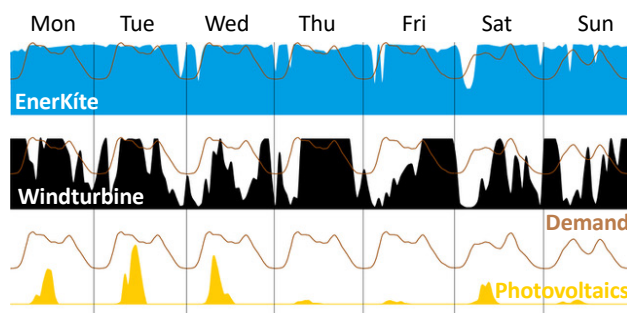




## CHALLENGE

**Today's renewables are volatile**



Delivering a source of electricity  
yielding more energy than wind or PV

at almost **any time**  
and almost **everywhere**

**Our mission is to develop**  
**non-volatile, cost efficient**  
**scalable renewables**

Image: Generation profiles against hourly demand. Simulation of a typical week in January for Northern Germany, Homer Pro.

## THE IDEA



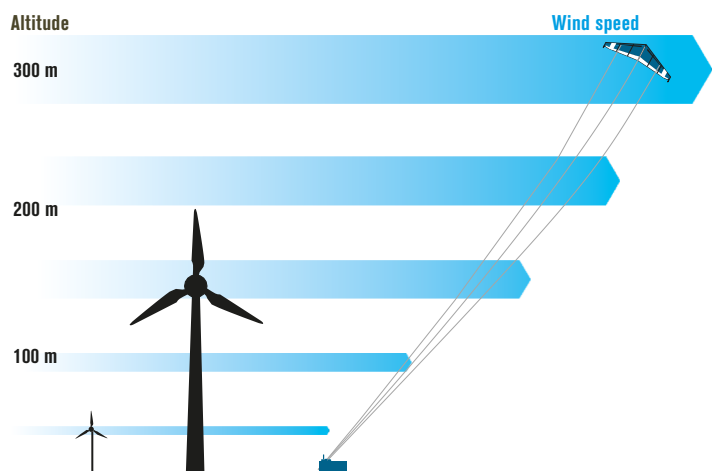
## HIGH ALTITUDE WINDS

### Harnessing abundant winds at high altitude with kites

30% times more wind speed  
2 times the power

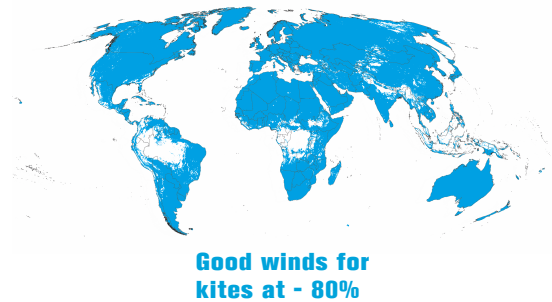
90% less material  
50% of the cost  
2 times the yield

Smart software, sensor networks and automation replaces massive structure



# AIMING HIGHER

## Expanding the wind power opportunity



**Wind energy can power the world a hundred times over.**

Source: 3Tier Global Windmap, Annual winds at 80 m above 6.5 m/s (left) equals 25% and above 4.5 m/s (right) equals 80% of the landmass.

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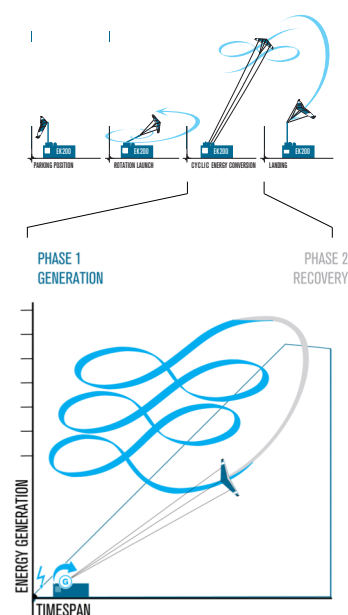
# HOW IT WORKS

## Autonomous launch, generation, landing

Cyclic operation in two phases according to the reverse "Yo-Yo" concept.

