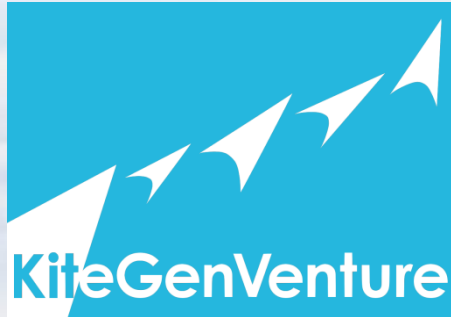


High Altitude Wind Power (HAWP)



For a sustainable production of electricity from renewable source
Low cost - Low environmental impact



Strategic Business Plan

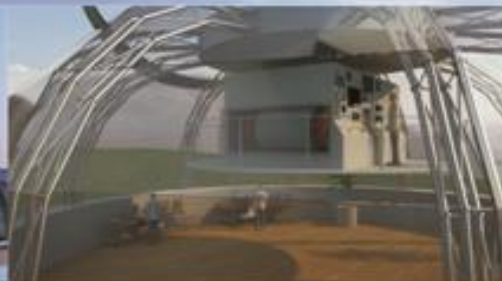


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Product history and strategic goals

Prototypes phase ended

- **2003. Project starting**
- **2006. Ist prototype**
Mobile - 30kW nominal output - Limited to low altitude experiments - Control system test
- **2007. IInd prototype**
Mobile - 30kW nominal output - Altitude test up to 800mt - Production cycle test - Cabling and generation test
- **2010-2012. IIIth prototype**
3MW nominal output - Stem configuration for wind gust management test - Duty cycle integration - Cut-in and cut-off testing



Industrialization phase of KITEGEN STEM 3 MW

- **2014H1**
Continuous production test of Target design configuration - 3MW output test - Tropicalization design - Complete machine test
Availability for existing partner's initial orders
- **2015H1**
Wing and ropes design improvement - First farm and ancillary systems construction - Quantitative target based production
Commercial availability
- **2017H1**
CAPEX/OPEX optimization - Software and management procedures update - Wing and ropes optimization -
Increased Capacity Factor



Team and corporate structure

Current status and future activities

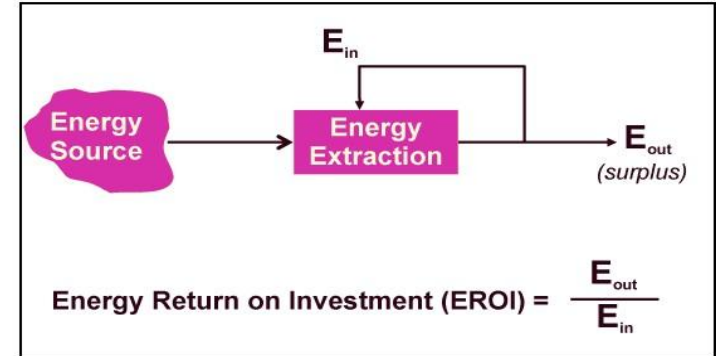
	Kite Gen Research Srl	Sequoia Automation Srl	SOTER Srl
Founded	2009 in Turin (ITA)	1997 in Turin (ITA)	2011 in Turin (ITA)
Legal status	Società a Responsabilità Limitata (LTD)	Società a Responsabilità Limitata (LTD)	Società a Responsabilità Limitata (LTD)
Current Economic activity	Granting exploitation rights of intellectual property and similar products	Installation of instruments and appliances for measuring, checking, testing, navigating and other purposes (including industrial process control equipment)	Shareholding (Holding company)
Future economic activities	New IP delivery, IP maintenance and enforcement	Research and development Industrialization Machines production	Business & Partnership development, Farm project planning execution and support, R&D funding
Management form	Sole administrator + BoA	Sole administrator	BoD + MD
BoD	M.Ippolito 1 auditor	R. Renna	M.Ippolito (President) D. Zari (MD) E. Reyneri, M. Boetti

The "real" (energetic) cost of energy

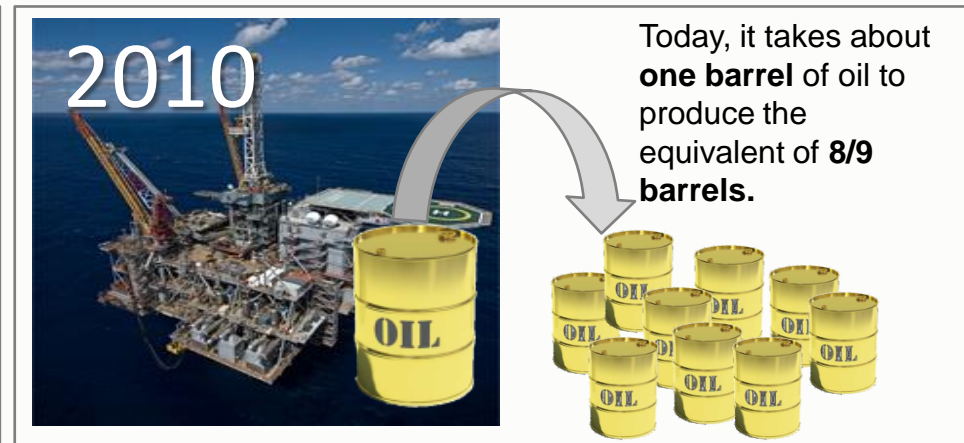
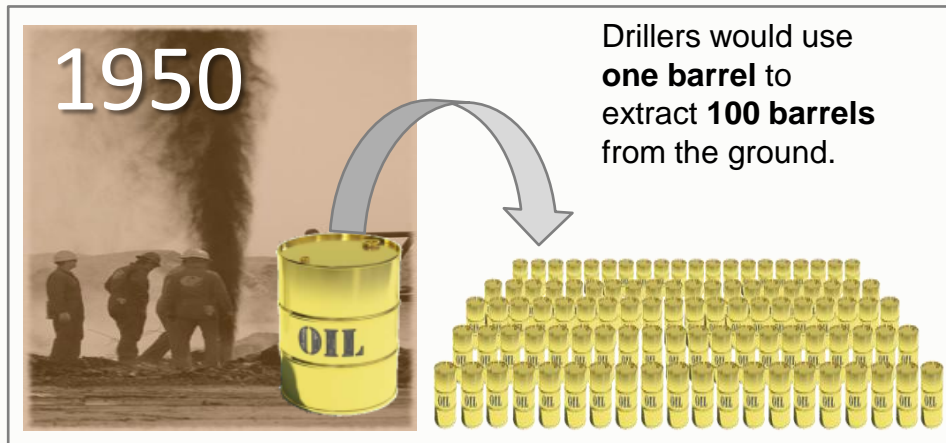
The EROEI is defined as the Energy Return Over the Energy Invested ratio in a plant during its operational life (Picture 1).

