a major contract from FIAT Aviation Division for the creation of an automatic system for the bearings mounted on boxes to Eurofighter Tornado gear according to the stringent specifications of MIL procedures.
1998: Start of production of the SeTAC series, a device "SEQUOIA Triaxial Acceleration Computer" alongside several R&D EU founded projects.
2002: The novel features of motion tracking in three-dimensional space of SeTAC instrument, intelligent acceleration sensor designed in Sequoia automation have led to the idea to develop an application in the renewable energy field, the Kite Wind Generator, which aims to build the high-altitude wind to produce electricity
2005: Began work on the first KiteGen prototype.
2007: Founded the company KiteGen srl which has consumed much of his time ever since.
Massimo Ippolito left university in favour of pursuing his coveted industrial training. He is an expert in energy and environmental matters.

KiteGen people: Dr Eugenio Saraceno

Current
From 2013: JDA Project Manager and System Integrator - KiteGen Project Responsible for System Integration and Architecture, Partners and Cooperation

Past
2012 Senior Project Manager at Central Bank of Italy
2003-2011 Senior ICT Consultant at Telecom Italia S.p.A. and Wind Telecomunicazioni S.p.A.,
1999-2002 Software Manager at SIRTI S.p.A.
1998 Software engineer at Eustema S.p.A.

Key Skills
Software and Firmware Engineering, Systems Integration, System Architectures, Relational Databases, OLAP data processing, Energy Industry and Technologies, Energy Management
Object Oriented Programming Paradigm, Java, C++, C, XML, PL*SQL, Networking and Protocols, Industrial Automation, Presales, Technical Documentation and UML, Testing and Quality

Education
SAFE - Rome
Post Graduate Master, Energy Resource Management, Environment 2004–2005

University of Rome Tor Vergata
Master's Degree, Computer Engineering 1991–1997

The Energy Problem

What is sustainable energy?

Industrial society, that is the society we live in, was founded upon combusting energy stores contained in fossil fuels and to a lesser extent the fission of uranium. Once these resources are used they cannot be replaced raising concerns about the sustainability of industrial society.
This has lead to the concept of using sustainable energy resources. Those are resources that are so vast, they will never be used up on the human civilisation time scale. These sustainable energy resources fall into two broad categories: 1) those based on capturing solar energy and 2) those that are based on harnessing the energy embedded from the supernova precursor to our solar system.

Supernova sustainable energy resources

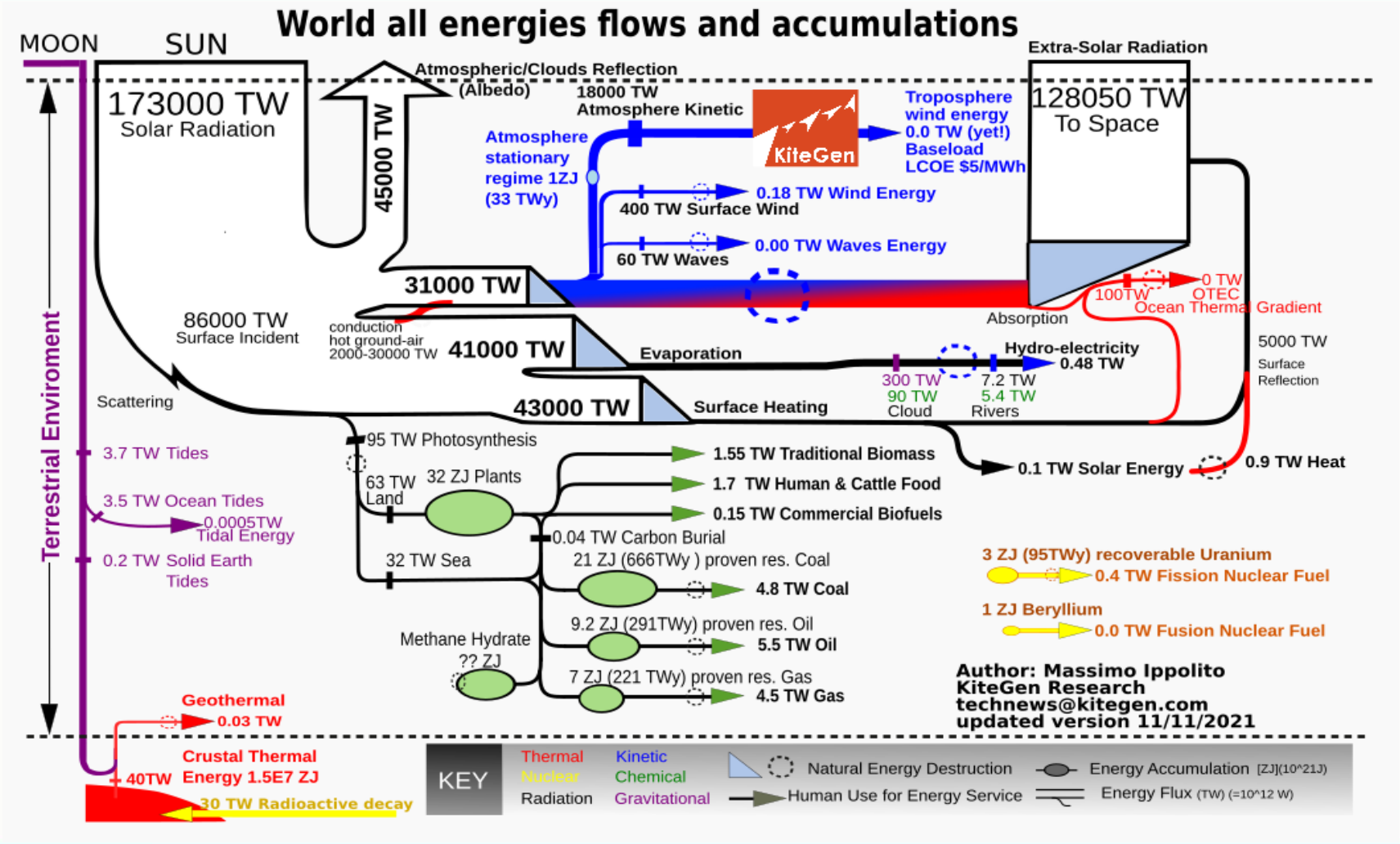
- Tidal power
- Geothermal power
- Hydroelectric power

Solar sustainable energy resources

- Solar photovoltaics
- Solar thermal power generation
- Solar thermal hot water production
- Surface based wind turbines
- **High altitude wind generators**
- Wave power
- Hydroelectric power

It is important to understand that the radioactive metals uranium, thorium and potassium were formed in the supernova. This is the heat engine within the Earth that drives plate tectonics. Hydroelectric power appears on both lists because it relies upon The Sun to cause the rain to fall but equally relies upon plate tectonics to create the surface relief required to create the potential for power generation. High altitude wind power is highlighted as the only renewable energy resource that has yet to be exploited by Man, and it is potentially vast.

Current world energy situation



What is the size of the high altitude wind resource?

High altitude wind power, also known as tropospheric wind power, is based on the concept of capturing the kinetic energy of high altitude winds and converting it to electricity. Kinetic energy is the energy possessed by an object that has mass that is in motion. The equation for kinetic energy (KE) is:

$$KE = 0.5 * mass * velocity\ squared$$

Where mass is measured in kilograms (Kg), velocity is measured in meters per second (ms-1) and the resultant kinetic energy is measured in joules (J).

The mass of air in the atmosphere is approximately 5.15*10^18 Kg. And the mean wind speed is approximately 20 ms-1. Hence the KE of the atmosphere is approximately:

$$KE = 0.5 * 5.15*10^{18} * 20\ ^2$$

= 1030*10^18 J (EJ) or about 286,000 TWh

How much energy does Mankind use every year?

According to the BP Statistical Review of World Energy 2016, the human population on Earth consumed 13,147 million tonnes of oil equivalent (toe) in 2015 (this does not include wood burned by primitive societies in the developing world).

KE in troposphere at any point in time = 1030*10^18 J (1ZJ)

Energy used by Mankind in 2015 = 496*10^18 J or 138.000 TWh

Hence, at any point in time there is at least 4 times* the KE in the atmosphere to power the whole world for one year. KE in the atmosphere, in the form of wind, is a response to temperature gradients created by incoming solar radiation. The energy source for the atmosphere is therefore replenished every day by The Sun.

1 million toe = 39.7 trillion British Thermal Units (BTUs) and one J = 0.00095 BTUs. Hence global annual energy consumption = 4.96*10^20 J.

Why sustainable energy?

There are two primary reasons for wanting to increase the share of sustainable energy in the global energy mix:

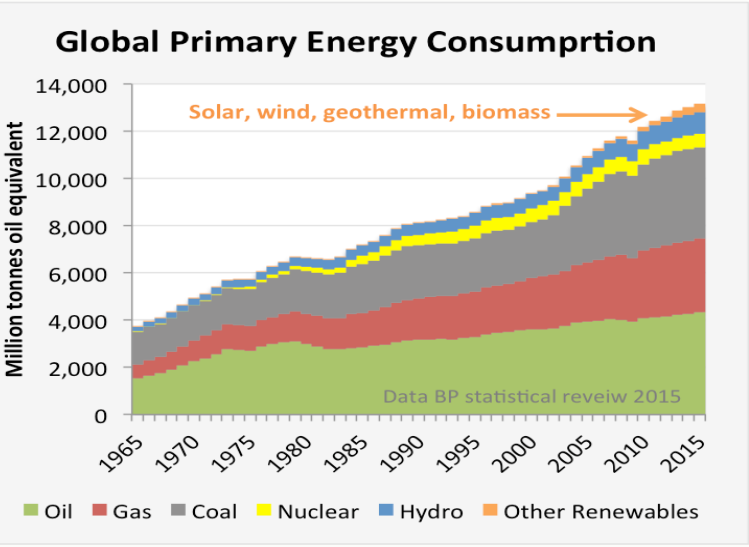
1) Obligations to meet COP 21 emissions committments
2) Declining supplies of indigenous primary energy in parts of the world such as Europe that creates trade imbalances and energy security concerns.

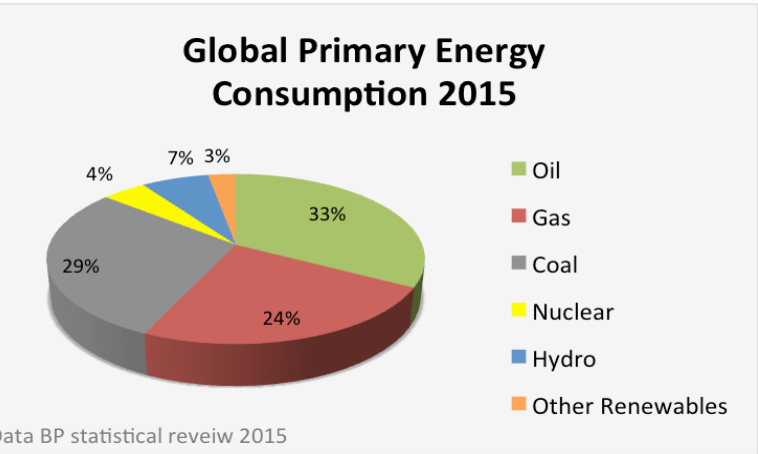
United Nations
Framework Convention on Climate Change

At COP 21 in Paris, Parties to the UNFCCC reached a historic agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement requires all Parties to put forward their best efforts through “nationally determined contributions” (NDCs) and to strengthen these efforts in the years ahead.

The KiteGen Stem may provide national governments with an effective way to achieve their climate goals.

Sustainable energy in the World today





Global primary energy consumption has more than trebled since 1965 reflecting population and economic growth and prosperity.

Energy is fundamental to everything we do from growing food, providing heat and light, manufacturing and transport. The amount of energy we use is a rough proxy for our level of prosperity and well-being.

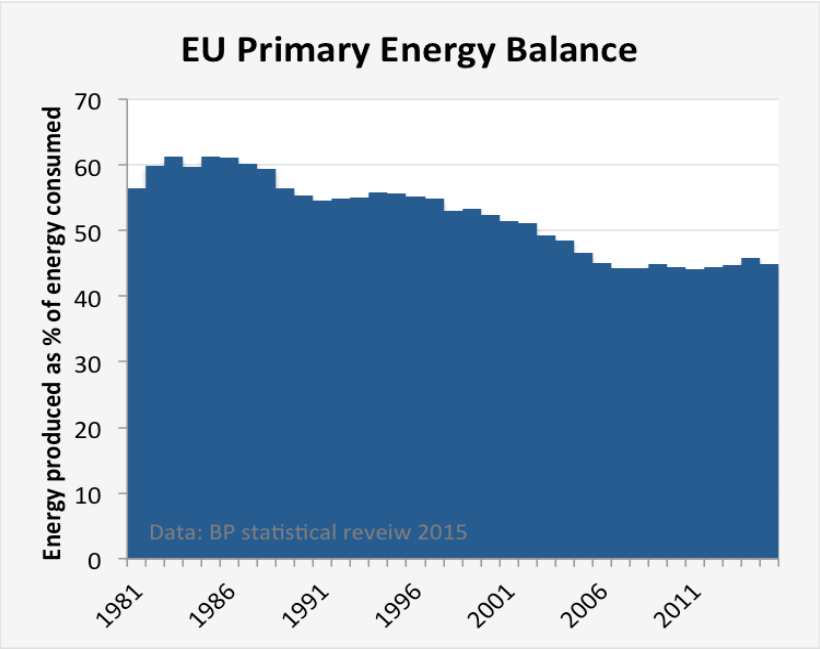
However, despite the expenditure of €5 trillion on solar and wind devices, other renewables still account for only 3% of global energy production.

Low carbon sources (nuclear, hydro and renewables) were 12% in 1990 and stand at 14% today. One reason for this poor performance is that wind turbines and solar devices are inherently inefficient and expensive.

High Winds: a sound solution for the issue of European Union Energy Security

Energy imports come mainly from Russia that is a major supplier of oil, gas and coal. Norway is a major supplier of oil and gas. Gas is also imported via pipeline from North Africa (Libya and Algeria). Liquefied natural gas is imported from all over the world. This dependency on imported energy creates concern about security of supply. It also creates balance of trade issues in some countries such as the UK.

A major problem for Europe, therefore, is growing dependency upon imported energy (see chart) combined with the challenge of reducing CO2 emissions. The main strategy to tackle these problems has been the deployment of wind turbines and solar PV on an epic scale. However, both of these strategies produce expensive and unreliable energy that is only made viable by a system of consumer paid subsidies. This is hardly a sound foundation for economic prosperity.

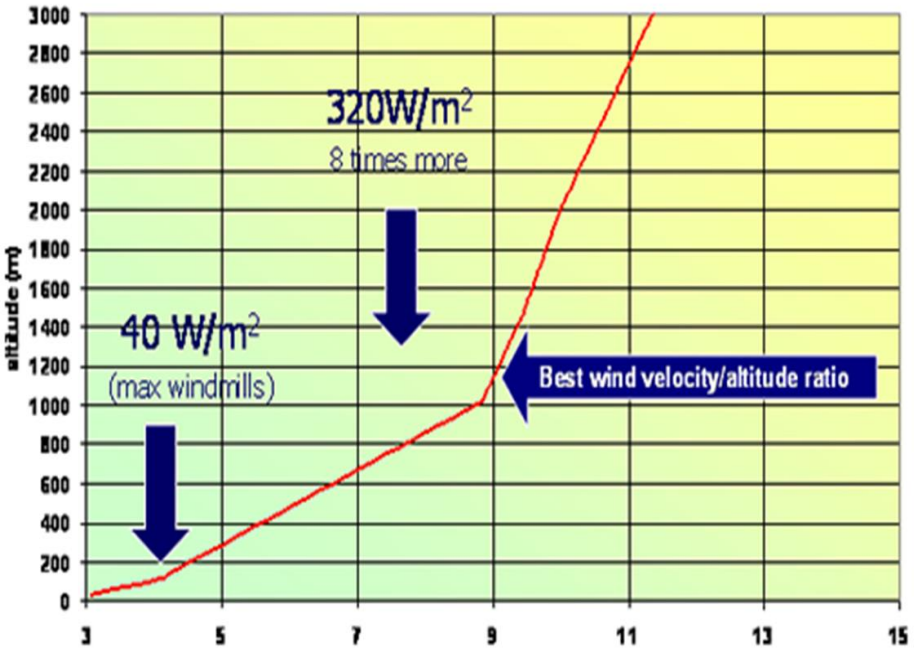


The KiteGen Stem is designed to produce abundant clean electricity, unsubsidised at a cost that is competitive with coal.

High altitude winds (1)

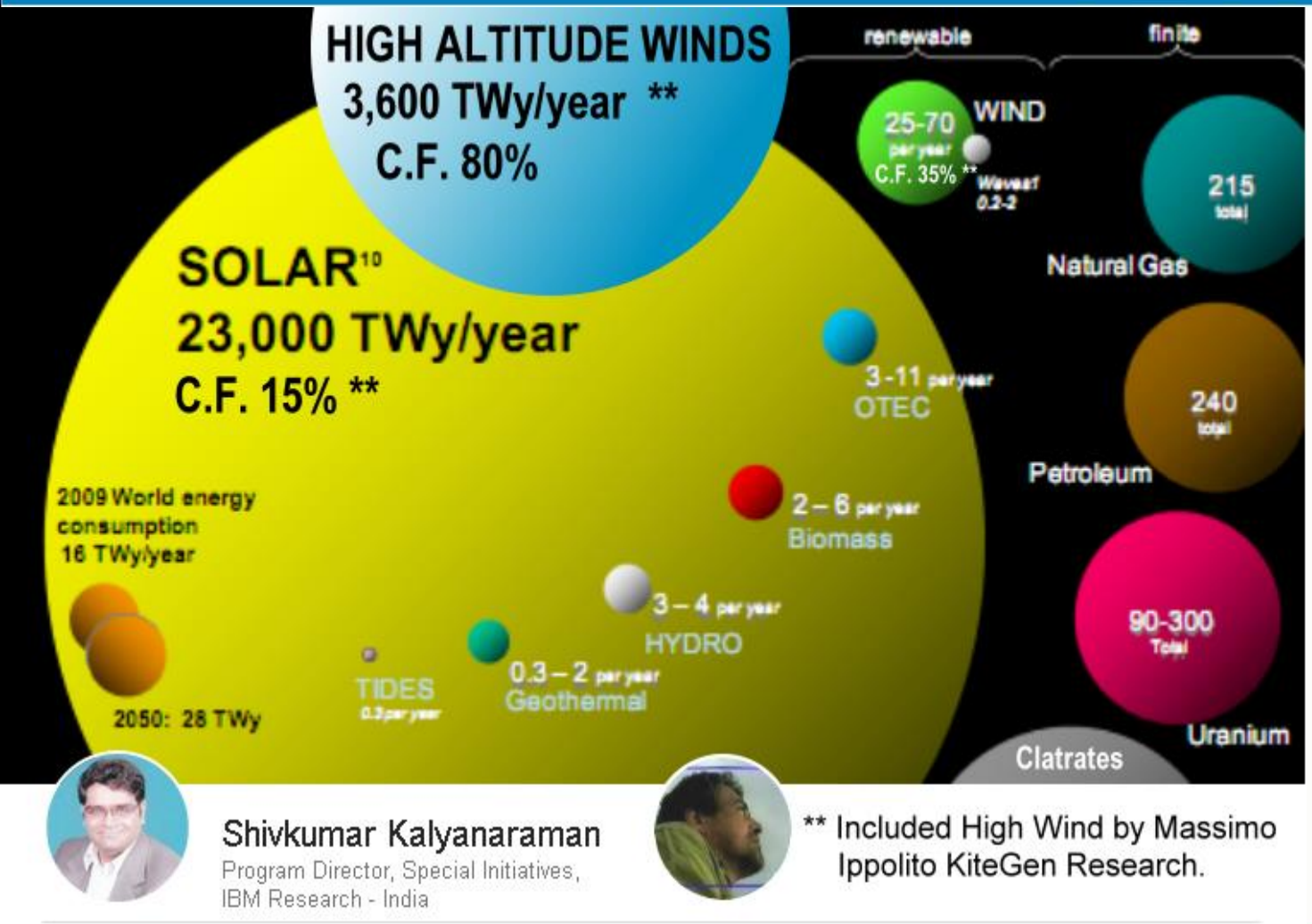
The first real innovation of KiteGen lies in the choice of a high-performance energy source: the **high altitude winds**, a huge, virtually endless and almost universally available energy power, but still to be explored.

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 – 16 m/s
Capacity Factor	1550 hours/year	5000 – 7000 hours/year

High altitude winds (2)



Shivkumar Kalyanaraman
Program Director, Special Initiatives,
IBM Research - India

** Included High Wind by Massimo Ippolito KiteGen Research.

When the (C.F.) capacity factor of the tapping devices is considered the high altitude winds result the far most important energy resource available to mankind in absolute

The energy problem and its solution

Major Problems for Power Producers	KiteGen® Solution
High human and environmental impact, risks and disasters due oil spill, nuclear, shale gas, collapse of coal mining, community costs and related financial losses	Safe for humans, plant equipment and the environment and optimal financial performances
Trouble in finding new available energy sources at competitive prices and in significant quantities, especially among the renewable ones	100% renewable with capability to achieve LCOE lower than any other energy source fossil fuels included
Inability to satisfy the rising energy demand, due to the fossil fuels peak production	3600 TW of available and renewable power resource, currently never harnessed
Regulations issued by governments on control of emissions in atmosphere and climate change	Technology with zero emissions and huge net energy balance (EROEI).
Intrinsic intermittence of solar and wind energy sources	Up to 6500 hours/year of 3MW equivalent production, independent from specific site
Uncertainty about the continuity of government incentives	Lower LCOE guarantees independence from incentives and grid parity
Inadequacy of the energy distribution systems and grids	Stable production will ease saturation problems and dispatching

Some basic principles of High Altitude Wind Power

The KiteGen Stem

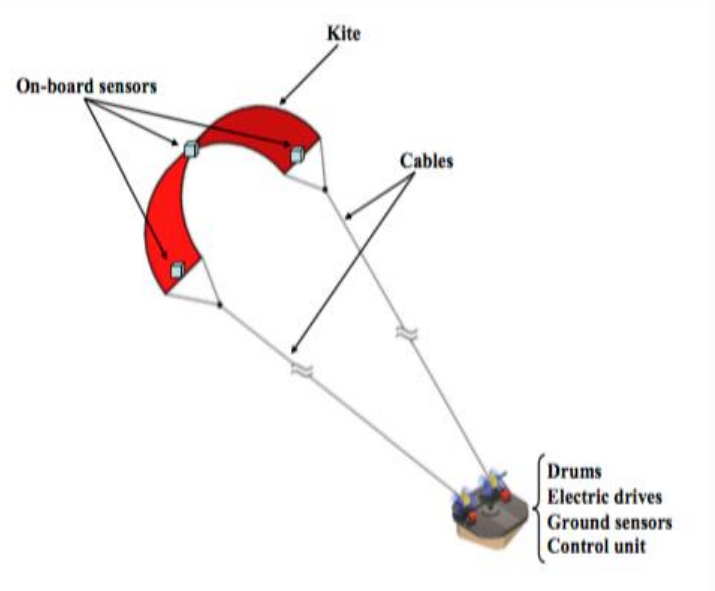
At this point we want to provide a simple overview of the KiteGen Stem before getting into the details.

The KiteGen Stem is designed to produce abundant clean electricity, unsubsidised, at a cost that is competitive with coal.

The Kite (or power wing) flies cross wind in the sky at an altitude between 500 and 2000m, at speeds up to 80 m per second. The aerodynamic lift of the kite generates enormous forces of 20 tonnes on the cables or ropes.

The force is transmitted to a fixed ground station via two ultra strong ropes made of Dyneema. The ropes are coiled on two drums attached to power generators.

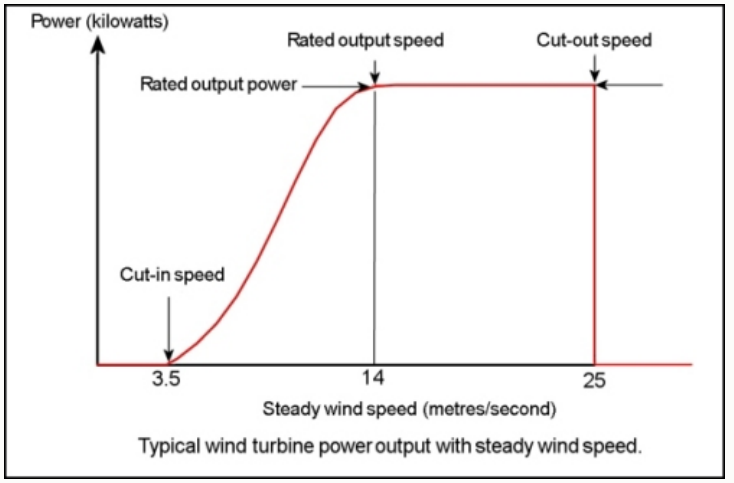
The kite flies away from the ground station unspooling the drums, driving the generators to make electricity.



The KiteGen Stem will make low cost electricity because much of the cost in exploiting wind power lies in the mass of the structures deployed. A 3MW wind turbine has a mass of 1300 tonnes (including foundations) compared with a KiteGen Stem that has a mass of 20 tonnes.

Why go high? (1)

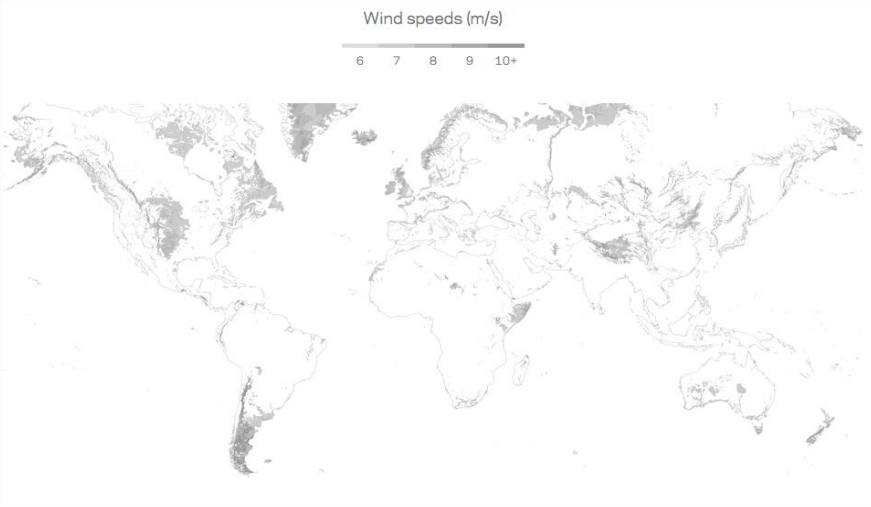
If you live in Western Europe, you are probably accustomed to wind blowing for a lot of the time. That is because our weather is dominated by Atlantic cyclone systems coming onshore. Conventional ground based wind turbines have an operational wind speed range of 3.5 to 14 meters per second (ms-1) with a cut out at 25 ms-1. That is they reach maximum power at 14 ms-1 but need to be switched off at 25 ms-1.



Typical wind turbine power output with steady wind speed.

The key wind speed range of 3.5 to 14 ms-1 is commonly reached 100 m above ground level (turbine hub height) across much of Europe, hence ground based turbines have been widely deployed.

But here's the catch, over much of the land surface of The Earth surface winds are too light for surface based wind turbines to work, shown in white on the map.



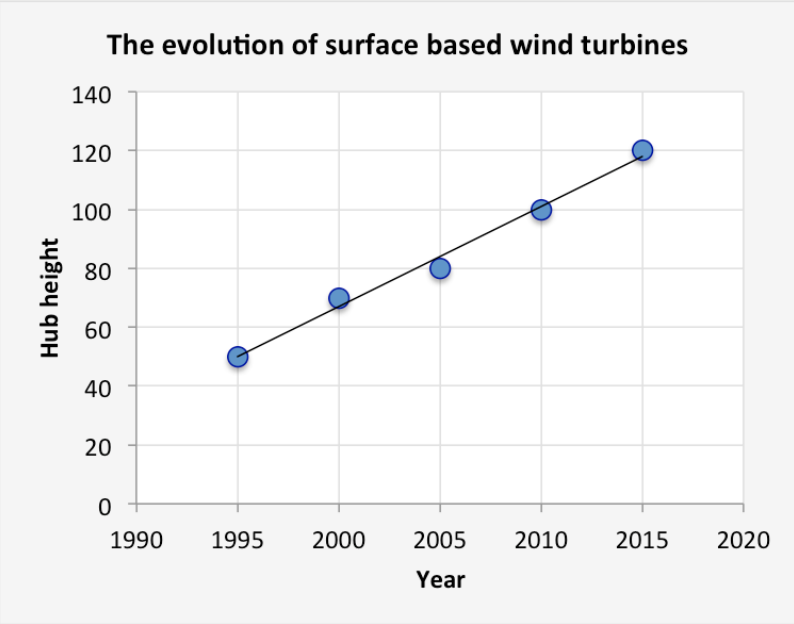
Why go high? (2)

There are two reasons for wanting to access wind at altitudes higher than conventional turbines can reach.

1) The winds on average blow much stronger
2) The winds on average are more constant

Stronger winds at altitude are the reason wind turbines have grown taller and taller with time but at the same time they have become more massive and require more energy to build.

Hence in areas where land based turbines simply won't work a new approach is required to capture energy from the near ubiquitous winds at altitude. This is where KiteGen comes in. High altitude kites are able to capture energy from high altitude winds and convert it to electricity.



Note that Power increases by the cube of wind speed. A little more wind leads to a lot more power. This is one of the grounding principles of wanting to access high altitude wind.

Why go high? (2)

At this point we meet a first important equation:

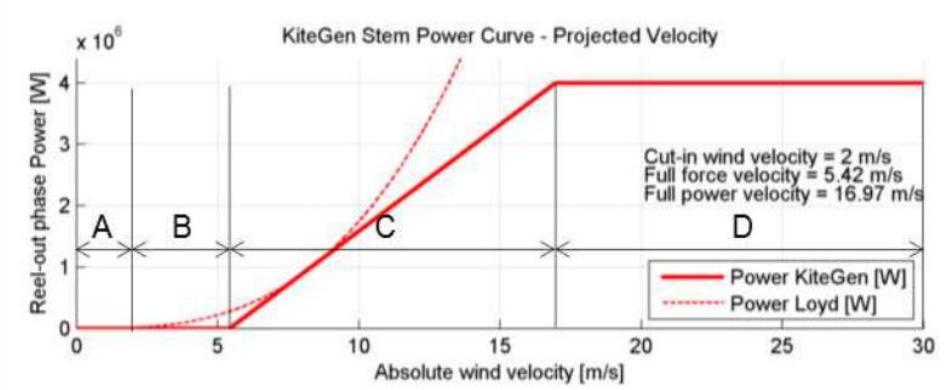
Force on the rope = ½ * wind_speed^2 * aerodynamic_efficiency * air_density

It is the force exerted on each rope by a wing having a certain aerodynamic_efficiency feature and with the given wind_speed and air_density conditions.

Where the force exerted by a wing was applied by means of ropes to a power generator whose control logic impose a constant torque (nominal force), having forces greater than the nominal force would allow the generator to rotate at a certain speed unwinding the rope called by the wing to maintain the constant force.

Thus there would be a power production

Power = nominal_force * unwinding_speed



Therefore the power curve for a kite generator of given nominal will have four phases depending on the available wind speed:

A. Machine off
B. Takeoff: the force is less than the nominal force but enough to fly
C. Cut in: the force exceeds the nominal force; ropes unwind and production starts
D. Full power: the wind is so strong that it unwinds the rope at a speed max_speed such that we have the Nominal Power=constant force*max_speed. Stronger winds are to be managed flying off the power spot or reducing the altitude in order to provide always a constant force. Cut off wind speed will be near 70 m/s

KiteGen early prototypes

The first two prototypes of KiteGen (2005 and 2007) were both truck mounted using fabric sports kites. This stage of development was used to set up the kite control systems and to develop the operational concepts that led to the KiteGen Stem.

Many operational concepts were reviewed. Most were rejected and the best path chosen where key concepts were patented along the way.

For example, controlling flight via two ropes (as opposed to one rope) was patented by KiteGen. And controlling flight by maintaining a constant force on the two ropes is also a KiteGen patent. The latter is achieved by using the actuators as either generators that absorb energy making electricity or switching to use them as motors to recall the kite. Thus variations in the available energy are continuously ironed out.

The side-slip manoeuvre was also conceived and patented at this time. This is where the kite is moved into a position where it loses all lift and can then be recalled by the actuators using a small fraction of the energy generated during the production phase. Note that it is easier to illustrate the sideslip using the animation as opposed to real footage that appears on the same video.

Full power

Transition

Sideslip

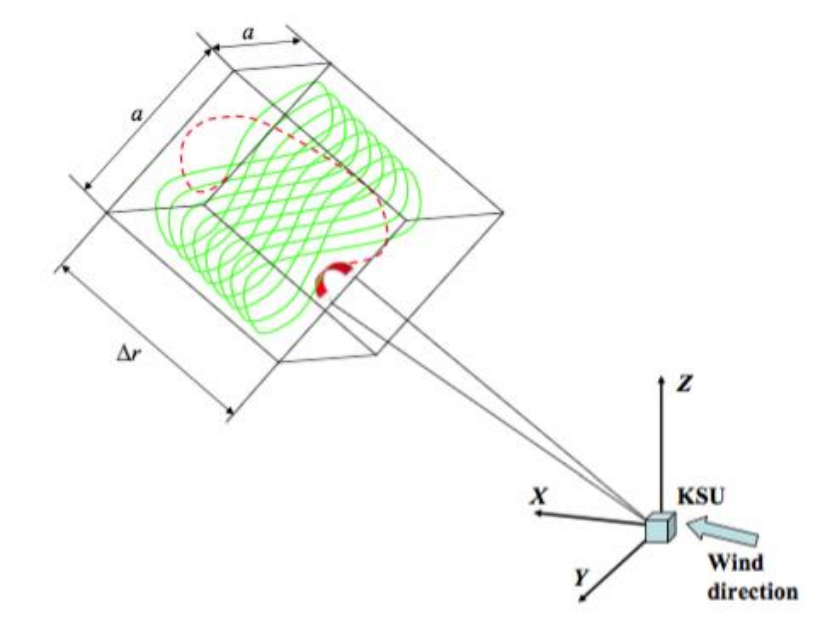
The electricity production cycle

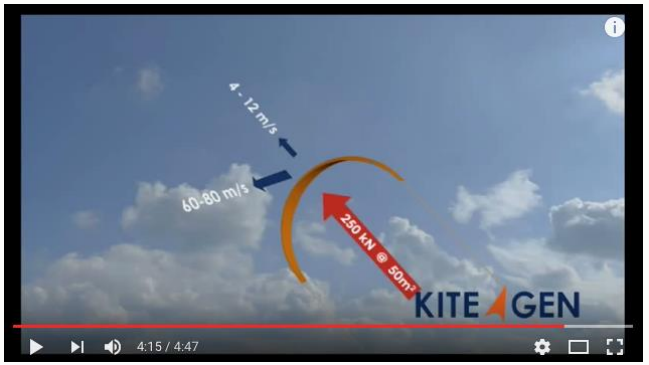
A kite flying cross wind will trace out either a circular or figure of 8 flight path. KiteGen chose the figure of 8.

The kite flies away from the base station (KSU) tracing out figures of 8 in the sky (green line). The aerodynamic shape causes the kite to fly at great speed, up to 80 meters per second, which also generates enormous forces on the ropes. To maintain constant force, the ropes are allowed to unwind on their drum generating electricity.

At the end of the production phase, the sideslip manoeuvre is performed and the kite is recalled (dashed red line) and the cycle repeated. This production cycle is variably called pumping or the yoyo cycle.

One advantage of this mode of operation is that with tens of kites in a KiteSwarm, the production cycle can be staggered between units producing a more uniform electrical output. With ground based turbines it tends to be either all or nothing.





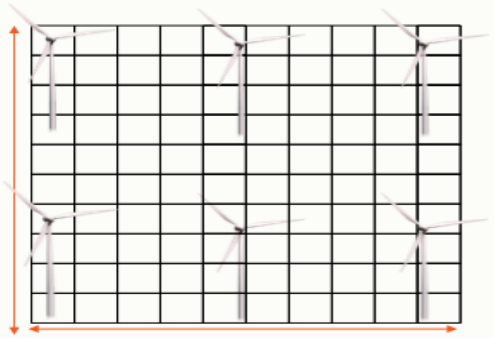
Betz' law and territorial energy density

Ground based wind turbines function by converting the kinetic energy of the wind into rotational motion and electrical power. One can imagine a tube or pipe of air flowing through the turbine blades.

It is not possible for turbines to extract all the kinetic energy. If they did, the exit velocity would be zero and there would be zero flow of air through the blades. Betz' Law from 1919 states that the maxium amount of energy turbine blades can extract is 59.3%. Turbines are also arranged in two dimensions on the land surface. These factors impose territorial density on wind turbines that need to be widely spaced so as to not interfere with each other.

Kites have an advantage over turbines in that they are continuously moving, sampling fresh wind in three dimensions. Neighboring kites may fly at different heights. Kites do not necessarily break Betz' Law but it does not apply in the same way. Kites only need to sample a small portion of the kinetic energy from the large wind front they are exposed to. Hence the territorial energy density of a KiteSwarm may be substantially higher than for a wind farm.