Oil, in the 1950's, had the highest EROEI ever recorded for any energy technology: roughly 100. In the 1970's it had already dropped below the value of 40. Today it has decreased below the value of 10, and we can assume that it will continue to decrease.

In other words, **oil is finishing its "life cycle,"** not because there is no more oil (and "by-products") to extract, but because their energetic cost of extraction is increasing and therefore the EROEI is decreasing to values not sufficient to sustain growth and progress.



Picture 1: EROEI - Energy Return over Energy Investment





High Altitude Wind Power

HAWP



**Exploit even a small part of this huge resource
can solve the global energy challenge.**

Competing Methodologies



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

1. Fly/Ground generation:



- the power generation took place on the ground, with tethering cables that normally pull a drum rotation
- or directly on the flying element and later transferred to ground using a power cable

2. Heavy/Lighter than air:

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

3. Pumping/Continuous generation:

- Pumping involve a cycled production later described. Used in heavy/ground gen
- Continuous production is available in fly gen systems (or future ground gen)

	Fly gen	Ground gen
HEAVY		
LIGHTER		

Orange square: KiteGen Stem Pink square: Makani Power Blue square: Magenn

Overview of Players status (2/2)



	Business Focus	Status	Company structure	Finance
Ampyx Power, Delft <i>Netherland</i>	Plane	Is building pumping wind generator with rigid airfoils 10kW prototype	Founded by ex-members of TU Delft team	<ul style="list-style-type: none"> ✓ Financed by seed investors and subsidies ✓ IInd round financing
Kite Power <i>Netherland</i>	generator on board rigid airfoils	Two different altitudes investigated 500-1000 m 10 000 m	about 30 people based in Santa Cruz	founded in 2009 by single investor JoeBen Bevirt (CEO) I st round financing
Guangdong HA WP <i>China</i>	<ul style="list-style-type: none"> ✓ Pumping Parachute Generators ✓ Generator on ground 	recently shifted from flexible to rigid airfoils - 30kW prototype - 1 MW generator envisaged	CEO left the team in 2009 and company shrank from 40 to 15 people.	First round financing
Kite Gen Research <i>Italy</i>	<ul style="list-style-type: none"> ✓ Large wings, fully automatic system, ground generation ✓ floating platform in off-shore version 	- Industrialization of Stem 3 MW - the only player with a working MW-size prototype	impressive management team - Strong partnership with multinational	Financed by seed investors and subsidies until 2012 - Industrial plan financed

Geographical spread of main players

MAIN PLAYERS:

SOME INVESTORS:



A collection of logos for various investors:

- Google
- سابك (SABIC)
- سابك (SABIC) - Arabic text
- BOEING
- ALSTOM
- ZEPPELIN Power Systems
- CAT
- Oltmann Gruppe
- DSM BRIGHT SCIENCE. BRIGHTER LIVING.
- FESTO

The concept

KiteGen® is the last evolution of wind energy exploitation: a radically new and innovative patented concept and system, with an estimated EROEI of 375, a value high enough to be the best "energy source" and most convenient technology known today to take advantage of high-altitude winds and produce clean energy without any CO2 emissions.

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

In order to exploit this huge amount of energy a radical change of perspective has been done:

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



Today

2. but large wings, driven by a high-tech control system based on avionic sensors, fly at high altitude, harvesting the energy of powerful winds, much faster and constant than those available to traditional windmills.



Very near future

KiteGen® is a working reality largely competitive with any power generation systems, renewables and conventional, including nuclear energy, both in terms of power rating and cost of energy produced.

Development history



Mobile Pumping Kite Generators

(KSU1 - Kite Steering Unit 1)

Kite Gen was in pole position in the high altitude wind energy exploitation world contest

Pumping Kite Generators

(Stem 3 MW generator)

March 2012, first flight and generation tests in Sommariva Perno (Italy)

Mobilegen 1 (2006)



- 1st prototype
- 30kW nominal output
- Limited to low altitude experiments
- Control system test

Mobilegen 2 (2007)



- 2nd prototype
- 30kW nominal output
- Altitude test up to 800mt
- Production cycle test
- Cabling and generation test

Stem 3MW (2010-2012)



- 3rd prototype
- 3MW nominal output
- Stem configuration for wind gust management test
- Duty cycle integration
- Cut-in and cut-off testing

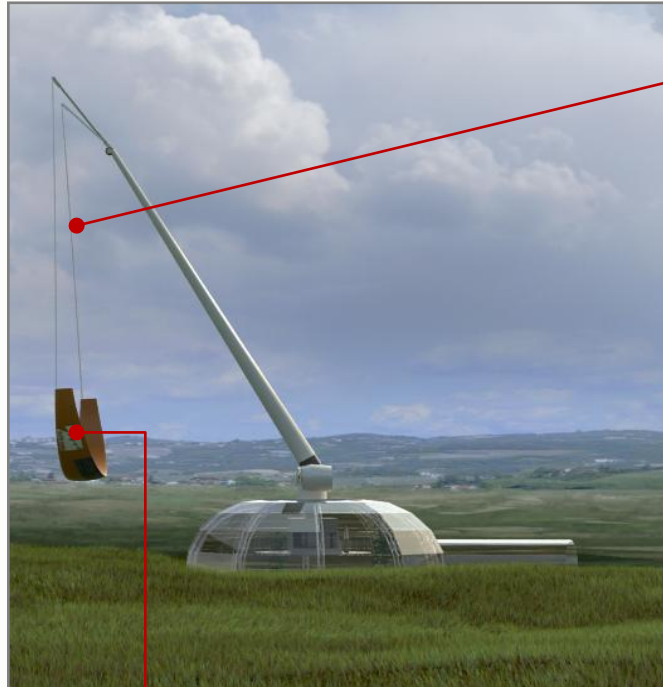
PROTOTYPES PHASE ENDED

KiteGen Stem generator 3MW (1/5)



The KiteGen Stem is an industrial robot that can independently manage the flight of a large wing.