6 wind turbines x 3 MW
18 MW/Km²

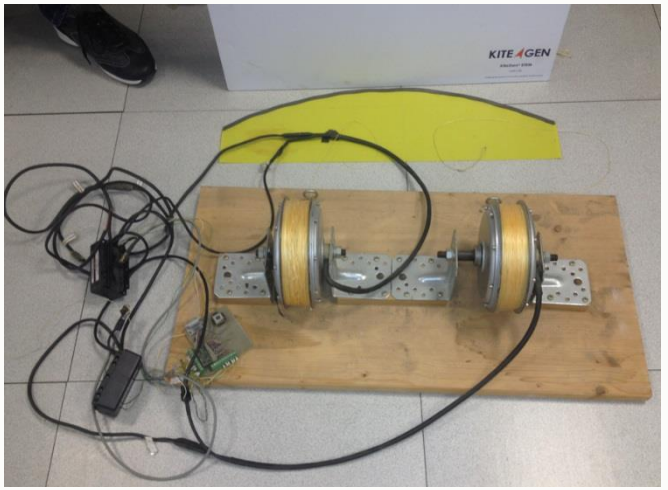


121 KiteGen STEM x 3MW
Density **250** MW/Km²

The KiteGen Stem, prototype history and technical details

Milestones and prototypes (1)

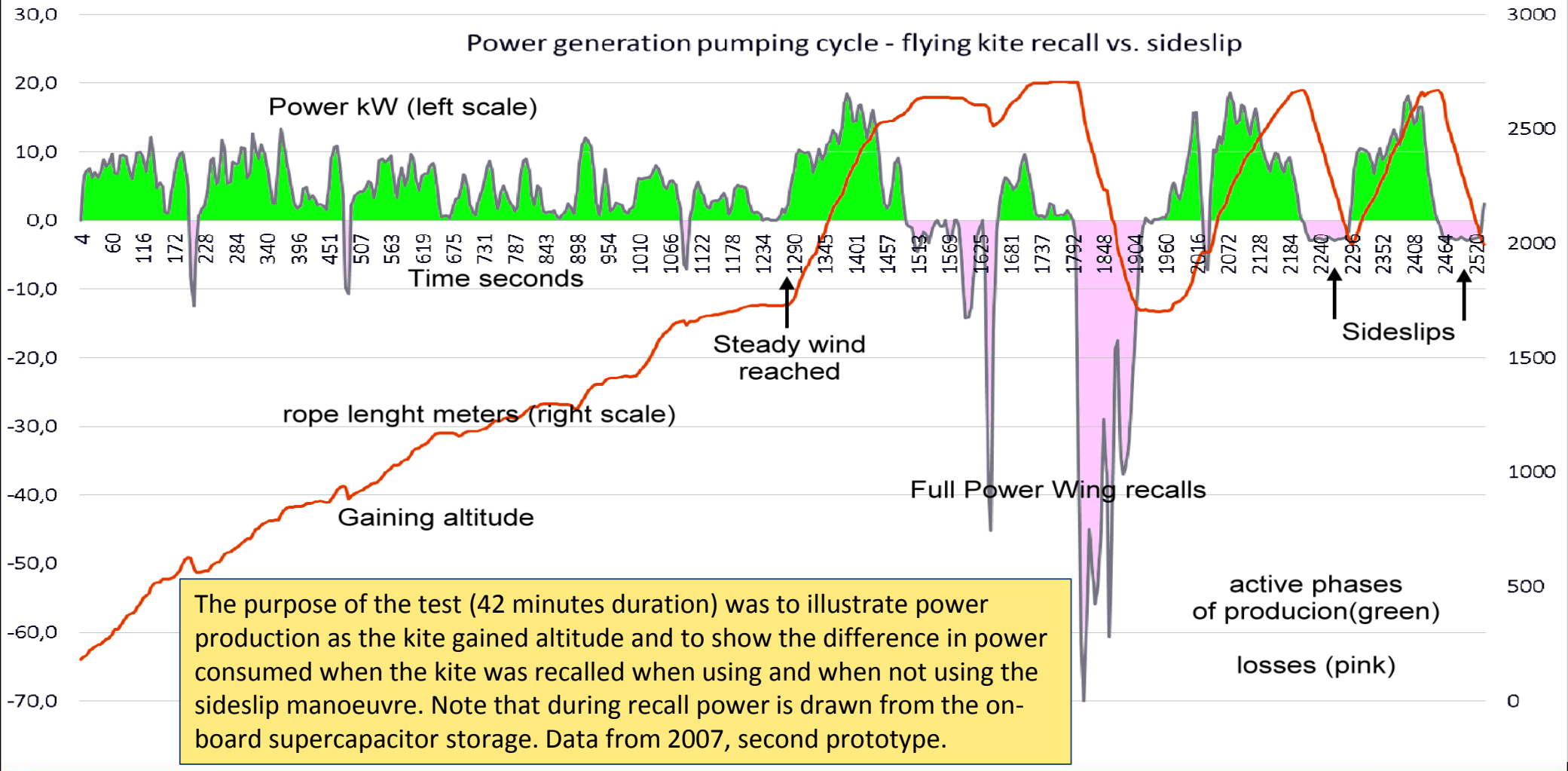
2003. **Theoretical framework and patenting** of the KiteGen technology. Small investigation prototype realized with e-bike hub motors.



2006. Proof of concept with a prototype flying a sport kite, the **Mobilegen** with 40 kW nominal power, reached 100 kW peak power in traction during a test. Validation of the concept that high altitude kites can generate electricity, but no solution to close the production cycle yet. First in the world to generate kite-electricity

2007. Development of the **second improved Mobilgen prototype** (40 kW, up to 2500 m. altitude flying test), setup and validation of the side-sleep manoeuvre to close the production cycle. Patenting the new findings.

Test flight data using a 40 kW mobile generator



The purpose of the test (42 minutes duration) was to illustrate power production as the kite gained altitude and to show the difference in power consumed when the kite was recalled when using and when not using the sideslip manoeuvre. Note that during recall power is drawn from the on-board supercapacitor storage. Data from 2007, second prototype.

Milestones and prototypes (2)

2008. **7th EU Framework Project KitVes**: KiteGen considered as one of the promising solutions in the production of clean energy on board of ships. Further patent activity following deep system analysis. The prototype suffered the intrinsic limitation of funding of a research project, but several propaedeutically aspects were investigated deeply and successfully: ropes endurance, extensive FMECA, inertial platforms and piloting AI.

2009. **CESI-Research** (now RSE): First Italian altitude wind assessment; concept comparison: KG Carousel judged by such public institution as the most promising and feasible solution for the exploitation of high altitude wind power.

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

Milestones and prototypes (3)

2010-2012. KiteGen Stem: strategic decision focused to the development of the fourth prototype approaching the industrial scale. Design/development of many brand new parts/components and successful take-off procedures.
The first true KiteGen Stem with igloo shaped ground station and carbon fibre stem (picture right). This prototype was constructed in a test site to accommodate 3 MW nominal power rating but since we did not have a kite of that rating to fly the generating kit of the 40 kW Mobilegen was used instead. This prototype validated the stem concept and many new components. But it also showed where improvements could and should be made.
Up to this point all prototypes used fabric sports kites. These typically have aerodynamic efficiency between 3 and 6 and kite areas between 5 to 50 m^2. And as one of the next slides show, this imposes serious limitations on using fabric kites in industrial scale power generation. Fabric kites were prone to burst open posing a serious problem.

Flights at Sommariva test site

Milestones and prototypes (4)

2011. Foundation of **KiteGen Venture** the holding company, Main objective: looking for early KiteGen wind farm customers/adopters.

2013. Cooperation and **JDA agreement** with SABIC (Saudi Arabian Basic Industries) for the setup of the necessary composite materials and chemicals, agreement for 200 KiteGen Stem installation plan in Saudi Arabia following some validation milestones.

2014. Design and manufacturing of the composite Power Wings in several different geometrical configurations.

2015. To date Project presentations, due diligences and negotiations with all major energy companies, including Exxon, Enel, Saudi Aramco, Huaiy, BP, Saipem etc. The common outcome of such activities, despite a tecnical success, exposed a perceived strategic problem of KiteGen ubiquitary source and tech, with a lack of world hegemony.

Milestones and prototypes (5)

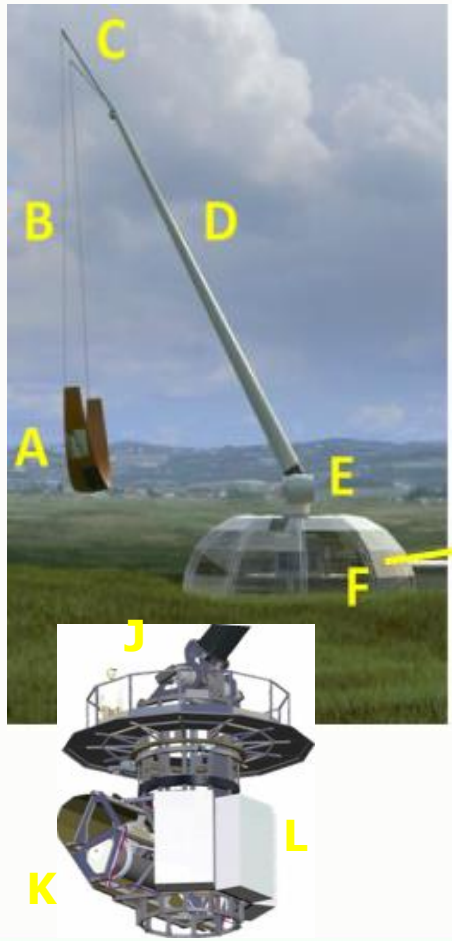
2015. Supply chain first set up; manufacturing development of subassemblies; partner scouting/evaluation; Test of the industrial machine; validation and components refining and revision loop. The Power Wing is tested in gravity drops and is proven to have an outstanding aerodynamic efficiency.

2016. Completion of the Full Technology Package and comprehensive specification of all components, wing and machinery. Ready to setup the system mass production. Efforts to enforce and engage the full supply chain for the project with commercial/production agreements. Components endurance tests, addressing safety and security issues.

It has been built as a full-scale prototype and has been used to aid systems configuration and testing the durability and performance of components. The single stem on prototype is now constructed from welded aluminium rods which are lighter and stronger than carbon fibre used in prototype 4. After successfully realizing the single trussed stem it was possible to design a twin 36m stem that can launch the power wing (see following slides). That brings us up to date. The twin 36m stem is under construction and KiteGen needs fresh capital to build a first pre-series to be deployed on field trials and to initiate the production phase.

The KiteGen Stem machinery structure

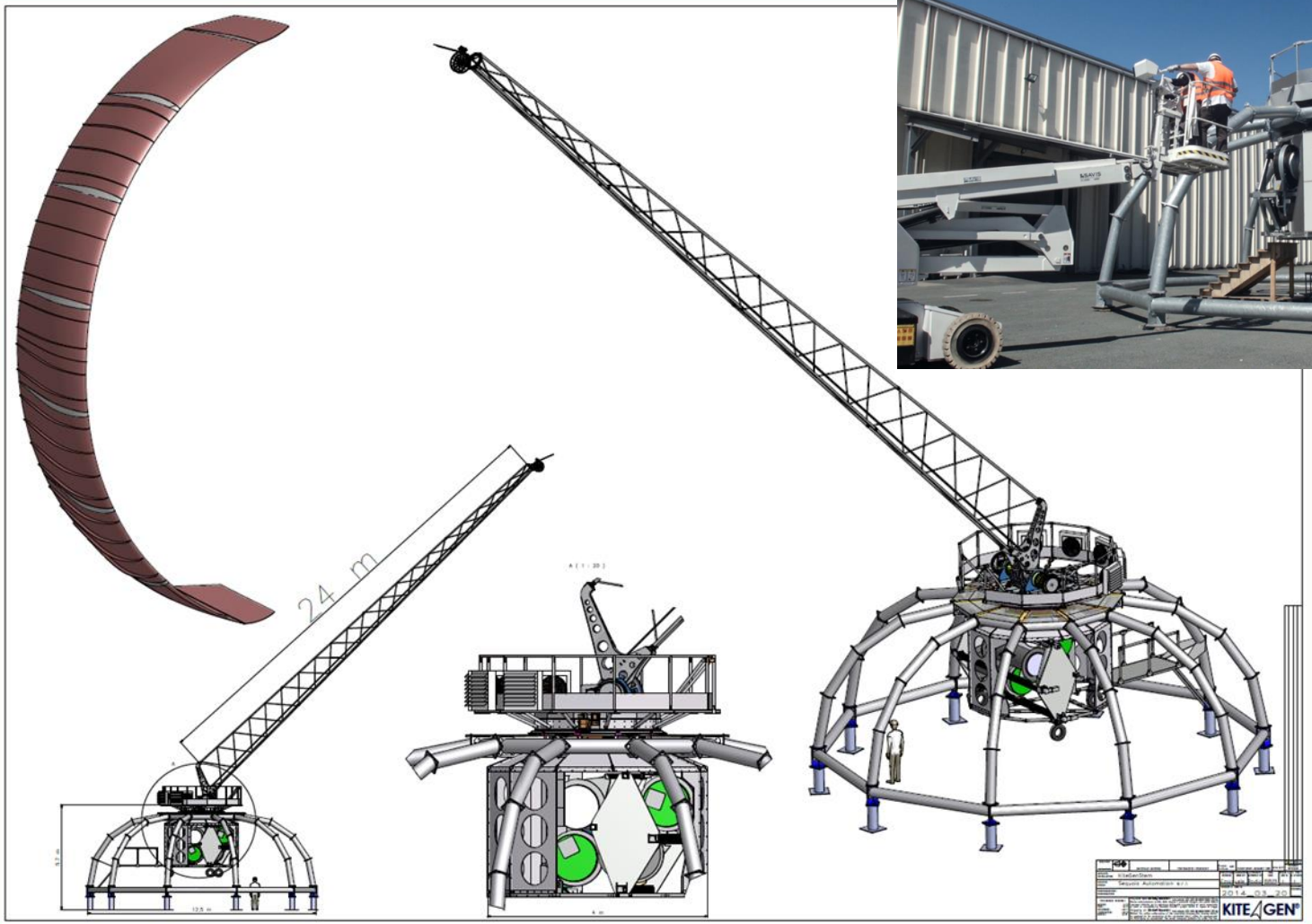
Structure description
- **Power wing**: Composite material flexible wing structure, 150mq
- **Tethering**: designed for 60 ton max traction, 20 ton working conditions
- **Compass** (optional) + Stem: gust control within few msec, dual cable control, 24 m
- **Ground structure**: flexible for gust control, 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

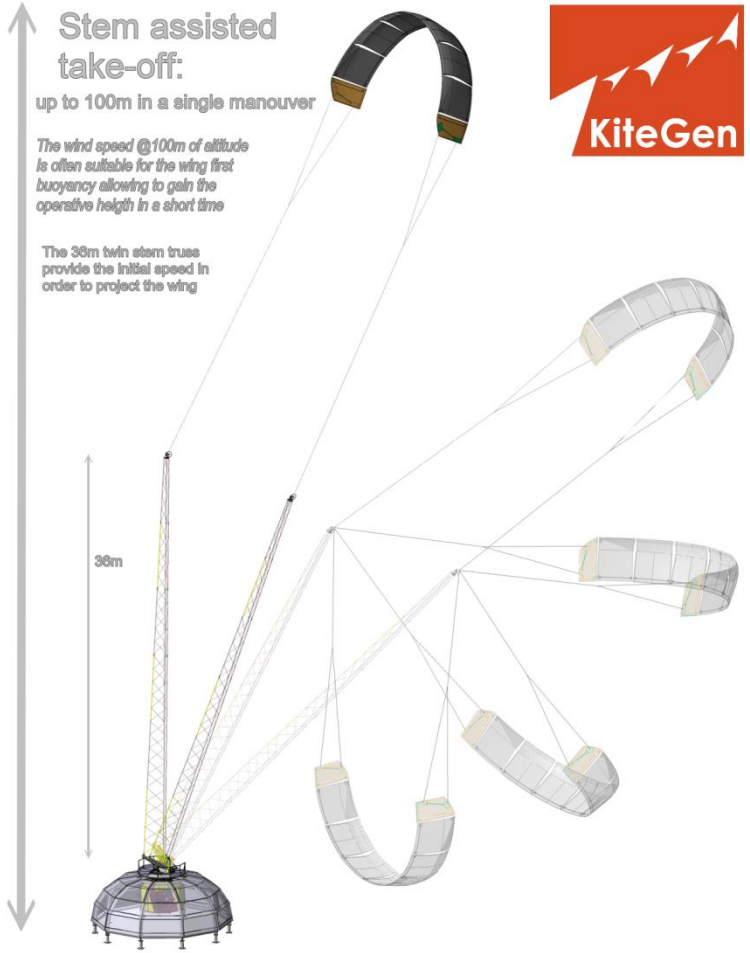
I. Cabinet and 6 actuators
J. Motorized joint
K. Drums
L. Motor drivers and control

KiteGen Stem: drawings snapshot



Double Stem and take-off operations

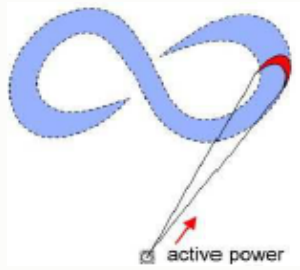
The final design suitable to handle at ground the big wings. The double stem is the extension of the manipulator



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 polymeric ropes** 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 wing is driven to a position where it loses wind force and lift. At this point, it is wound up and brought back to the minimum height. Then the cycle restarts repeatedly.

All the heavy machinery for power generation and the management of the entire system is on the ground, consisting of an **dome-shaped base** and a 24 meters long **stem**, connected to the wing through the ropes. The base hosts the heart 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.

Extensive Test & Refinement Activity

The limitations of fabric sports kites and the development of the power wing

The weakest link in the KiteGen prototypes flying fabric kites was the kites themselves that have a tensile strength of the order 10 kN. Exceed that and the kites simply burst open. As a rule there is seldom a shortage of wind energy, and the fabric kites need to be positioned in a way that maintains the force below 10 kN. This sets an upper limit on the power output from a fabric kite based system at < 100 kW, and hence a fabric kite based system could never be developed into a commercial electricity generator.

Thus in 2014 KiteGen took the strategic decision to develop the semi-rigid power wing that is an essential component of the 3 MW generator. The Power Wing is designed to withstand 150 kN of force and has an area of about 100 m^2. It also has an aerodynamic efficiency (AE) of the order 28 compared with fabric kites that have AE of 3 to 6.