- Power kites, giant semi-rigid air foils, with high aerodynamic efficiency, harness energy from the wind, whilst being automatically piloted.
- All the heavy machinery for power generation stays on the ground.
- To connect the two systems, high resistance lines transmit the kites' traction and at the same time control their direction and angle to the wind.



A tethered system, connected to ground station by two high tech specialized cables

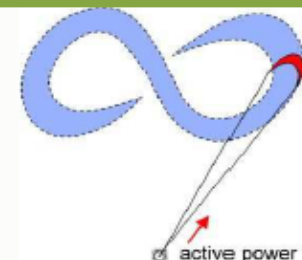


- ✓ A specialized semirigid wing with on-board sensors, flying at 300 km/h up to 9km height
- ✓ A unmanned «aerial vehicle», automatically controlled in milliseconds from a ground based control system

» How it works

The "KiteGen Stem generator" combines a very simple concept of energy production – that of the bicycle's dynamo generator - with an extremely advanced technology.

- KiteGen STEM transforms high-altitude wind energy into electricity, transmitting the force generated from the wing to a number of alternators located on the ground. Two high-strength cables transmit the traction of the wing and control direction and orientation.
- When the cables are fully unwound, the wing is guided to a position where it loses wind resistance and the cables are wound up. The energy consumed during this phase is equal to a fraction of the energy produced during the unwinding phase.
- The automatic kite flight control system, receiving data from on-board avionic sensors, autonomously pilots the power kites, so that their flight patterns can be controlled, synchronized and directed to maximize the production of energy.



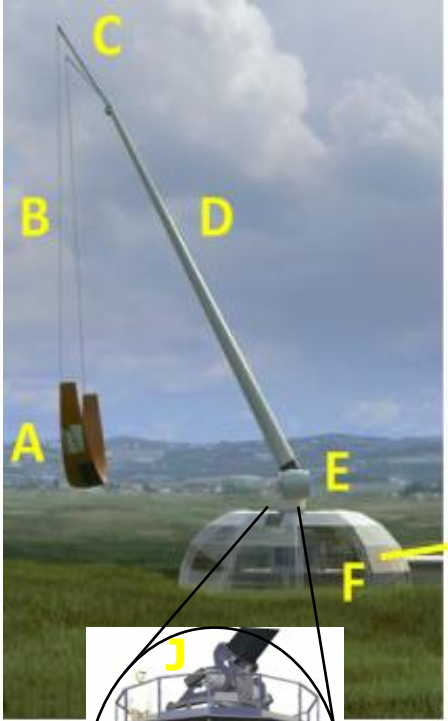
KiteGen work phases.

The wing flies from the height where cut-in wind speed is available (normally above 5-800mt, but max 9000 mt are possible), its trajectory loop is shaped as an horizontal «8», just like the kite-surfers do, and while rising up about 500mt from start height, the wing pulls the two ropes from the hearth of the machine (Active Phase).

When the maximum height is reached the wing performs the side-slip manoeuvre (patented) that rewinds the two ropes (Passive Phase) with a minimum expenditure of energy from the one gathered in the active phase. Then the cycle restarts.



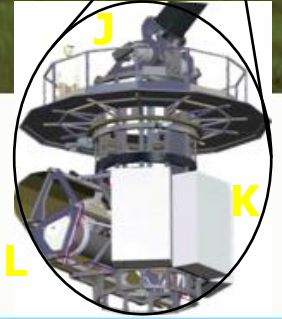
» Stem product design



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



- I. cabinet and 6 actuators
- J. motorized joint
- K. drums
- L. motor drives and control



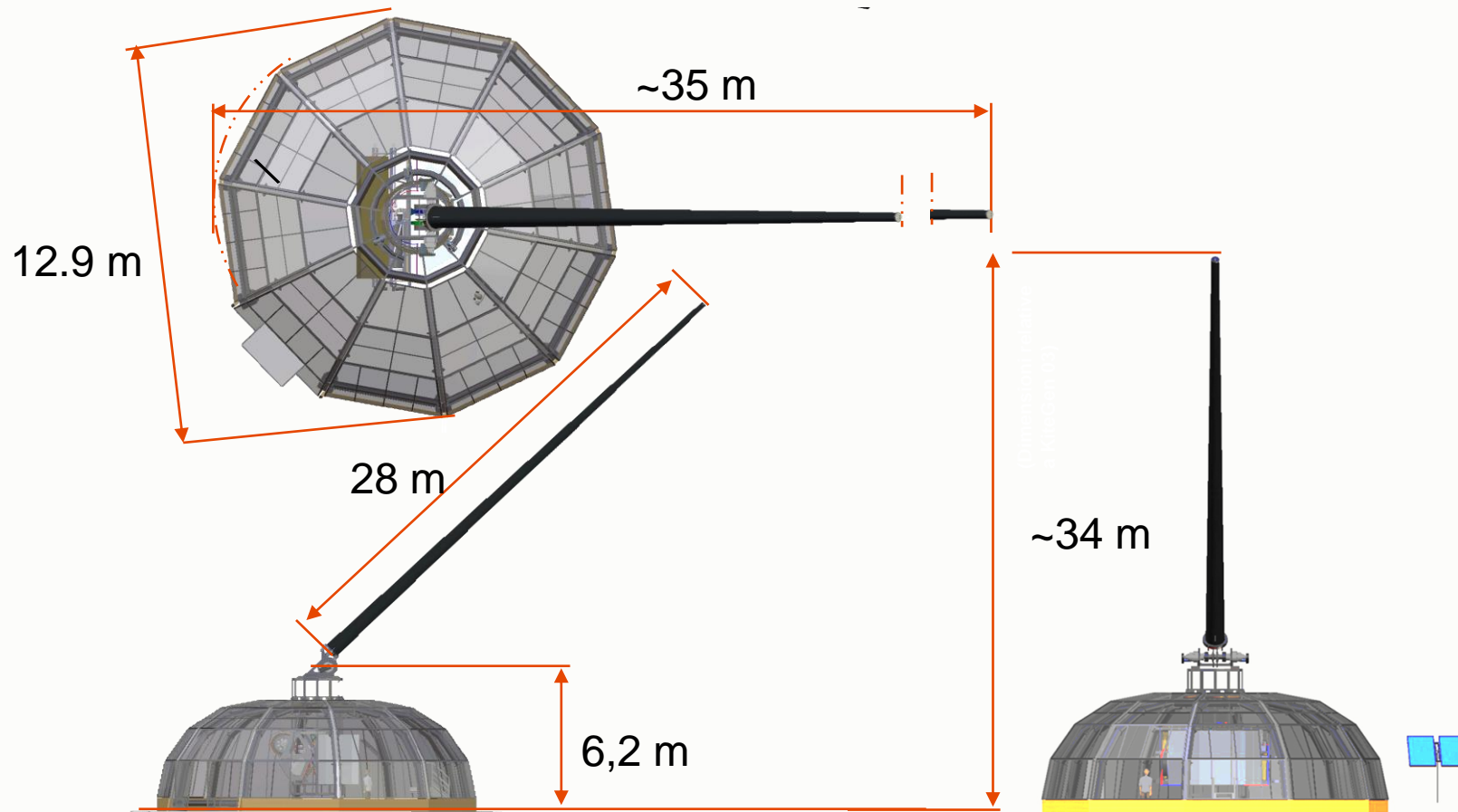
Structure description

- **Power wing:** Composite material flexible wing structure, 150mq
- **Tethering:** designed for 60 ton max traction, 30 ton working conditions
- **Compass (optional) + Stem:** gust control within few msec, dual cable control, 21 mt
- **Ground structure:** flexible for gust control, contain power generators, 13 x 6 mt d x h. 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

KiteGen Stem generator 3MW (4/5)



» Dimensions



Main advantages



- Production of great amounts of energy from renewable source and without CO2 emissions.
- A simple technology, but totally innovative and superior performances. .
- Production, throughout the year, of more than double the energy produced compared to a traditional wind turbine of similar size..
- Higher availability of installation sites with lower impact.
- Greater energetic density per square kilometer of territory.

PERFORMANCES

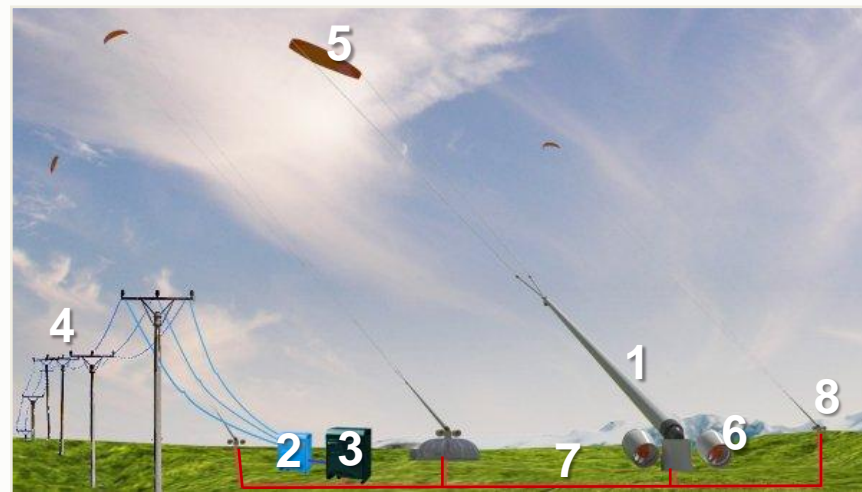
- A KiteGen STEM generator, with a power of 3 MW, provides up to 6.500 operating hours yearly at rated power (depending on the site's features i.e. fly max height permit), ensuring very high ROI.
- The generator is reliable and suitable for any site, even if with little or no wind at ground level and difficult to access.
- The small size and reduced weight (less than 20 tonnes) makes the generator easy to carry and install.
- The simplicity of the machine and its robust construction ensure no degradation of performances over time.
- The only parts subject to wear are the cables and wings, consumable materials for the operation of the machine for a certain work time at rated power, after which they are replaced.



Wind Farm configuration

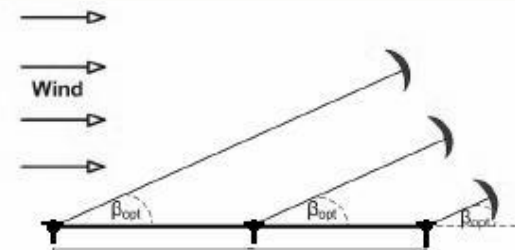
KiteGen Stem generator in Wind farm configuration

- The KiteGen[®] generator is a base module, suitable for solutions able to ensure a high scalability of the generation plant. "Wind Farm" configuration consists of a series of generators grouped together on a limited ground/sea space, in order to obtain greater energy production on a single limited site (Picture 1).
- This is possible both on sea and on the ground, with significant economies also from an organization and management point of view.
- Traditional windmills require spaces between the generators of on average 8-9 times the rotor's diameter, in order to prevent generated turbulences from reducing efficiencies
- KiteGen[®] exploits a third dimension (the altitude) and, thanks to the electronic integrated control system, can divide the flying space in order to make the wings fly always on a unbiased front wind in a reduced territorial space.
- KiteGen[®] generators can be placed 100 meters apart, thus enabling, on the same area required by traditional windmills, a nominal power production 4 times greater (Picture 2)



Picture 1: Wind farm configuration and grid connection

1. KiteGen[®] generator 3MW
2. Static converter
3. Short round trip accumulator
4. Electric line VHV
5. Flying Kite with radio datalink
6. Servo assisted take-off system (Energy needed <2kWh/launch)
7. Bus DC 600V (1600A x Tower)
8. KiteGen[®] wind farm