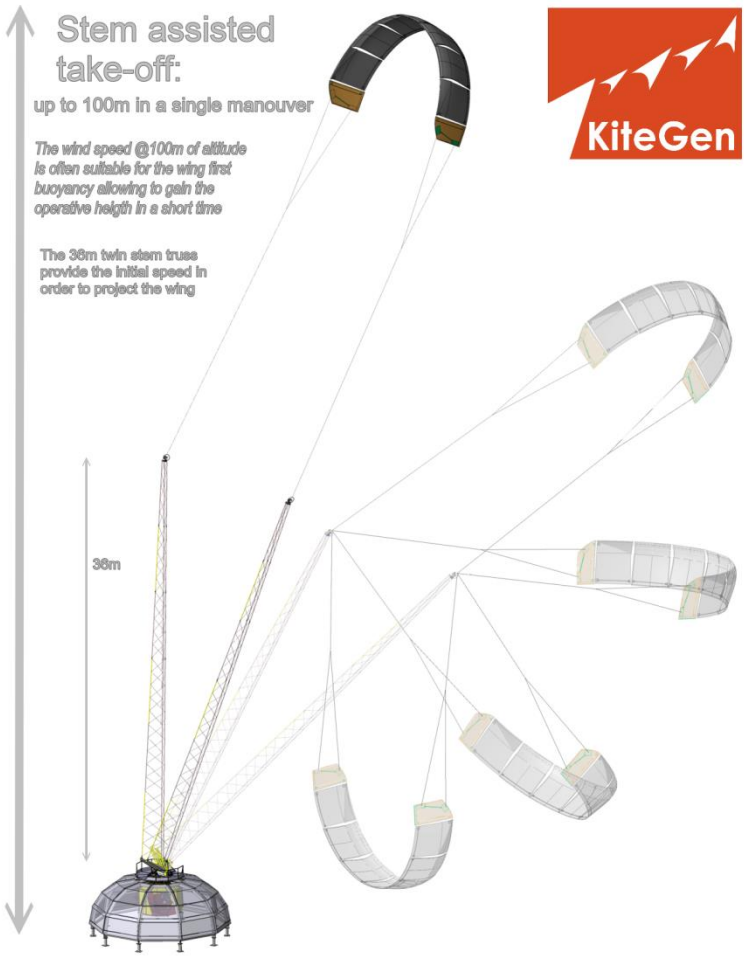
Its time to introduce another equation….

Equation 2:
Force on the ropes = ½ windspeed^2 * aerodynamic efficiency^2 * area of wing * air density

… from which we see that the higher AE, larger kite area combined with higher tensile strength gives the power wing a huge advantage over fabric kites.

Picture: Eugenio Saraceno left, Massimo Ippolito right and Dr Euan Mearns (author of this presentation) centre.

The 14 parts of the KiteGen Stem (1)

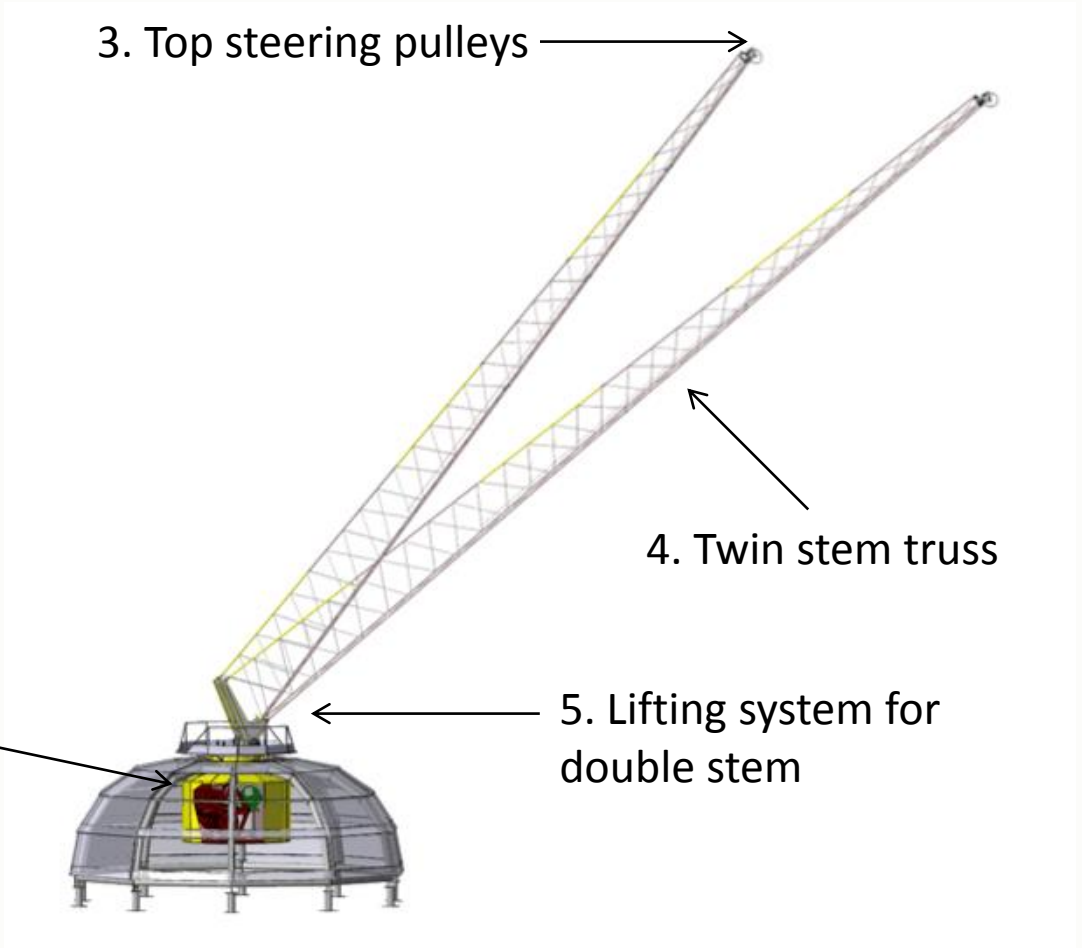


The sixth prototype is now under development and comprises 14 systems that are aggregates of components, the majority of which have already been tested. This slide and the following slides identifies and describes 9 of these systems.

1. Power Wing
2. Ropes
3. Top Steering Pulleys
4. Twin stem truss
5. Lifting System for double stem
6. Main bearing, dome (“igloo” spring), rotating engine room
7. Alternators “diamond shaped” frame with sliding drums and pulley system
8. Special low friction pulley (K-Pulley)
9. Weak Force Gauge
10. Supercap storage racks
11. Electronics (radio, sensors and control boards)
12. Power Electronics (servo drive DC BUS, sliding contacts and grid inverters)
13. Cooling system
14. Software, HW & services

The 14 parts of the KiteGen Stem (2)

1. Power Wing
2. Ropes
3. Top Steering Pulleys
4. Twin stem truss
5. Lifting System for double stem
6. Igloo, main bearing, revolving engine room
7. Alternators, rope drums and diamond frame
8. Special low friction pulley (K-Pulley)
9. Weak Force Gauge
10. Supercap storage racks
11. Electronics (radio, sensors and control boards)
12. Power Electronics (servo drive DC BUS, sliding contacts and grid inverters)
13. Cooling system
14. Software, HW & services



The 14 parts.. 1) Power Wing

The power wing comprises 9 sections joined by ultra-high performance zippers. Each section has a core of Nomex that is a honeycomb aramid fibre (paper). Nomex (below left) is ultra-light, ultra-strong and pliable.

In final configuration, the Nomex will be sandwiched between Kevlar skin creating a very light, strong and durable construction.

The Power Wing sections are moulded in the shape of aerofoils and has an aerodynamic efficiency of 28. It carries a GPS and radio transmiter and is studded with motion sensors so that its location and shape are always known and transmitted to ground. The wing carries a micro-turbine (below right) to power on-board electronics.

Lightest Possible Construction
Fabricators use this sandwich core when high strength-to-weight ratios are required. This honeycomb is an aerospace-grade aramid fiber constructed from DuPont Nomex® paper that is phenolic coated. Over-expanded cell structures allow it to be more flexible, which also makes it perfect for use in tight radius curves.

http://www.fibreglast.com/product/Nomex_Honeycomb_1562/Vacuum_Bagging_Sandwich_Core

The 14 parts.. 3) Top steering pulley

The Top Steering pulley's is a sensor itself including the function is to guide the ropes along the stem pole to the engine room in the most straightforward way. Whatever the direction of the ropes exiting the top steering pulley (TSP), it will follow them automatically moving a bearing and a piston. The inertial platforms placed on the TSP continuously measure the dynamic and the angle of the bearing and of the piston in order to guide the movement of the stem truss.

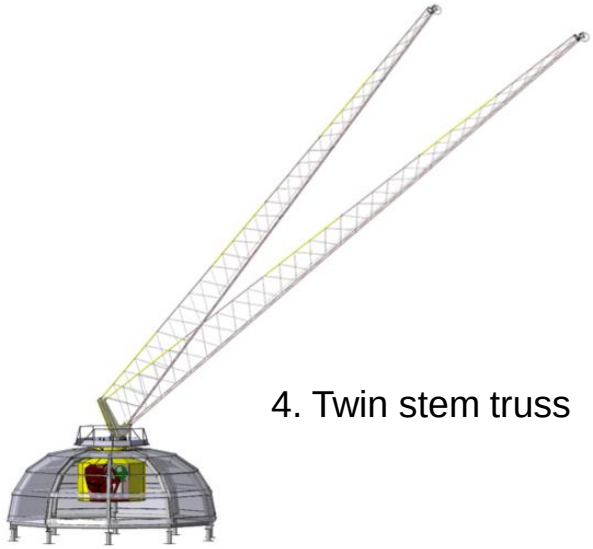
The 14 parts.. 4) Twin stem truss

The stem truss is a 36 m long light trussed aluminum arm. Prototype 6 will have two stem trusses located on top of the KiteGen igloo. They can rotate, elevate or divaricate.

During takeoff, the stems are apart but during normal flight they come together. The top steering pulleys control the attitude of the two stem trusses

The stem trusses have six main functions:

1) To manage and control kite take off
2) By moving they can create lift
3) Rope management
4) Force sensor
5) Shock absorber
6) Kite positioning and navigation

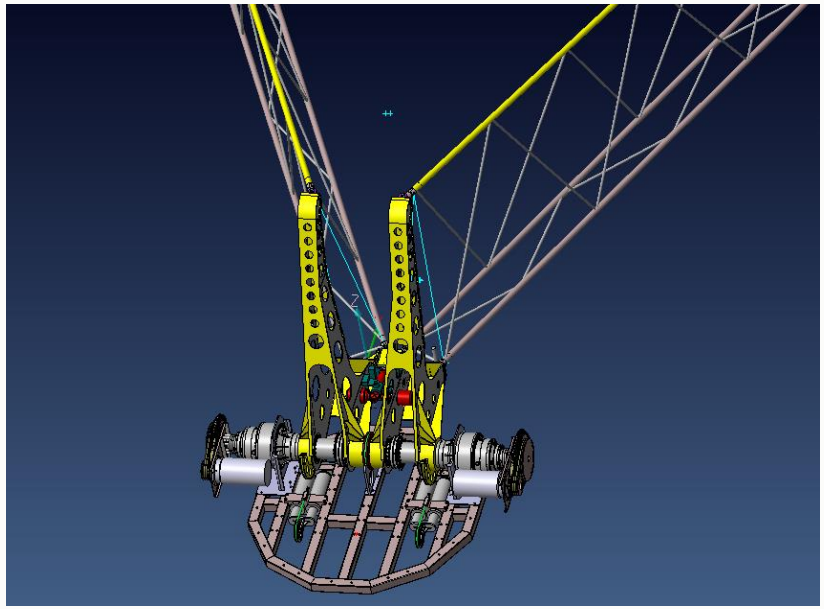


4. Twin stem truss

The 14 parts.. 5) Lifting system for double stem

The lifting system is the device that raises or lowers the stem arms and moves the arms in or out depending upon the operational mode.

The lifting system is mounted on top of the main bearing that allows the stem truss and lifting system to rotate through 360˚ to follow or control the kite.



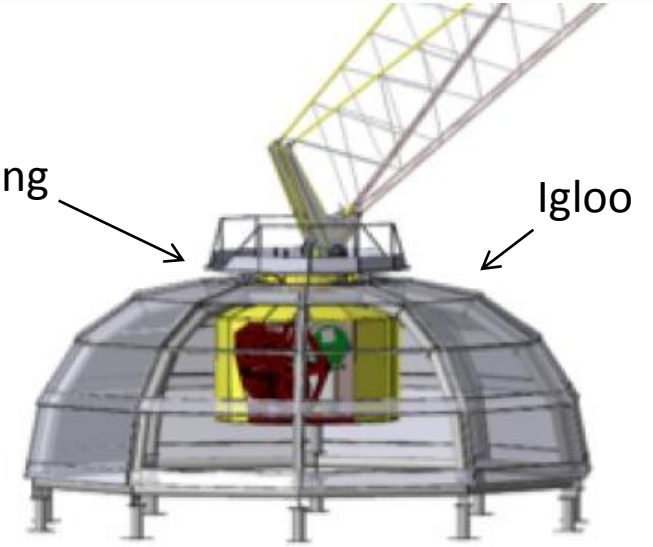
The 14 parts.. 6) Igloo, main bearing, revolving engine room

The igloo is a steel structure with three main functions:

1) It anchors the whole generating system to the ground
2) It supports the revolving engine room
3) It acts as a shock absorber for irregularities resulting from wind gust

The main bearing sits on top of the igloo. The lifting system for the stem truss is mounted on top of the main bearing while the revolving engine room hangs below the main bearing. The main bearing is borrowed from the turret of a military tank.

The revolving engine room houses the actuators (generators / motors), power electronics, supercap storage etc.



Revolving engine room

The 14 parts.. 7) Alternators, rope drums and diamond frame

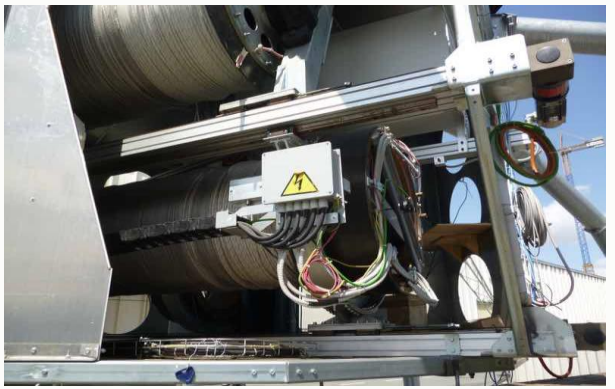
The two ropes feed through the top steering pulleys down through the two stem trusses where they are spooled onto sliding rope drums. The rope drums slide laterally on the “diamond” frame allowing the rope to be spooled neatly.

The alternators act either as motors to recall the kite and to maintain constant force on the ropes and to cause differential force on the ropes for kite navigation and control.

Or they act as generators during the power operational phase when the kite flies away from the base station generating electricity.

There is room for up to three alternators on each rope drum. In prototype 6 there will be space for up to 8 alternators of 400 kW each.

The typical rope unwinding speed is 0 to 10 ms-1 resulting in 290 rpm max on the rope drums.



Rope drums, alternators and frame in situ on prototype 5.

The 14 parts.. 8) Special low friction pulley

With 150 kN force on the ropes as they enter the main pulley reducing to near 15 N as they exit the pulley there is large frictional losses as the ropes stretch along the circumference of the pulley.

The K-Pulley design is alternative to the multiple pulley line described at the previous point. It is a low friction pulley that changes its diameter in order to avoid the friction on the rope. **This design allows a coaxial positioning of the alternators on each line or a bigger single alternator.**

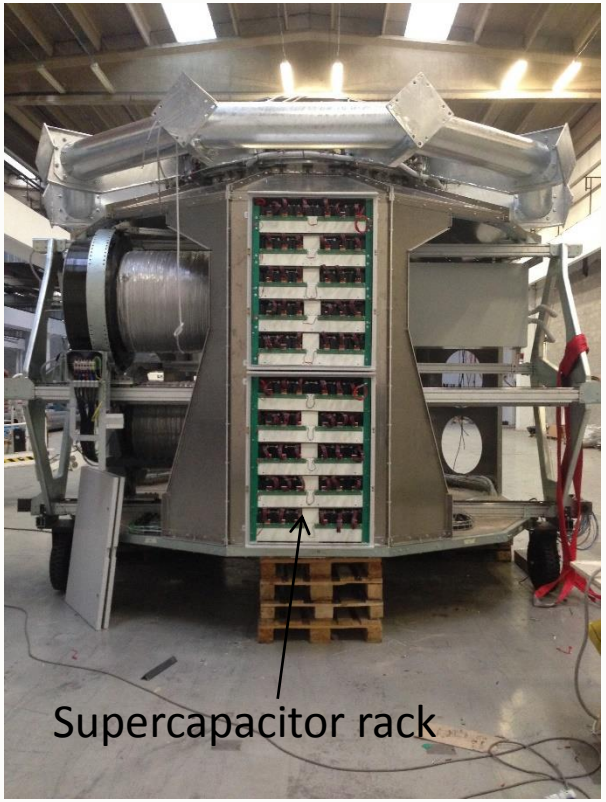
This device needs further design and prototyping effort before implementing in the industrial plan. Thus the costs of the present task are not included in the plan and the activity will be managed as a Design and Build Bid task.

The 14 parts.. 10) Supercapacitors and storage racks

Each KiteGen Stem is equipped with on-board power storage in the form of 480 supercapacitors (2.7 V 3000F) mounted in series in a rack attached to the rear of the diamond frame.

The primary function of the supercapacitors is to provide electricity for kite recall. This on board storage also allows the KiteGen to safely recall and land the kite in the event of grid failure.

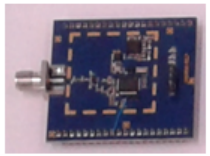
Supercapacitors are able to easily withstand the hundreds of daily charge / discharge cycles where conventional batteries would be destroyed in days.



The 14 parts.. 11) Electronics

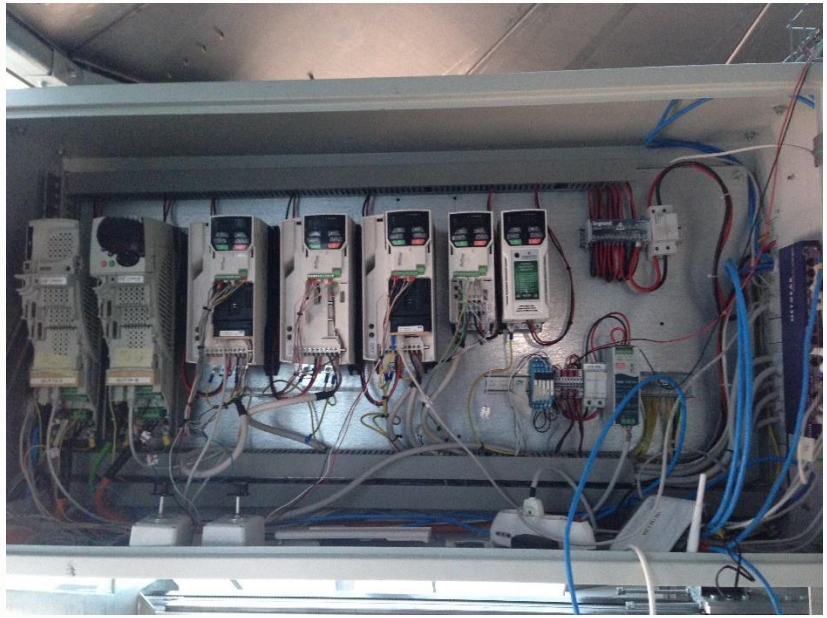
A key part of the KiteGen concept is automated control. In fact the technology has only recently been enabled by advances in GPS (global positional system) and motion sensors (magnetometer, accelerometer and gyro sensor).

There are 7 automated control processes in total, just 5 are shown opposite.