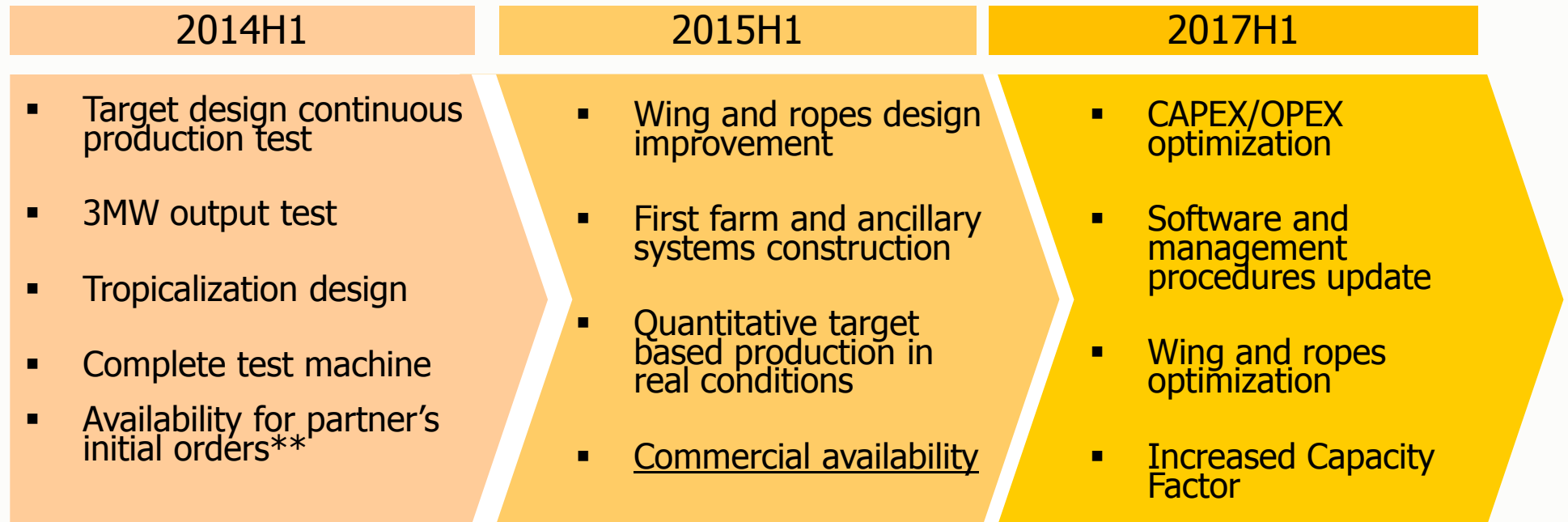


Picture 2: Spatial distribution of KiteGen[®] Wind Farm

KiteGen® industrialization plan



State of art: Industrialization phase of KiteGen Stem 3 MW ongoing*



TARGET LCOE: 23 €/MWh

TARGET LCOE: 10 €/MWh

* Source: Sequoia Automation Industrialization Plan

** **Saudi Jubail CCU project.** KiteGen® will be responsible for the concept and basic engineering, front end engineering design (FEED) and detailed engineering, procurement, construction (EPC) and future maintenance of the power facility. This project will be the renewable energy cornerstone of a Saudi 66 billion \$ program aiming to power the region water desalinization.

Current companies assets

KRG - SEQUOIA

- **3000 international Patents**
- Contract for Saudi Jubail CCU project
- Agreements with ENAC/ENAV and on-going contacts with EASA
- 17.000 sqm, Stem R&D and building site near Turin
- 30 FTE staff for R&D
- 2 € Mil equipment for R&D and pre-series building
- Award - Internationally evaluated business idea



KGV

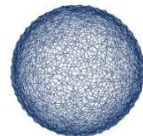
- **22,68% share of Intellectual Property (KGR)**
- International development and future holding
- Active partners in the banking, wind project development, transportation, project development, consulting, legal sector

Award - Internationally evaluated business idea



award

CESI



COP15
COPENHAGEN
UN CLIMATE CHANGE CONFERENCE 2009



SEVENTH FRAMEWORK
PROGRAMME



EXPO
2010
SHANGHAI CHINA



Prospects of KiteGen® technology development

KG Stem offshore



- **Objective:** develop offshore version of Stem
- **Activities:** floating platform design, location definition, testing, control optimization
- **Effort:** 2y
- **Result:** new product sales

KG Carousel



- **Objective:** Carousel product development
- **Activities:** whole design, prototyping, testing
- **Effort:** 5y
- **Result:** new product sales, power up GW

KG Carousel Offsh.



- **Objective:** Carousel product development
- **Activities:** whole design, prototyping, testing
- **Effort:** 5y
- **Result:** new product sales, power up GW

K-Bus E-mobility



- **Objective:** E-Mobility
- **Activities:** whole design, prototyping, testing
- **Effort:** 1y
- **Result:** new product sales



TECHNOLOGY PLANNED DEVELOPMENT



NASA Langley Research Center
"Wind Energy Airborne Harvesting System Study"
awtdata.webs.com

- **Objective:** Carousel product development
- **Activities:** whole design, prototyping, testing
- **Effort:** 5y
- **Result:** new product sales, power up GW
- **Status:** concept
- **Costs:** 0,5 €Mil/MW
- **PBT:** 8y
- **Value prop:** greater scalability, high power density, even lower LCOE



TECHNOLOGY PLANNED DEVELOPMENT



NASA Langley Research Center
"Wind Energy Airborne Harvesting System Study"
awtdata.webs.com

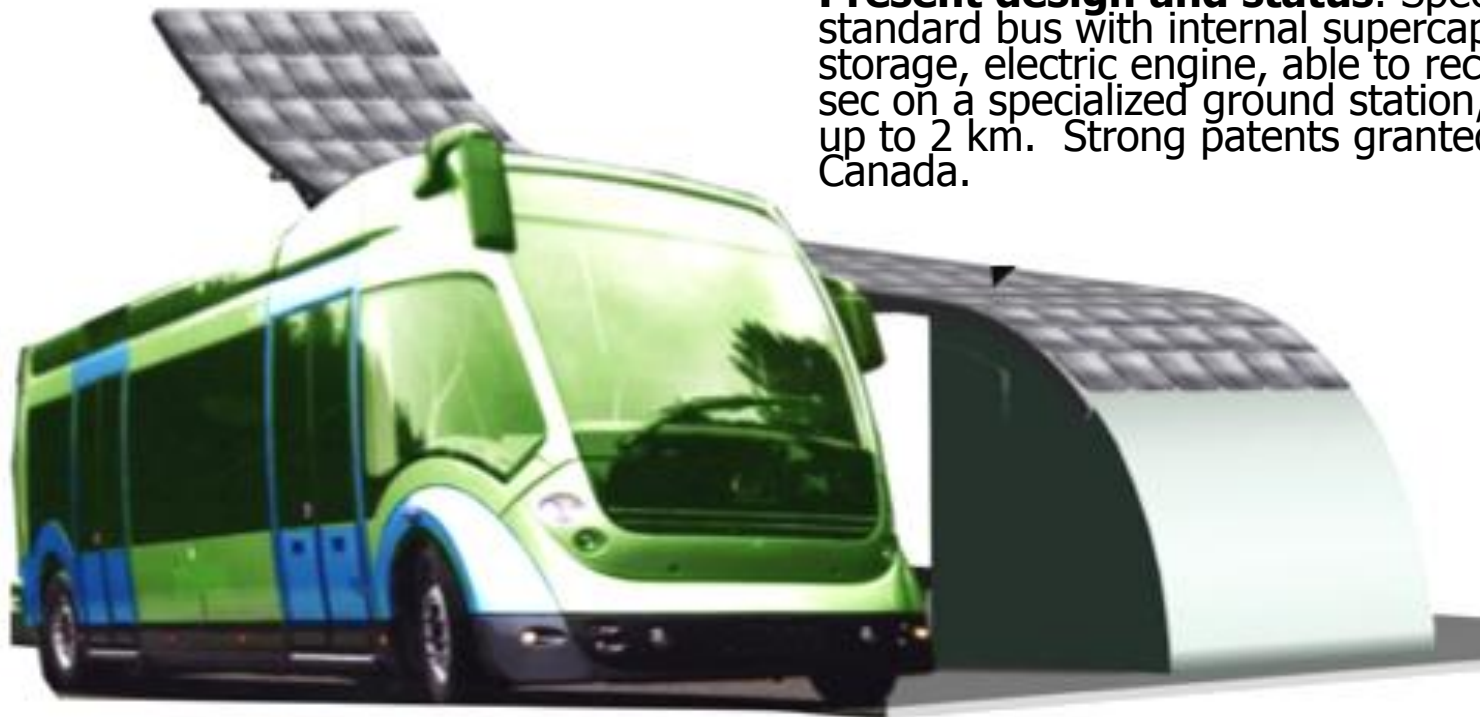
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KiteGen® technology enabled applications

» K-Bus E-mobility – Patented ultrafast recharge system

A new collective mobility paradigm, solving battery life limits

- **Present design and status.** Specific or standard bus with internal supercapacitor energy storage, electric engine, able to recharge in **5** sec on a specialized ground station, and to travel up to 2 km. Strong patents granted in EU, USA, Canada.



Comparison: KiteGen® and 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*	1700
Weight including foundations (tons)	20	2000
Min. distance between generators (m.)	100	1000 (9 x blade diameter)
Average ground machine height (m.)	30	150
Nominal power	3 MW	3 MW
Territorial energy density (average, MW/kmq)	300	4
Produced energy cost (€/MWh, Italy)	<20**	90-150

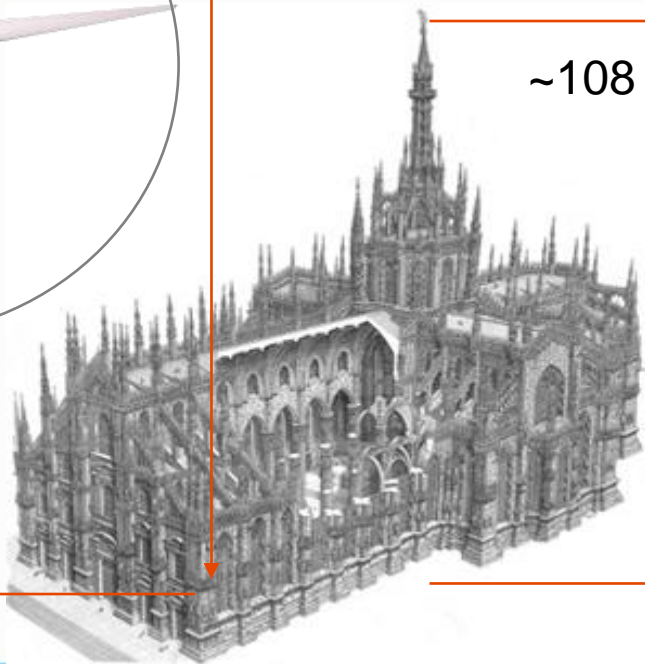
* Advanced Technological Learning Curve, ** Advanced Economical Learning Curve;

Comparison: KiteGen[®] and Conventional turbines

» Dimensions



Vestas V90 3MW
~150 m



Duomo of Milan
~108 m



KiteGen Stem 3MW
~34 m

- But 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.