Board name	Available firmware tasks	components and connectors	Applications
Radio board 	Radio Rx/Tx Loadcell readout Aileron pwm	8051 silab chipset Antenna Uart	Long range Radio Rx/Tx
STM32F405 daughterboard 	Wing board and Imu reading Multirelays Canbridge Top steering pulley	Usb Alternative oscillator 3 Uart 3 I2C channels ADC	Interchangeable micro for kiteboard and miniboard
STM32F405 microboard 	I2C slave encoder	Usb Uart 3 I2C channels	IMU I2C slave Encoder
GPS 	Gps	Uart	Wing position sensor
IMU microboard	Imu	BNO055 imu Barometer I2C or Uart output	Magnetometer, accelerometer and Gyro sensor with quaternions math and autocalibration

The 14 parts.. 12) Power electronics and DC Bus

The DC Bus is the parallel connection of the servo drives, the supercap racks and the sliding contacts. The DC voltage on the bus depends on the charge status of the super capacitors and ranges from 350 to 1200 V, the same range allowed for the servo drives which manage the AC alternators through an inverter. During the production phase the alternators generate current that is stored in the supercaps while their voltage rises. During the wing retraction phase (sideslip) the alternators consume a fraction of the generated energy, taking it directly from the supercap storage. The sliding contacts allow the suspended and rotating engine room to have a "wireless" connection to the kite farm DC bus it shares with the other generators. The common DC Bus goes to the grid cabin to an inverter rack that transforms it back to AC and sends the produced energy to a transformer that raises the voltage before exporting power to the grid.



Energy return of KiteGen, wind turbines and solar PV

The ERoEI of the KiteGen Stem

ERoEI stands for Energy Return on Energy Invested and is a concept borrowed from ecology to describe the efficiency of energy gathering systems.

ERoEI = energy acquired (energy return) / energy used (energy invested)

The concept is not universally used or accepted. We happen to believe it is of central and vital importance. Industrial society runs on net energy. When ERoEI falls below the range 7 to 10, there is insufficient net energy to run society as we know it.

Net Energy = ERoEI - 1

The ERoEI of a KiteGen stem is worked out by calculating how much energy is used to produce the machine (energy invested) and this is compared with the energy that the machine will produce over its life time (energy return).

Assumptions

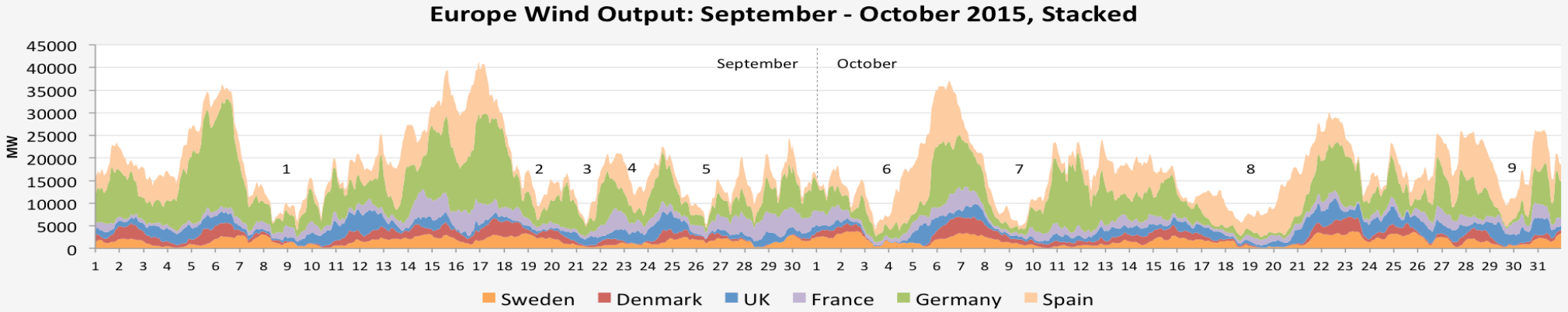
Capacity factor = 0.54 Lifespan = 20 years Power = 3 MW Mass of superstructure = 20 tonnes
Energy intensity of materials 40 MWh / tonne

Energy produced during lifetime =
3*24*365.25*20*0.54 = 284,018 MWh

Energy required to create and to maintain machine = 20 tonnes * 40 MWh / tonne = 800 MWh

ERoEI = 284,018 MWh / 800 MWh = 355

The trouble with wind turbines



The chart shows actual wind power production for continental Europe during September and October 2015. 9 episodes of low output (lulls) are numbered. At present the power requirement during the lulls is being met from coal and gas. But both coal and gas generators are losing market share (i.e. money) while being asked to provide higher grid services. These traditional utilities upon which we are still 100% dependent are being driven out of business.

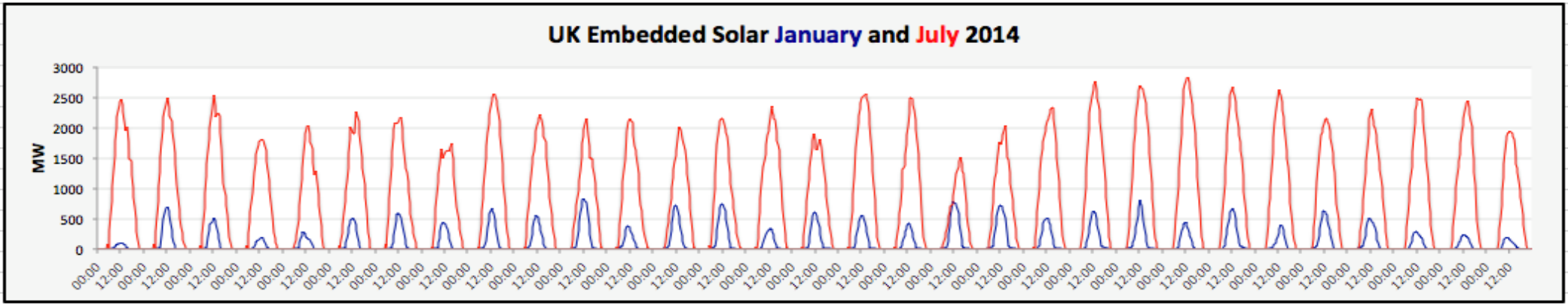
There is much talk about solving the intermittency issue by building interconnectors. These will solve nothing at times of pan-European calm.

The other popular proposal is to store surpluses for use at times of shortage. We can forget batteries and pumped storage hydro since neither are scalable or affordable.

The only energy storage strategy that might work is chemical storage, i.e. hydrogen, ammonia or synfuel. But the trouble here is that making a chemical store and converting back to electricity, about 70% of the energy is lost.

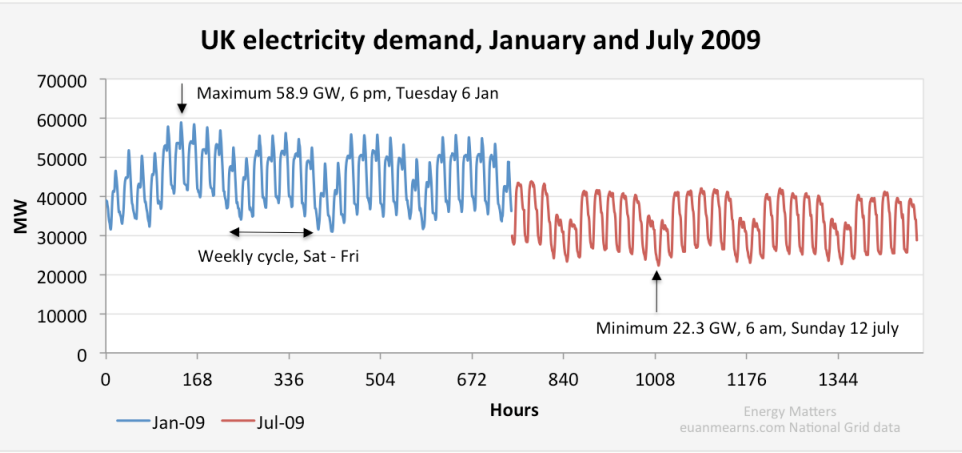
KiteGen has no intermittency issues due to the more constant nature of high altitude and the lower nominal wind speed. Furthermore, we can afford to waste **some of the cheap electricity** to create dispatchable power via chemical stores.

The trouble with Solar PV



The chart above shows UK solar production for January and July 2014. The daily peaks show that output in summer is roughly four times the output in winter. That is because the days are longer, the sun gets higher in the sky and there is less cloud. In the winter time the sun has set by 6 pm, the time of highest demand and solar output is zero.

The chart right shows the pattern of UK electricity demand. Demand is always higher in winter when solar output is at its lowest and peaks each week day at around 6 pm when The Sun has set.



The load factor for UK solar is around 10%. At that level, it is unlikely the panels will ever recoup the energy used in their construction (in China) (ERoEI<1). This technology is effectively proven to fail at high latitude, and yet continues to enjoy €billions in consumer paid subsidy.

Comparison: KiteGen Stem Vs conventional turbines

Overview of Relevant Factors

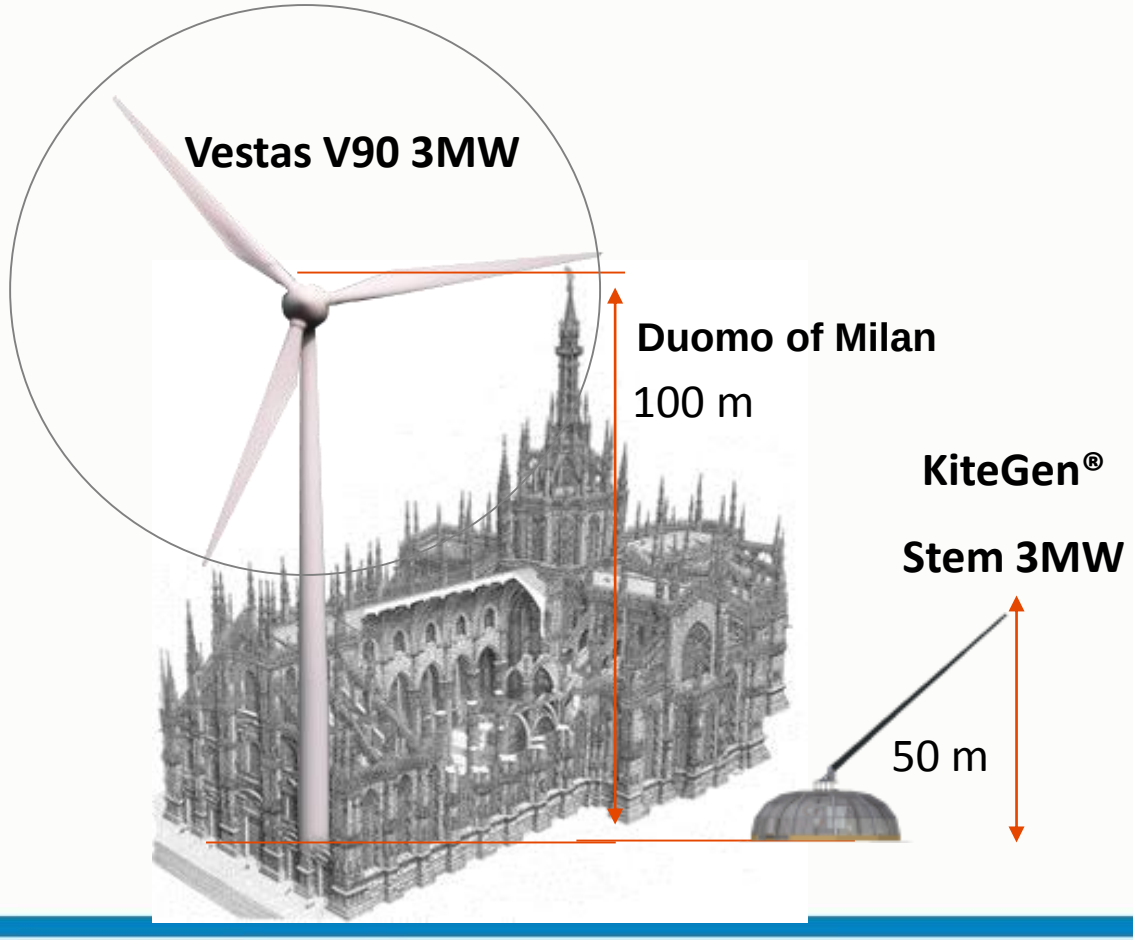
Among other factors, the relevant ones are dimensions, masses, logistics, disposal, environmental impact, capacity factor, territorial energy density, site properties, levelized costs of energy, intermittence and EROEI, as shown in the table below:

	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 blade diameter)
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)	11**-30*	90-150

* Advanced technology learning curve

** Advanced economical learning curve

Dimensions



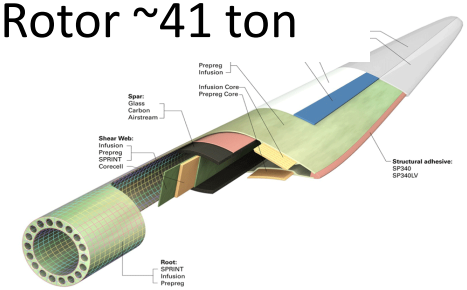
- High altitude wind remains out of the reach of current and the future's aero-generating towers, already more than 100m high. Above a certain height the structure that holds up the rotors becomes exponentially heavier, more unstable, and above all more costly
- The relatively higher wind availability 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 Comparison

Conventional turbines

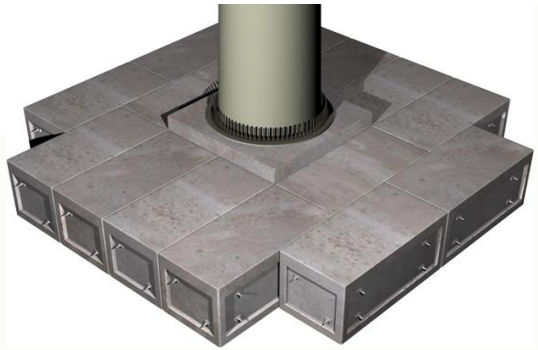
Nacelle ~70 ton

Rotor ~41 ton



Tower ~ 285 ton

Foundation ~1000 ton



TOT ~ 1400 ton

KiteGen Stem 3MW

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

Igloo + Stem ~12 ton

Foundation < 10 ton

TOT ~ 22 ton

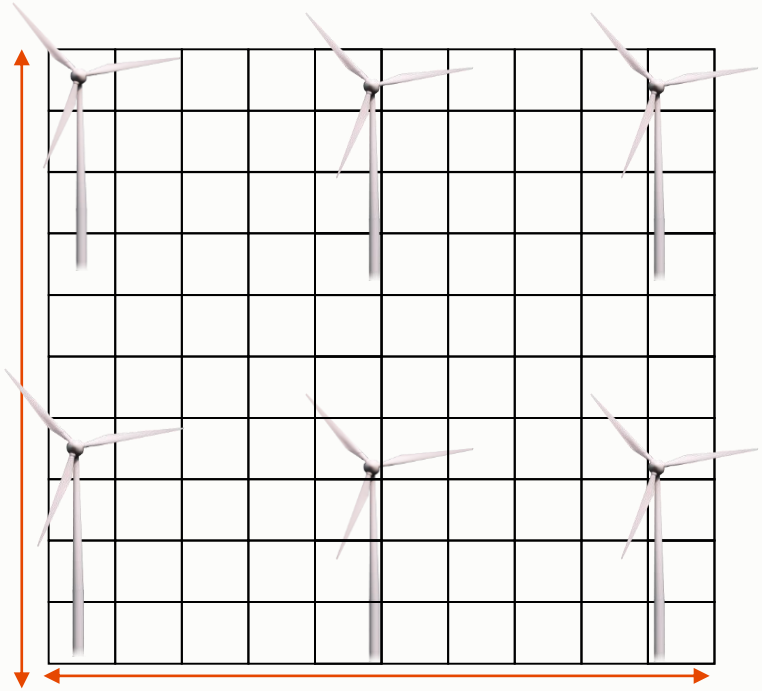
Troposphere Wind Farm Concept (1)

Each wing fly inside a cone of pertinence and is actively controlled with an overall position error of max 10m in the airspace.
The position control accuracy is wind independent

Troposphere Wind Farm Concept (2)