Comparison: KiteGen[®] and Conventional turbines

» Masses

Conventional turbine

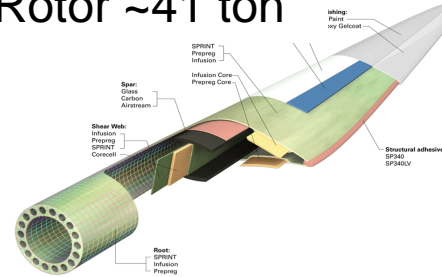
Nacelle ~70 ton



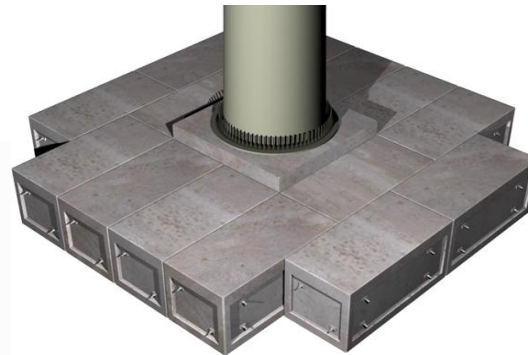
Tower
~ 285 ton



Rotor ~41 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 < 20 ton

Comparison: KiteGen® and Conventional turbines

» Logistics, assembly and decommissioning

Conventional turbine



KiteGen Stem 3MW

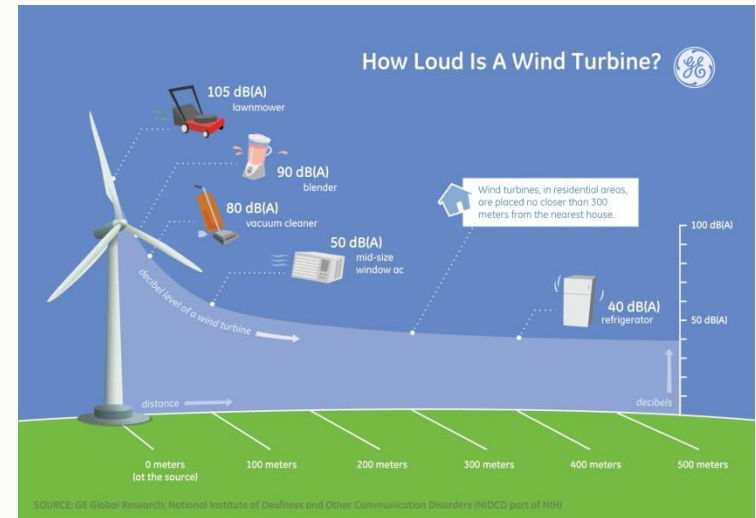
- No component with a weight exceeding 120 kg
- Shipment in 3 containers 40"
- It does not require special equipment for assembly
- Easily removable and installation site easily restorable (use of micro-piles for foundations)