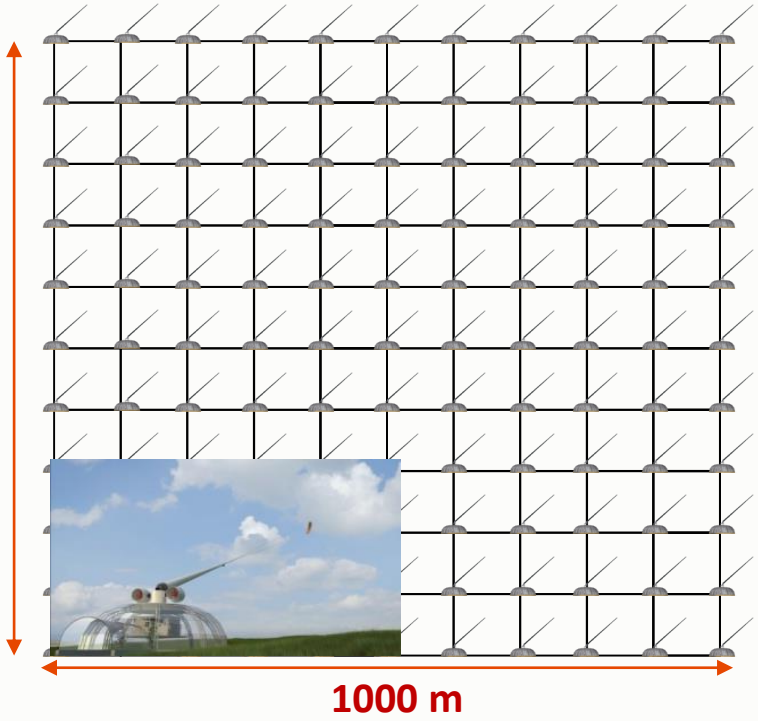
6 wind turbines x 3 MW

18 MW/Km^2

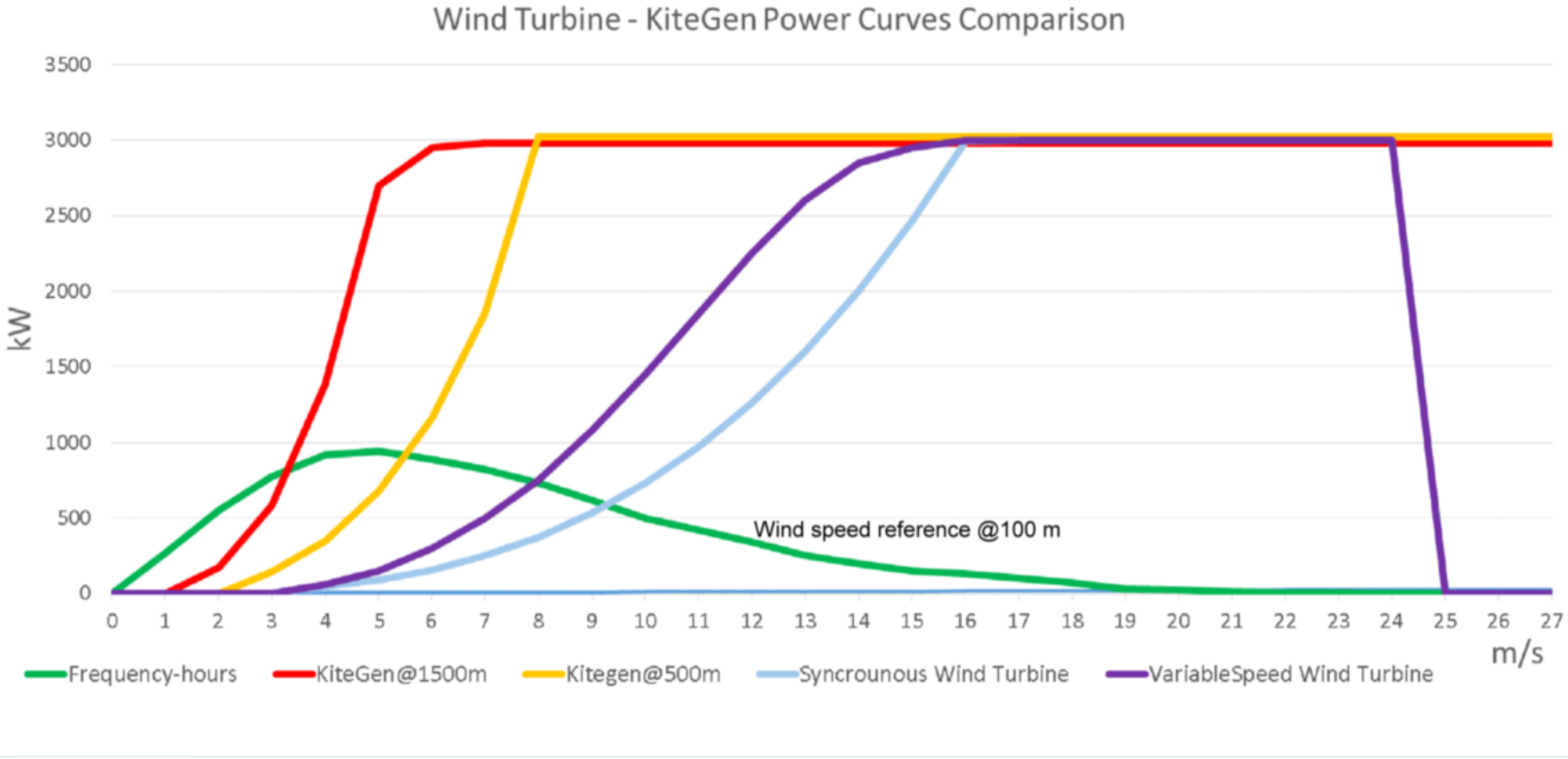


121 KiteGen STEM x 3MW

Density **250** MW/Km^2



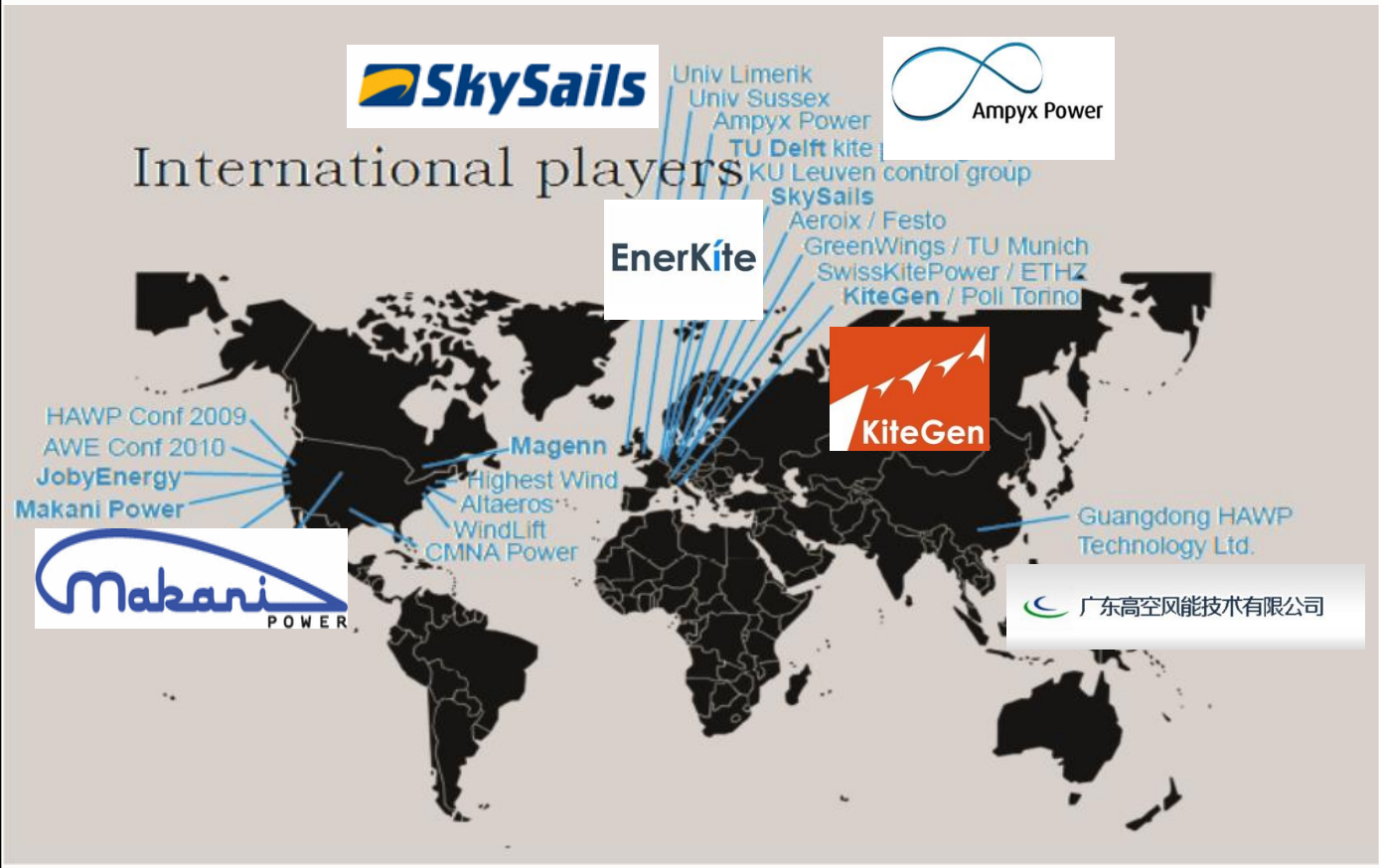
Performance of the concept



Competitors

Huge and growing interest

MAIN PLAYERS:



SOME INVESTORS:

MITSUBISHI HEAVY INDUSTRIES, LTD.
Google
سابك
sabic
BOEING
ALSTOM
ZEPPELIN Power Systems
CAT
Oltmann Gruppe
DSM
BRIGHT SCIENCE. BRIGHTER LIVING.
FESTO
SoftBank

[Holding Company]

KiteGenVenture

[Patents holder]

KiteGen

Competitors: Flygen vs Groundgen

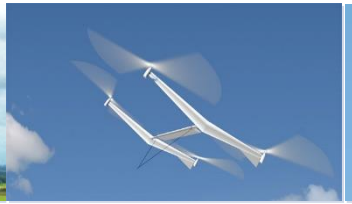
KiteGen has numerous competitors globally. Competitors can be divided into two main classes. Those with ground-based generators like KiteGen and those with airborne generators like Google X Makani. KiteGen was an early mover in this field and surveyed the technology options at an early stage and went on to patent the key components of a kite based, two cable, ground based generator system. Air borne generators will work but are considered inferior in many ways to ground based generation. Owing to our patent cover, other air borne concepts are being driven in sub-optimal directions. **We consider that KiteGen is 4 to 5 years ahead of nearest ground based generator rivals.**

MAKANI

KPS KITE POWER SOLUTIONS

KitePower

The competitive scenario

Makani Power USA	Altaeros USA	X-Wind GERMANY	Sky Wind Power GERMANY	Ampyx Power NETHERLANDS	Sky Sails GERMANY
					
FlyGen concept. Generator on board. The tether carries energy from the kite to the grid, connecting it to the ground station.	Tethered airborne platforms designed to lift a lightweight wind turbine up to 600m above ground.	Combines automatically steered kites, grounded rail systems and cable car technology on linear or circular track.	Flying electric generator with rotors that both lift the vehicle and convert the kinetic energy into electricity.	PowerPlanes flying repetitive cross-wind patterns, attached with a cable to a ground-based generator.	Ship traction using crosswind power. Traction power-kite with flying actuators.
30 kW protoype. Recently shifted from flexible to rigid airfoils.	First funcional BAT prototype launched in 2012. The company is claiming to work on the first commercial scale BAT.	A 400m linear test track is in operation since 2011. Closed loop prototype is under construction.	Small prototype tested in December 2011 flying with additional safety tethers through a limited range of the required manoeuvres.	10 kW scale prototype with rigid airfoils.	50 kW prototype already sold to pilot customers.
DRAWBACKS*: -Conducting tethering cables instead of insulating ropes as in KiteGen. - Harnessing propellers whch add drag thus limiting the aerodynamic efficiency of the system. - Risk of total investment loss should a crash occur	DRAWBACKS*: - Need of helium (non renewable source). - The trigonometric ratio between bouyancy force and wind drag vectors excludes them from the category of troporspheric wind.	DRAWBACKS*: - No relevant patent coverage, they patented a blimps rail generator. - Rail concept presumably developed in infringment with our KiteGen Carousel patent.	DRAWBACKS*: - Conducting tethering cables - Heavy structure suitable for jet streams exploitation only.	DRAWBACKS*: - No patent coverage - Lack of scalability due to the flat wing that require an heavy longeron to sustain the wind force.	DRAWBACKS*: Patent coverage for ship traction but not for energy production.

* According to KiteGen point of view. Benchmarking reports are available on request.

[Holding Company]

[Patents holder]

Business plan and Economics

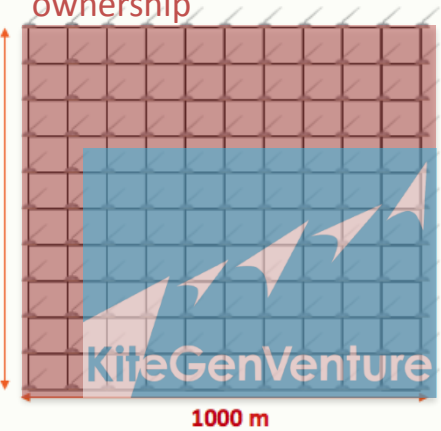
Business plan

KiteGen is on the cusp of changing from an R&D company to one where manufacturing and electricity sales will dominate our activity.

Supply chain with xx partner companies manufacturing components

KiteGenVenture

Third party investors including community ownership



System assembly, deployment, commissioning, operational guidance and servicing. On-going R&D for KiteGen stem optimisation and other products.

KiteGen may take shares in KiteSwarm generating plant always retaining a controlling interest,

Electricity sales to grid

KiteGenVenture [Holding Company]

[Patents holder] KiteGen

Let us dare to imagine

According to the BP statistical review of world energy 2016, global electricity production in 2015 was 24,098 TWh.

Let us dare to imagine that KiteGen can produce dispatchable unsubsidized energy at 30€/MWh LCOE and it becomes the clean electricity generation platform of choice starting to displace other energy sources ....
Let us dare to imagine that in a number of years KiteGen captures just 1% of that market, i.e. 241 TWh / y. Let us assume €50 / MWh average market price. That gives an electricity generation market value of €12 billion per year that KiteGen may potentially target.
So how many KiteGen stem machines would this take to service? A single 3 MW KiteGen working at 54% capacity will produce:

3*24*365*0.54 = 14.2 GWh / year

241 TWh / 14.2 GWh = 16,972 machines

with a selling price of €2.5 million each = €42.4 billion from machine sales.
There is no doubt that this is an exciting market to engage with.

Now let us dare to imagine that KiteGen can sell dispatchable, unsubsidised electricity at €30 / MWh and that it becomes the clean electricity generating platform of choice.....

Cost of energy and LCOE

Number of cumulative installations	2	4	6	20	50	500	5000	50000
Industrial cost of a 3MW unit €	10,000,000	7,500,000	2,857,143	1,650,000	500,000	500,000	500,000	500,000
Annual production MWh/MW	600	1,000	1,400	1,800	2,200	3500	5000	7000
Primary energy saved MWh/MW	1,258	2,096	2,935	3,774	4,612	7,338	10,482	14,675
% Interest Rate	3%	3%	3%	3%	3%	3%	3%	3%
Plant lifetime	25	25	25	25	25	25	25	25
% tax	0%	0%	40%	40%	40%	40%	40%	40%
Depreciation (% of CAPEX)	30%	40%	50%	60%	70%	80%	90%	90%
Number of years to depreciate	9	9	9	9	9	9	9	9
Yearly insurance cost (% of CAPEX)	3%	3%	3%	3%	3%	3%	3%	3%
Yearly O&M (% of CAPEX)	5%	5%	5%	5%	5%	4%	4%	4%
Variable cost of consumable parts €/MWh	2.00	2.00	1.90	1.90	1.80	1.80	1.8	1.8
Yearly cost of CAPEX %	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%
cost €/MWh (IEA methodology)	764.75	345.57	121.26	55.51	15.09	9.68	7.31	5.74

Number of cumulative installations	2	4	6	20	50	500	5000	50000
Industrial cost €/MW	3,300,000	2,500,000	952,381	550,000	165,000	165,000	165,000	165,000
Annual production MWh/MW	600	1,000	1,400	1,800	2,200	3,500	5,000	7,000
Primary energy saved MWh/MW	1,258	2,096	2,935	3,774	4,612	7,338	10,482	14,675
% Interest Rate	3%	3%	3%	3%	3%	3%	3%	3%
Plant lifetime	25	25	25	25	25	25	25	25
Yearly O&M (% of CAPEX)	7%	7%	7%	7%	7%	7%	7%	7%
Variable cost of consumable parts €/MWh	2.00	2.00	1.90	1.90	1.80	1.80	1.80	1.80
Yearly cost of CAPEX %	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%	5.74%
LEC €/MWh (NREL methodology)	702.85	320.57	88.59	40.84	11.36	7.81	6.01	4.80

Note that relatively few machines production allows a short technological learning curve and will bring the LCOE to un unprecedented low figure unreachable by all other energy conversion technologies.

Payback times in top 10 countries

Indicative numbers of years for kite swarm payback in top 10 countries				technology maturity (MWh/MW)				
Country	market volume (TWh)	on grid energy purchase prices €/MWh (2016)	market type	1800	2200	3500	5000	7000
China	4,921	60	state regulated (wind on grid tariffs)	23	6	4	3	2.5
United States	3,848	26-50	free regional markets	-	11.5	7.5	5.5	4.5
India	1,027	41	free market	-	9	6	4.5	3.5
Japan	921	60	free market	23	6	4	3	2.5
Russia	870	13-20	free regional markets	-	22	15	10.5	9
Germany	521	30	free market	-	12.5	8.5	6	5
Brazil	514	65-70	state regulated (wind ppa)	20.5	5.5	4	3	2
South Korea	505	55	state owned (wind ppa)	25	7	4.5	3	2.5
Canada	493	13-20	free regional markets	-	22	15	10.5	9
France	437	27	free market	-	14	9	6.5	5.5
United Kingdom	312	49	free market	-	7.5	5	3.5	3
Italy	294	50	free market	-	7.5	5	3.5	3

Indicative payback time for a KiteSwarm generating plant in selected countries. Assuming the average day-ahead market price of 2015 for countries with free electricity exchanges and the power purchase agreement tariff for wind in other countries

Financials (1)

Description of the simplified balance sheet for the batch production of machines (next slide):

- The machine selling price projection is based on the actual productivity of the generator (MWh/MW) that is foreseen to start with low values.
- The feasible technical productivity level of 6800 MWh/MW is foreseen to be reached when a critical numbers of installed machines allows the economic and technological learning curve.
- Note that the projected IRR for the investor is targeted at less than one third of the envisaged productivity rate
- The machine projected production cost is based on real market surveys provided by our supply chain on the basis of the scale (discounts on number of items to be produced). The cost evaluation reached the best maturity as several prototypes at industrial scale were already done.
- The easy logistic (generator units lower than 20 tons) allows doubling each year the machine production as in the projection.
- One of the factors helping high revenues is that the commercial structure costs are negligible, having available hundred deployers looking for novel and rentable RES.
- Though the astounding IRR is appropriate for balancing a high-risk investment, a proper technical due diligence can easily show that the most of the perceived technical risk of the project has been mitigated by careful design and methodology for validation. We are aware that is a cost a new concept with the highest potential like KG has to pay.

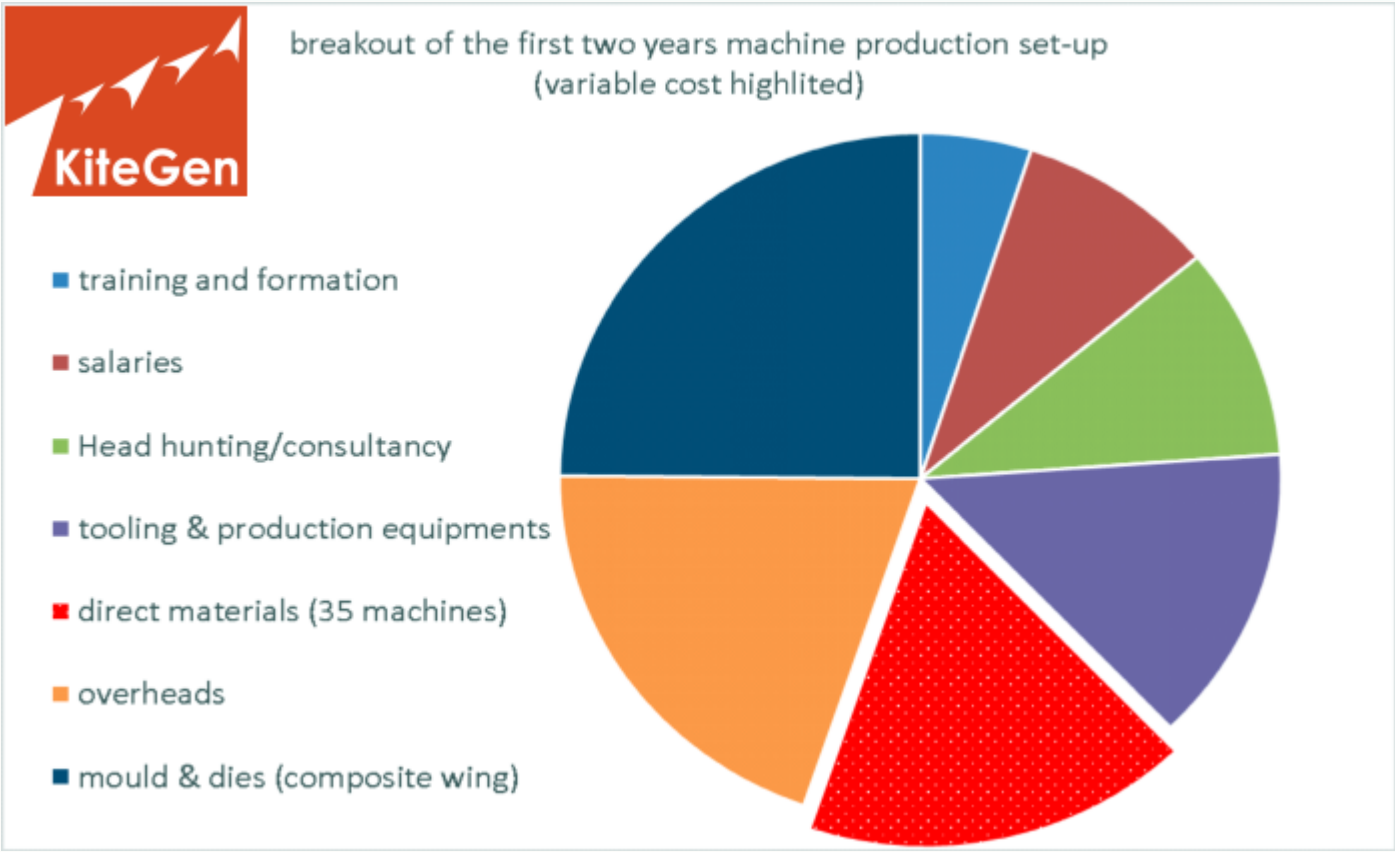
Financials (2) Simplified NPV balance sheet

KiteGen machines: production and selling balance sheet, model KG-Stem 3MW troposphere wind power generator								
The 4 years cash flow could be fully reserved to the the investors								
	€ x 1000	Already Contracted		Investment required		Bank loan interest + overheads		
	Year	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7
Data	Machine Availability (hours/year)	0	340	1700	2000	3000	5000	6800
	Machine selling price (unit)	N.A.	€ 600	€ 1,632	€ 1,920	€ 2,880	€ 4,800	€ 6,528
	Machine production Cost (unit)	€ 10,000	€ 2,000	€ 1,800	€ 1,000	€ 800	€ 700	€ 600
	Number Produced/Sold Machines	5	30	200	500	1000	2000	4000
Incomes	Selling Machines (Total €/year)	€ 0	€ 18,000	€ 326,400	€ 960,000	€ 2,880,000	€ 9,600,000	€ 26,112,000
Costs	production cost (Total €/year)	-€ 50,000	-€ 60,000	-€ 252,000	-€ 350,000	-€ 560,000	-€ 980,000	-€ 1,680,000
Cash	cash flow machine selling activity	-€ 50,000	-€ 42,000	€ 74,400	€ 610,000	€ 2,320,000	€ 8,620,000	€ 24,432,000
	IRR selling machines @ 4th year	124%						

Key features:

- Conservative growth in machine sales
- Low availability anticipated in early years as teething problems solved
- Reliability improves with time (availablity)
- Selling price geared to reliability
- Total investment of €92 million (years 1 and 2)
- Machine production is used as a proxy for investment in years 1 and 2
- See next slide for detailed breakdown of investment in years 1 and 2

Financials (3) Details of investment years 1 and 2



The main cost is related to the realization of series of molds for the wing.
Overheads include the patents maintenance and the legal assistance for the management of the supply chain contracts, the logistic needed for the Campus wind farm foreseen in Giaveno (near Turin) with 12 machines installed

Note that of the total investment of €92 million in years 1 and 2 only a small portion actually goes to machine manufacture. The majority of the investment is on production facilities, recruitment, training and personnel.

SWOT (1) Strengths

Strengths

- First mover in the field of high altitude wind power, early selection of what was, and still is, viewed as the most viable technology option, i.e. high altitude PowerWing kites.
- Development of several prototype kite power systems leading to the acquisition of about 40 international patents, some of which are crucial to the development of this family of technologies.
- In house expertise to tackle and solve all mechanical, technical and design challenges from aeronautics, power electronics, system control electronics and software and writing flight simulation code.
- Low cost power generation with very high energy return will enable subsidy free and affordable renewable electricity for all.
- System developed to technology readiness level 8.
- Validated final design and procedure for building and operating 3MW machines
- Comprehensive plan in the area of problem solving and decision making, positive reinforcement, motivation to build the suitable leading staff and team.

SWOT (2) Strenght - Weaknesses

Strengths (continue)

- More constant wind at altitude combined with kite control and on site energy storage may substantially solve the intermittent production problems associated with other forms of renewable electricity generation.
- While many of our competitors place their expensive generating kit up in the sky the KiteGen generating kit is on the ground.
- Years ahead of closest competitors to commercial power generation.
- Comprehensive 2 year plan to start the operations and the auto sustain of the learning curve
- Appears in Bill Gates' top 8 clean technologies to watch as reported in National Geographic.

Weaknesses

- Currently under capitalized and under resourced to take the technology to TRL 9.
- Problem recruiting, training and retaining suitably qualified and competent engineers.
- Securing reliable supply chain partners to provide high performance materials and equipment.
- Widespread lack of awareness about the energy problem and its dimension

SWOT (3) Opportunities

Opportunities for investors to:

- Participate in an energy generation technology that may substantially solve global problems of energy scarcity, energy security and unsustainable CO2 emissions.
- Participate in maturing this technology to the level where it becomes a multi-billion dollar business.
- Successful development of abundant and cheap electricity will provide many opportunities in other areas of the energy arena, for example in the manufacture of synthetic fuels for motor vehicles and of energy carriers like hydrogen to further address renewable electricity intermittency and dispatch.

Opportunities for National Governments and Industry to:

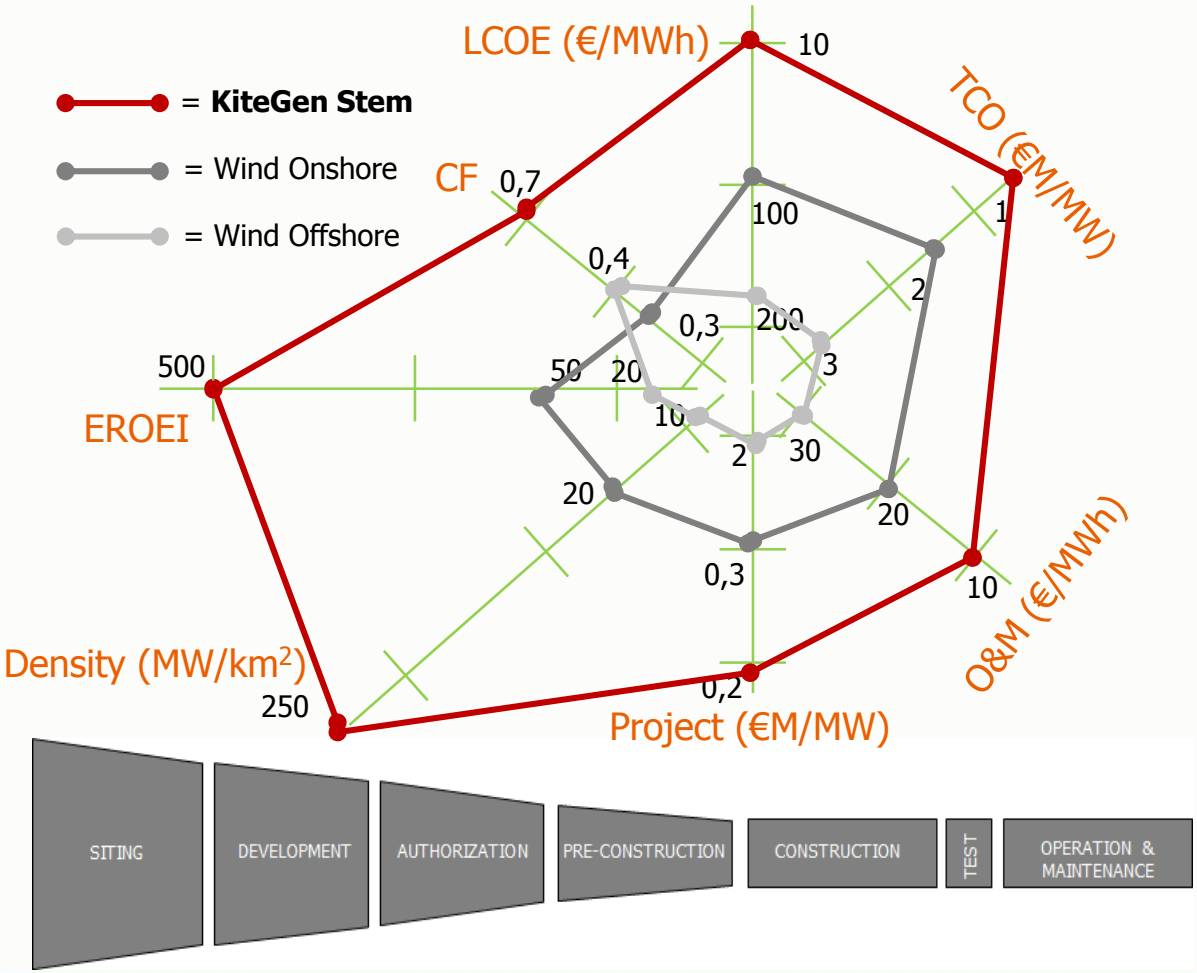
- Meet legally binding CO2 reduction targets.
- Develop cheap indigenous energy supplies that may provide tax revenues as opposed to the current subsidy drain.

SWOT (4) Threats

Threats

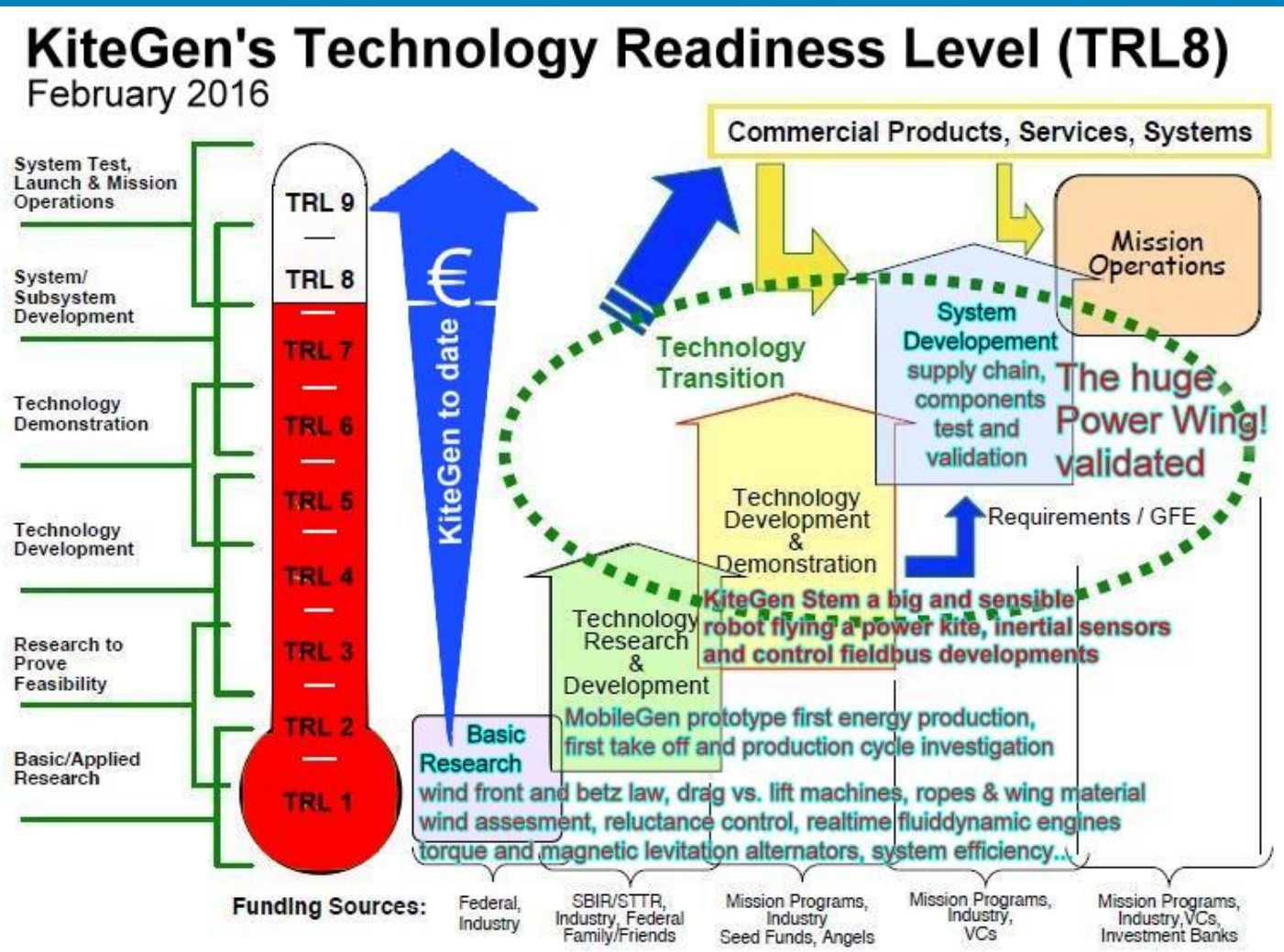
- Investors complain about the wide and ubiquitarian source of energy, that limit the owner's hegemony
- Competitor infringement of KiteGen patents.
- Dependent upon OECD governments granting consent for high altitude flight.

Product services and positioning



- **Sector**: renewable energy, high wind power
- **Product offered**: high wind farm shares
- **Services**: from feasibility study to farm management
- **Customers**: power producers, utilities, energy intensive industries (metal smelting, concrete production, refinery, etc)
- **Competitive positioning**: cost of energy competitive with traditional sources, equivalent initial investment respect current wind, lower operations costs, almost no limitations on siting, much easier logistics and delivery, smaller ground footprint
- **Product structure**: high wind farm composed of new KiteGen Stem generators
- **Strategic activities:** farms development, partnerships, participation portfolio, addressing R&D investments into new KiteGen® by-products or synergic technologies

TRL of KiteGen



KiteGen is a brand new concept indeed.
It was early obvious to the proponents both the challenge and the ineluctability of this paramount development.
Leading to the mission to investigate and solve all the technological problems impeding the exploitation of the biggest energy resource available to the humankind. To date the KiteGen scientists and technicians are depositary of an unprecedented knowledge and experience ready to drive the mass production and the deployment of such new energy presidium.

A Thermodynamic Solar Power Plant vs. A KiteGen Farm: Capital Cost – Apples to Apples

Here is a simple example that illustrates a solar technology in competition with KiteGen power plants. Let's suppose that a power company is planning to install a power plant and wants to implement it with a new and **economically unproven** energy harnessing concept. Furthermore, let's assume that the plant to be built in Morocco. The options for the new plant are KiteGen and thermodynamic solar. The company wants a simple, ball-park analysis of the front-end cost to build each of these options.

The requirements:

1. Electricity demand on this facility is 4,800 MWh/day, about the demand for a community of 700,000 average households of Morocco.
2. The "up time" of both plants must be equal. That is, both must be equally reliable and produce the demand for the same fraction of time over the course of one year.

Assumptions:

1. The thermodynamic solar plant will consist of a mirrored solar collectors, molten salt, and heat accumulator. The system will harness enough during the day to produce the necessary output at night.
2. Night time demand equals day time demand.
3. The new plant will be built in Morocco, a good spot for a solar plant

Economics-Apples to Apples (1)

Capital cost to generate energy	Termodynamic	KiteGen
Electricity Demand **(MWh/day)**	**4800**	**4800**
The net capacity to generate this load is the daily demand/ 24 hours – **Net capacity (MW)**	**200**	**200**
The capacity factor of a power plant is the ratio of its actual output over a period of time to its potential output if it were possible for it to operate at full nameplate capacity continuosly over the same period of time – **Capacity Factor**	**0.3**	***0.75**
The gross capacity to achieve this net capacity is the net capacity / the capacity factor of each option – **Gross Capacity Required(MW)**	**700**	**250**
The upfront cost to build a power plant of this gross capacity, or capital cost, **(€million/MW)**	**7.76**	**0.6**
Total Capital Cost **(€millions)**	**5432**	**150**
Total Capital Cost Including Storage **(€million)**	***9000**	****150**

Economics-Apples to Apples (2)

25 year operation	Termodynamic	KiteGen
A) Capex no interest rate **(€/MWh)**	**390**	**4,8**
B) Maintenance/OPEX based on 5% of the Capex/year **(€/MWh)**	**513**	**5.7**
(A+B) LCOE **(€/MWh)**	**900**	**11**
The Life Cycle Analysis could be inferred by the economics of the projects, the solar thermodynamic one is very capital intensive and almost the full investment both Capex and Opex is directly converted in the current mix of energy needed to build and maintain the plants, implying the consequent carbon emissions. An ERoEI value less than 2 means external energetic subsidy required **(Autopoietic ERoEI)**	**0.02**	**500**
Taking care of climate and the antropogenetic CO2, each human activity imply emissions in the atmosphere, KiteGen LCA expose negative emissions potential **(CO2tons/MWh)**	**70**	**-1.2**

* 1500m AGL limit, higher altitudes limits allows better CF

** energy sources with good CF, inherntly solve the storage issue with the conventional grid interconnections: http://www.kitegen.com/en/2016/03/30/spain-2015-lets-replace-turbines-with-kitegen/

Economics-Apples to Apples (3)

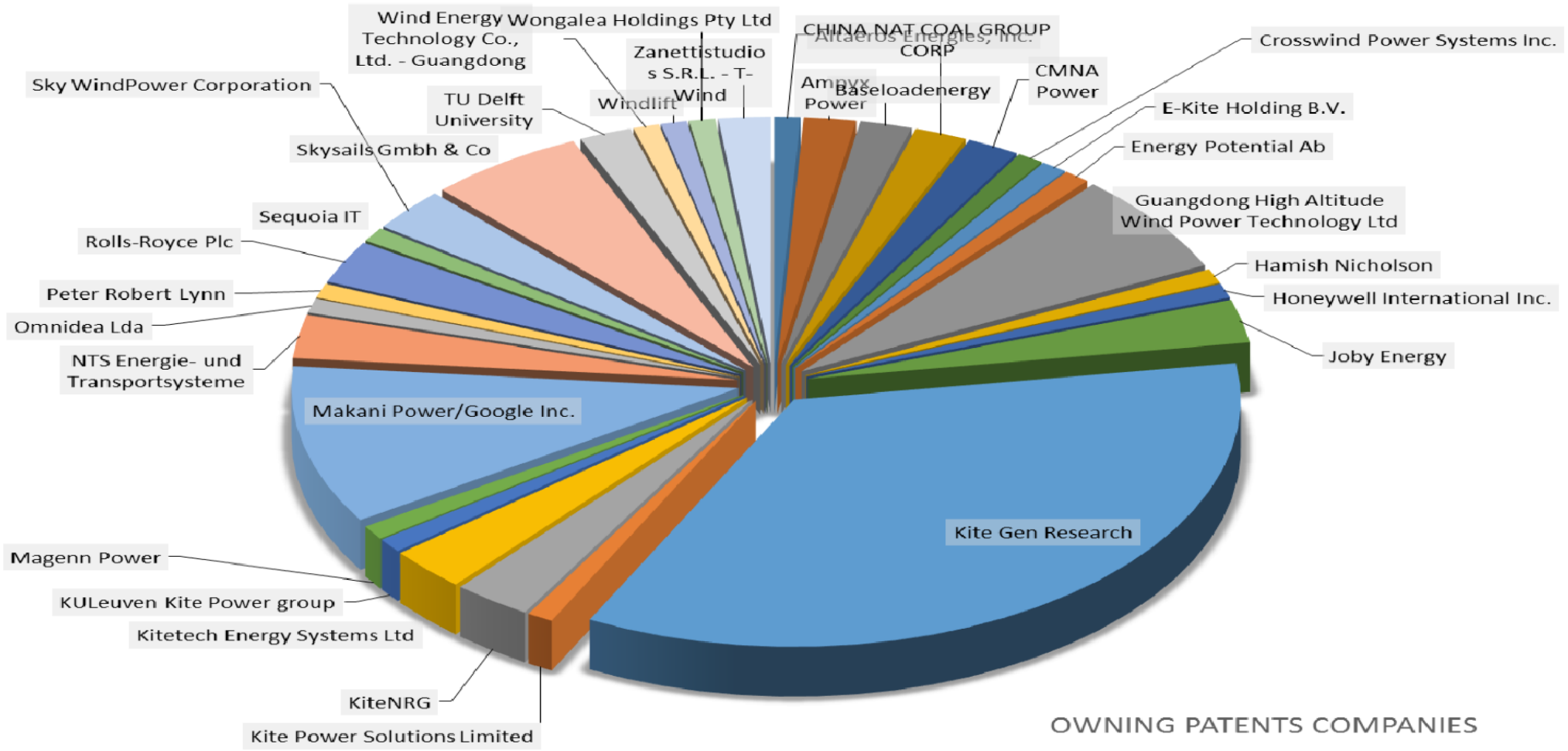
***The data adopted comes from the real thermodynamic solar plant project partially (2016) built in Morocco the Ouarzazate with the support of the European Bank of Investment and the World Bank.
According to the energy analysis all those projects, as the lessons learnt about events around Abengoa, Ivanpah , Archimede, are all doomed to bankruptcy.