Comparison: KiteGen® and Conventional turbines

» Environmental impact major benefits of our offer

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

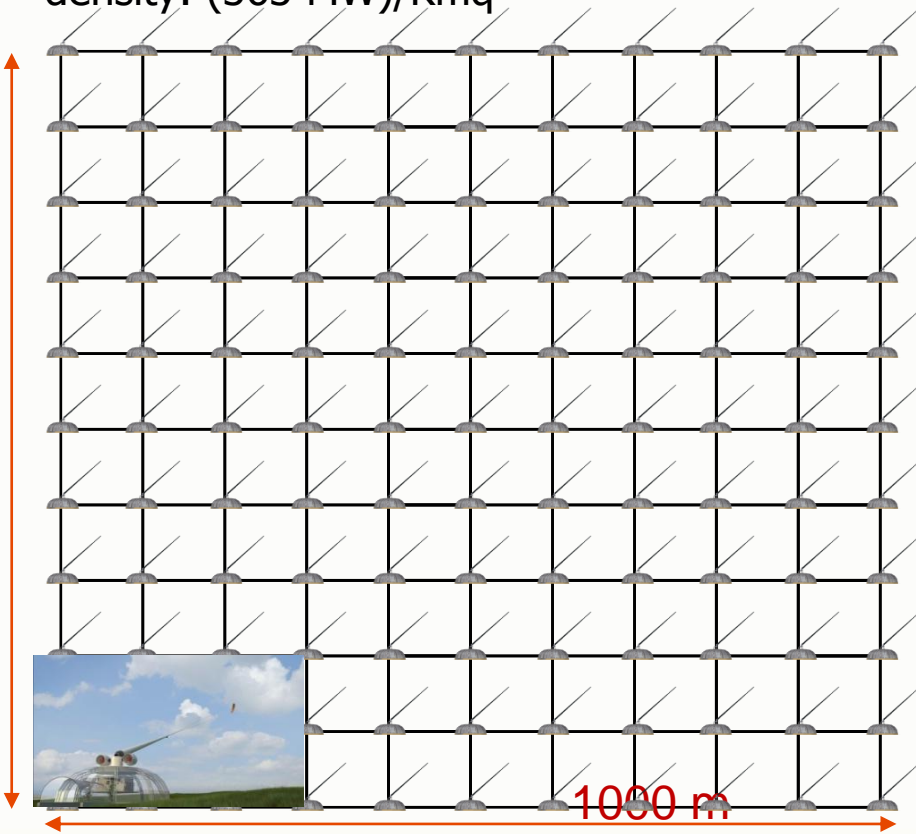


Comparison: KiteGen[®] and Conventional turbines

» Territorial energy density

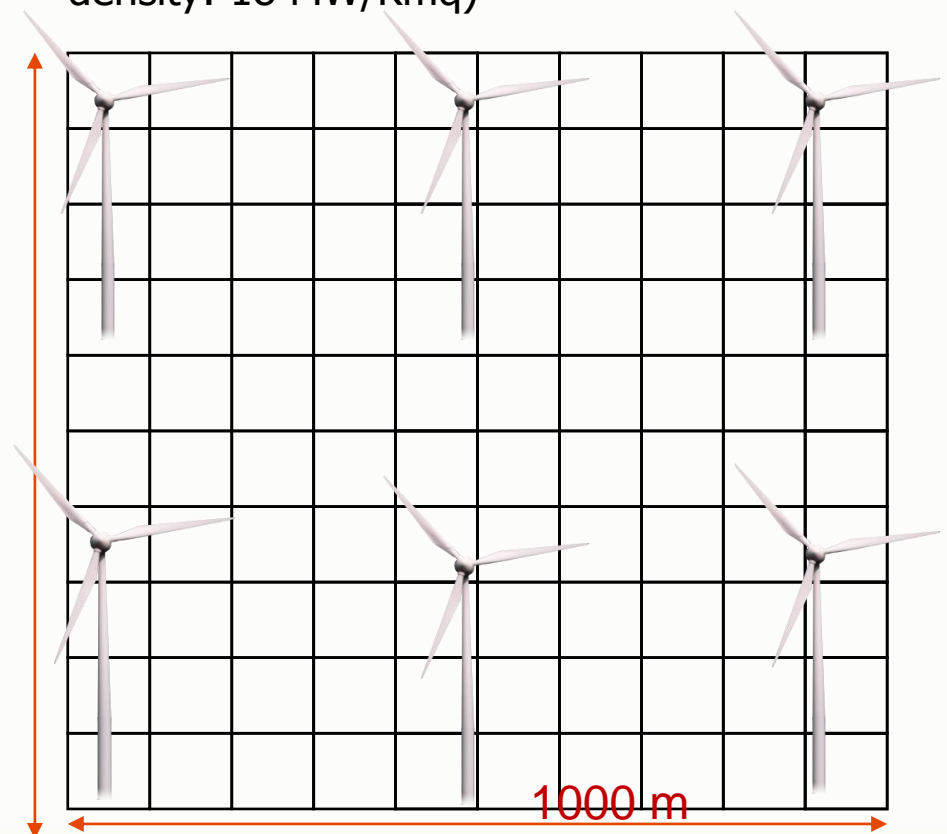
121 KiteGen STEM x 3MW

density: (363 MW)/Kmq



6 Conventional Turbines x 3 MW

density: 18 MW/Kmq



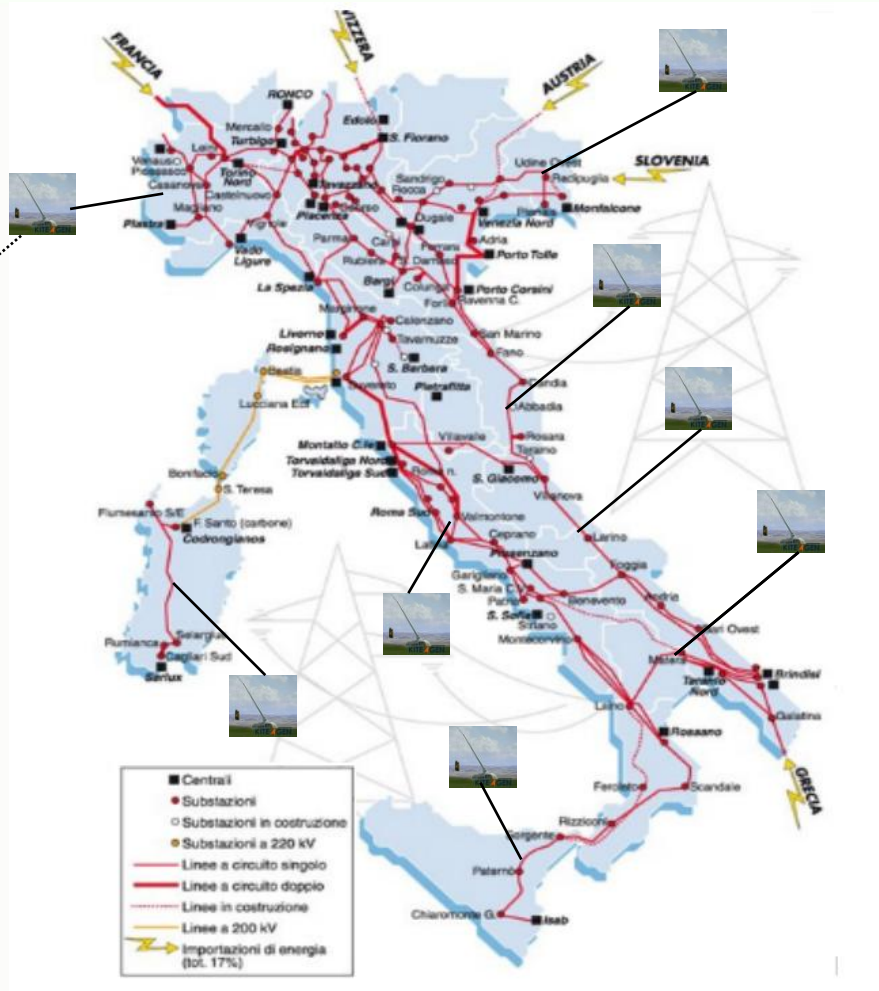
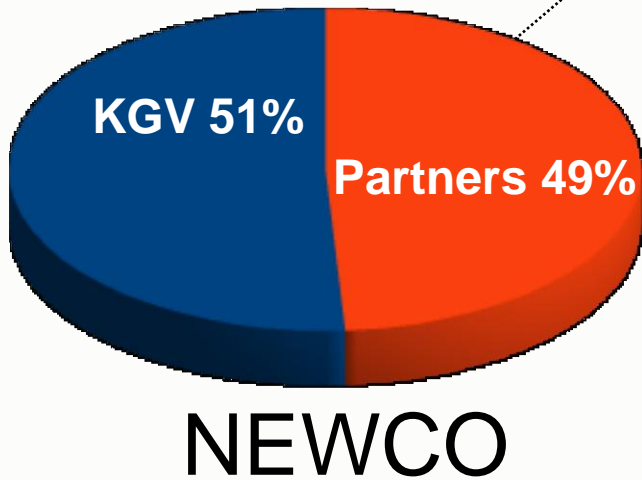
Business Development Program

Strategies



**Exploit even a small part of this huge resource
can solve the global energy challenge.**

Scenario with 8 KiteGen farms of size 33 MW



Opportunity of Investment in KiteGen Venture

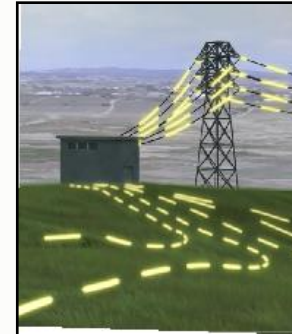


Energy-Intensive Industries



Industry Energy Consumption
ie: above 10 MW
(~1M\$/year)

Cost of Energy

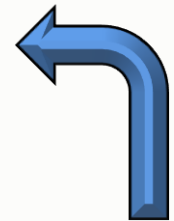


Profit from Energy

10 MW Free

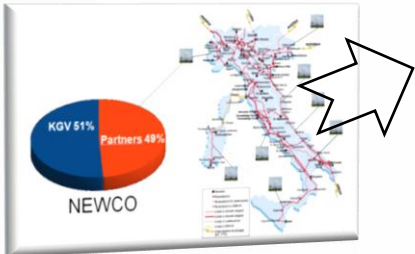


KiteGen Farm of 33MW



$$33 - 10 = 23 \text{ MW}$$

International Development



2020 - the KiteGen worldwide...



**KiteGen® Technology
Business Development Management**

KiteGenVenture Srl

Corso Lombardia, 63/c
10099 San Mauro Torinese (TO) Italy
Email: soter@kitegenventures.com

Awards - Internationally evaluated business idea



We strongly believe that the exploitation of this resource can be the solution that everyone is awaiting, in order to mitigate, if not cancel, our dependence on fossil fuels while drastically reduce the emission of greenhouse gases.