Economics-Apples to Apples conclusion

This back-of-the-envelope analysis suggests that a solar power plant that could deliver that same results as a KiteGen Farm would cost about 45 times to build and 37 times to operate. It is worth noting that the solar option cost excludes any subsidies, investment tax credits, etc., that could narrow the range, but it is obvious from this little exercise that with solar technology there is no chance that it will be sustainable, this policy misunderstanding was clearly foreseeable since the early start the KiteGen project thus our focus on it.
The involved banks exposed their self to critics about the energetic (emergy) unaware investment, and in the next future will be charged by the responsibility to have supported projects that emit much more CO2 in atmosphere than the electrical conversion of fossil fuel energy itself, this could assume incurring in lawsuit due the recent introduction of specific rules with penal effects about environmental disasters.

Appendix: KiteGen Patents

Intellectual Property Scenario



KiteGen Research Patents

Much of the current value of KiteGen lies in its extensive suit of patents. These cover not only the KiteGen Stem but other products. The patent catalogue is always being added to, updated and extended. There are about 40 key patents covering the KiteGen Stem that are registered in over 50 countries. KiteGen currently spends almost €1 million / year maintaining its patent catalogue.

The following pages provide some details of key patents and lists of the 40 key patents.

KiteGen Research Key Patents (1)

KiteGen have a total of 40 patents linked to high altitude wind power. Many of these are evolutions or additions to the core patented technology. Here are examples of 5 key patents. KiteGen patents are held in subsidiary company KiteGen Research.

Patent no: 4028646, first filed March 2004, Vertical axis wind turbine with control system steering kites

Renewable energy production from wind source by exploiting kites or airfoils through an automatic management and steering control. The kite (12) or airfoil automatic steering via cables (11) allows to manoeuvre the kite in different combinations of troposphere altitudes and directions, obtaining full power traction phases in specific direction, phases of stall with rewinding, and gliding phases even against the wind. The traction and the active mechanical energy are transferred to a carousel generator (18,19). The automatic steering logic is realized through the interface of servo actuators and sensors elements on the kites. Sensor information is continually updated to perform the decision-making and feedback control on the kite attitude and position in order to obtain precise and reliable manoeuvring

Patent no WO 2007122650, first filed 24 April 2006, AEOLIAN SYSTEM COMPRISING POWER WING PROFILES AND PROCESS FOR PRODUCING ELECTRIC ENERGY

An aeolian system is described for converting energ comprising at least one **power wing profile** (30) which can be driven from the ground immersed in at least one aeolian current (W) and a basic platform (1) for controlling the wing profile (30) and **generating electric energy placed at ground level** and connected through **two ropes** (2) to the power wing profile (30), such basic platform (1) being adapted to drive the wing profile (30) and to generate electric energy, **such two ropes (2) being adapted to transmit forces from and to the wing profile (30) and to be used both for controlling a flight trajectory of the wing profile (30) and for generating energy**. A process is further described for producing electric energy through such aeolian system.

KiteGen Research Key Patents (2)

Patent no: WO2007129341, first filed 10 May 2006, SYSTEM AND PROCESS FOR AUTOMATICALL Y CONTROLLING THE FLIGHT OF POWER WING AIRFOILS

A system (1) is described for automatically controlling the flight of at least one power wing airfoil (2) , comprising first detecting means (3) on board of such power wing airfoil (2) adapted to detect first pieces of information (3a) dealing with at least one position and one orientation in space of the power wing airfoil (2) and accelerations to which the power wing airfoil (2) is subjected; second detecting means (5) on the ground adapted to detect tension on the driving cables (21) of the power wing airfoil (2) and a position of a driving unit (9) counterweight; processing and controlling means (7) adapted to transform the contents of such information (3a, 5a) into a mechanical drive operating on the winches of the driving unit (9) to drive the power wing airfoil (2) along a flight trajectory TVl, TV2 , TV3, ..., TVn maximising a 'lift' effect generated on the power wing airfoil (2) . A process is further described for automatically controlling the flight of at least one power wing airfoil (2) through the system (1)

Patent no: 13002498.7DIV1, first filed 13 June 2007, Wind system for converting Energy through a vertical- axis turbine actuated by means of kites and process for producing electric energy through such system

A wind system for converting energy is disclosed, comprising: at least one kite (1) that can be driven from ground, immersed in at least one wind current W; a vertical- axis wind turbine (2) placed at ground level, **the wind turbine (2) being equipped with at least one arm (3) connected through two ropes** (4) to the kite (1), the kite (1) being adapted to be driven through the turbine (2) to rotate the arm (3) and perform the conversion of wind energy into electric energy through at least one generator/motor system (15a, 15b) operating as generator and cooperating with the turbine (2), the ropes (4) being adapted both to transmit mechanical energy from and to the kites (1) and to control a flight trajectory of the kites (1); each one of the arms (3) of the wind turbine (2) is supported through at least one supporting system (5a, 5b).

Patent no: PCT/IT2009/000260 , first filed 12 June 2009, FLOATING OFFSHORE KITE POWERED GENERATOR

An offshore infrastructure for tropospheric aeolian generator is described, which comprises at least one floating platform (1) able to host a tropospheric aeolian generator (2) driven by tethered kites (3) and at least one mooring line (5) anchored to a sea bottom through at least one sinker (6)

Kite Gen Research
SOA -Brevetti 2014 08

N. PROGR.	TITOLO	PAESE	N. DEPOSITO	N. BREVETTO	DATA DEPOSITO	LINK
1	AEOLIAN SYSTEM COMPRISING POWER WING PROFILES AND PROCESS FOR PRODUCING ELECTRIC ENERGY	EUROPEO	EP06745301.9	EP2010783	24/04/2006	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/1 - AEOLYAN SYSTEM COMPRISING POWER WING PROFILES AND PROCESS FOR PRODUCING ELECTRIC ENERGY.pdf
2	A DEVICE FOR THE PRODUCTION OF ELECTRIC ENERGY AND PROCESS FOR THE AUTOMATIC CONTROL OF SAID DEVICE	EUROPEO	EP06756283.5	EP2016284	10/05/2006	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/2 - A DEVICE FOR THE PRODUCTION OF ELECTRIC ENERGY AND PROCESS FOR THE AUTOMATIC CONTROL OF SAID DEVICE.pdf
3	SYSTEM AND PROCESS FOR AUTOMATICALLY CONTROLLING THE FLIGHT OF POWER WING AIRFOILS	INTERNAZIONALE	PCT/IT2006/000343	WO/2007/129341	10/05/2006	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/3 - SYSTEM AND PROCESS FOR AUTOMATICALLY CONTROLLING THE FLIGHT OF POWER WING AIRFOILS.pdf
4	AUTOMATIC CONTROL SYSTEM AND PROCESS FOR THE FLIGHT OF KITES	EUROPEO	EP07736828.0	EP2021624	03/05/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/4 - AUTOMATIC CONTROL SYSTEM AND PROCESS FOR THE FLIGHT OF KITES.pdf
5	SYSTEM FOR PERFORMING THE AUTOMATIC CONTROL OF THE FLIGHT OF KITES	EUROPEO	EP07849771.6	EP2091809	03/05/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/5 - SYSTEM FOR PERFORMING THE AUTOMATIC CONTROL OF THE FLIGHT OF KITES.pdf
6-9	WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM *(TEXT FOR PATENTS 6-7-8-9)*	INTERNAZIONALE	PCT/IT2007/000419	WO/2008/004261	13/06/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/6-9 - WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM.pdf
6	WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM (CLAIMS)	EUROPEO	EP13002498.7	EP2642119	13/06/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/6 - WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM.pdf

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7	WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM (CLAIMS)	EUROPEO	EP13002471.4	EP2642116	13/06/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/7 - WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM.pdf
8	WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM (CLAIMS)	EUROPEO	EP13002472.2	EP2642117	13/06/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/8 - WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM.pdf
9	WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM (CLAIMS)	EUROPEO	EP13002473.0	EP2642118	13/06/2007	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/9 - WIND SYSTEM FOR CONVERTING ENERGY THROUGH A VERTICAL-AXIS TURBINE ACTUATED BY MEANS OF KITES AND PROCESS FOR PRODUCING ELECTRIC ENERGY THROUGH SUCH SYSTEM.pdf
10	WIND ENERGY CONVERTER USING KITES (*TEXT FOR PATENTS 11-12-13-14*)	EUROPEO	EP13002476.3	EP2685091	13/02/2008	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/10 - WIND ENERGY CONVERTER USING KITES.pdf
11	WIND ENERGY CONVERTER USING KITES (CLAIMS)	EUROPEO	EP13002499.5	EP2682600	13/02/2008	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/11 - WIND ENERGY CONVERTER USING KITES.pdf
12	WIND ENERGY CONVERTER USING KITES (CLAIMS)	EUROPEO	EP13002474.8	EP2682598	13/02/2008	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/12 - WIND ENERGY CONVERTER USING KITES.pdf
13	WIND ENERGY CONVERTER USING KITES (CLAIMS)	EUROPEO	EP13002476.3	EP2685091	13/02/2008	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/13 - WIND ENERGY CONVERTER USING KITES.pdf

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14	WIND ENERGY CONVERTER USING KITES (CLAIMS)	EUROPEO	EP13002475.5	EP2682599	13/02/2008	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/14 - WIND ENERGY CONVERTER USING KITES.pdf
15	CONVERTITORE DI ENERGIA EOLICA MEDIANTE PROFILI ALARI DI POTENZA	EUROPEO	8720237.0		13/02/2008	www.kitegen.com/II - Proprieta intellettuale/patents/15 - CONVERTITORE DI ENERGIA EOLICA MEDIANTE PROFILI ALARI DI POTENZA.pdf
16	INFRASTRUCTURE FOR DRIVING AND ASSISTED TAKE-OFF OF AIRFOILS FOR TROPOSPHERIC AEOLIAN GENERATOR	EUROPEO	EP 2281117		29/05/2009	www.kitegen.com/II - Proprieta intellettuale/patents/16 - INFRASTRUCTURE FOR DRIVING AND ASSISTED TAKE-OFF OF AIRFOILS FOR TROPOSPHERIC AEOLIAN GENERATOR.pdf
17	AEOLIAN SYSTEM FOR CONVERTING ENERGY THROUGH POWER WING AIRFOILS	EUROPEO	EP11009044.6	EP2463516	15/11/2011	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/17 - AEOLIAN SYSTEM FOR CONVERTING ENERGY THROUGH POWER WING AIRFOILS.pdf
18	PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA	ITALIA	TO2013A000322	DA ASSEGNARE	22/04/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/18 - PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA.pdf
19	PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA	ITALIA	TO2013A000323	DA ASSEGNARE	22/04/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/19 - PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA.pdf
20	PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA	ITALIA	TO2013A000365	DA ASSEGNARE	07/05/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/20 - PULEGGIA PERFEZIONATA PER VERRICELLO AD ALTA EFFICIENZA.pdf

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21	SISTEMA E PROCEDIMENTO DI MESSA IN VOLO DI PROFILI ALARI DI POTENZA, IN PARTICOLARE PER GENERATORE EOLICO	ITALIA	TO2013A000480	DA ASSEGNARE	12/06/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/21 - SISTEMA E PROCEDIMENTO DI MESSA IN VOLO DI PROFILI ALARI DI POTENZA, IN PARTICOLARE PER GENERATORE EOLICO.pdf
22	ALA A FUNZIONAMENTO BIMODALE	ITALIA	TO2013A000481	DA ASSEGNARE	12/06/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/22 - ALA A FUNZIONAMENTO BIMODALE.pdf
23	SISTEMA PER LA MISURA DELLA VELOCITA' DEL VENTO IN QUOTA	ITALIA	TO2013A000485	DA ASSEGNARE	13/06/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/23 - SISTEMA PER LA MISURA DELLA VELOCITA' DEL VENTO IN QUOTA.pdf
24	SISTEMA DI MESSA A PUNTO DI UN'ALA AD ARCO	ITALIA	TO2013A000751	DA ASSEGNARE	13/09/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/24 - SISTEMA DI MESSA A PUNTO DI UN'ALA AD ARCO.pdf
25	DISPOSITIVO TENSIONATORE E MISURATORE DI TENSIONE DI ALMENO UNA FUNE	ITALIA	TO2013A000749	DA ASSEGNARE	13/09/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/25 - DISPOSITIVO TENSIONATORE E MISURATORE DI TENSIONE DI ALMENO UNA FUNE.pdf
26	ALA AD ARCO CON SPALLE PERFEZIONATE	ITALIA	TO2013A000750	DA ASSEGNARE	13/09/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/26 - ALA AD ARCO CON SPALLE PERFEZIONATE.pdf
27	PROCEDIMENTO DI GESTIONE, REGOLAZIONE E CONTROLLO DI UN GENERATORE EOLICO	ITALIA	TO2013A000752	DA ASSEGNARE	13/09/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/27 - PROCEDIMENTO DI GESTIONE, REGOLAZIONE E CONTROLLO DI UN GENERATORE EOLICO.pdf

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28	ALA AD ARCO A PROFILI ALARI DIFFERENZIATI	ITALIA	TO2013A000987	DA ASSEGNARE	04/12/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/28 - ALA AD ARCO A PROFILI ALARI DIFFERENZIATI.pdf
29	DISPOSITIVO PER LA PULITURA/ASCIUGATURA DI FUNI	ITALIA	TO2013A001051	DA ASSEGNARE	20/12/2013	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/29 - DISPOSITIVO PER LA PULITURAASCIUGATURA DI FUNI.pdf
30	FUNE AD ALTA EFFICENZA, IN PARTICOLARE PER IL GOVERNO DI PROFILI ALARI	ITALIA	TO2014A000001	DA ASSEGNARE	02/01/2014	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/30 - FUNE AD ALTA EFFICENZA, IN PARTICOLARE PER IL GOVERNO DI PROFILI ALARI.pdf
31	ALA AD ARCO DOTATA DI SISTEMA DI GIUNZIONE REGOLABILE DI BRIGLIE	ITALIA	TO2014A000017	DA ASSEGNARE	14/01/2014	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/31 - ALA AD ARCO DOTATA DI SISTEMA DI GIUNZIONE REGOLABILE DI BRIGLIE.pdf
32	FASOMETRO DISGIUNTORE MODULATORE	ITALIA	TO2014A000194	DA ASSEGNARE	12/03/2014	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/32 - FASOMETRO DISGIUNTORE MODULATORE.pdf
33	ALA BIMODALE PER PROFILO ALARE DI POTENZA	ITALIA	TO2014A000203	DA ASSEGNARE	14/03/2014	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/33 - ALA BIMODALE PER PROFILO ALARE DI POTENZA.pdf
34	SISTEMA E PROCEDIMENTO DI GESTIONE E CONTROLLO DEL VOLO DI PROFILI ALARI, IN PARTICOLARE PER GENERATORE EOLICO	ITALIA	TO2014A000217		18/03/2014	www.kitegen.com/dlg/II - Proprieta intellettuale/patents/34 - SISTEMA E PROCEDIMENTO DI GESTIONE E CONTROLLO DEL VOLO DI PROFILI ALARI, IN PARTICOLARE PER GENERATORE EOLICO.pdf

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35	IMPROVED PULLEY FOR HIGH-EFFICIENCY WINCH	INTERNAZIONALE	PCT/IT2014/000081	DA ASSEGNARE	26/03/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/35 - IMPROVED PULLEY FOR HIGH-EFFICIENCY WINCH.pdf
36	IMPROVED PULLEY FOR HIGH-EFFICIENCY WINCH	INTERNAZIONALE	PCT/IT2014/000082	DA ASSEGNARE	26/03/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/36 - IMPROVED PULLEY FOR HIGH-EFFICIENCY WINCH.pdf
37	SYSTEM FOR MEASURING THE WIND SPEED AT A CERTAIN HEIGHT	INTERNAZIONALE	PCT/IT2014/000129	DA ASSEGNARE	13/05/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/37 - SYSTEM FOR MEASURING THE WIND SPEED AT A CERTAIN HEIGHT.pdf
38	SYSTEM AND PROCESS FOR STARTING THE FLIGHT OF POWER WING AIRFOILS, IN PARTICULAR FOR WIND GENERATOR	INTERNAZIONALE	PCT/IT/2014/000154	DA ASSEGNARE	05/06/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/38 - SYSTEM AND PROCESS FOR STARTING THE FLIGHT OF POWER WING AIRFOILS, IN PARTICULAR FOR WIND GENERATOR.pdf
39	WING WITH BI-MODE OPERATION	INTERNAZIONALE	PCT/IT2014/000155	DA ASSEGNARE	05/06/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/39 - WING WITH BI-MODE OPERATION.pdf
40	APPARATO DI CONVERSIONE DI ENERGIA MECCANICA IN ENERGIA ELETTRICA	ITALIA	TO2014A000424	DA ASSEGNARE	28/06/2014	www.kitegen.com/dlg/il - Proprieta intellettuale/patents/40 - APPARATO DI CONVERSIONE DI ENERGIA MECCANICA IN ENERGIA ELETTRICA.pdf

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