**1. Generation phase (50 sec):** The wing flies cross-wind controlled by three tethers. Unwinding the tethers with optimal force and speed, the ground station generates electrical power.

**2. Short recovery phase (10 sec):** The wing returns to the starting point as fast and smooth as possible with minimal losses of the energy generated.



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## DEMONSTRATOR EK30

### Proof of concept

Rated power 30 kW

Hundreds of operational hours at several sites in three EU countries

Milestones achieved:

Autonomous control, 72h flight

Validate model for power prediction

Tested to charge Tesla, BMW, Opel

Proved to power off-grid events

Milestone pending:

Autonomous launch and landing



## FIRST PRODUCT EK200

### Portable power for off-grid and remote applications

Rated Power 100 kW

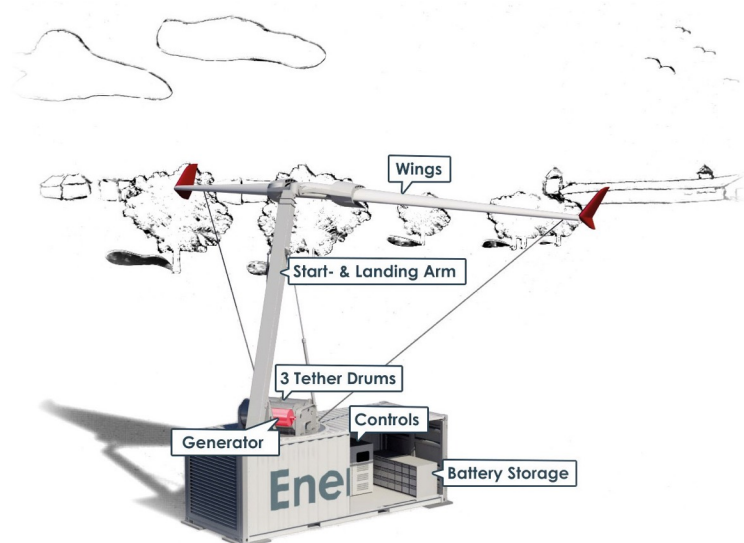
Supplies 200 households<sup>a</sup>

Saves 200,000 l diesel per year<sup>b</sup>

LCOE < 10 ct/kWh

Delivers 80% power at least 70% of the year

Entry in small series in 2020



Source: **a** | 3,000 kWh p.a. and household. **b** | Refers to 600 MWh/a and 1 l diesel equals 3 kWh<sub>el</sub>.

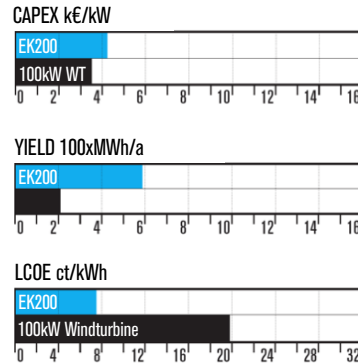
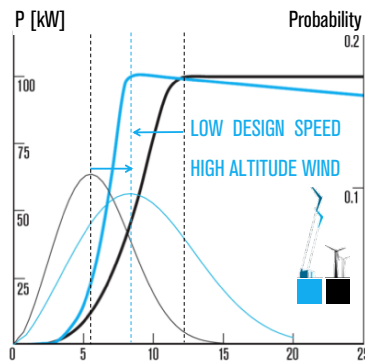
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# DESIGN CHOICES

9

## Comparison of Winturbine and EnerKite



Comparing at  
"EEG Reference"

6.5 m/s @ 100 m

Same Capex  
More Yield  
Less Cost of Energy

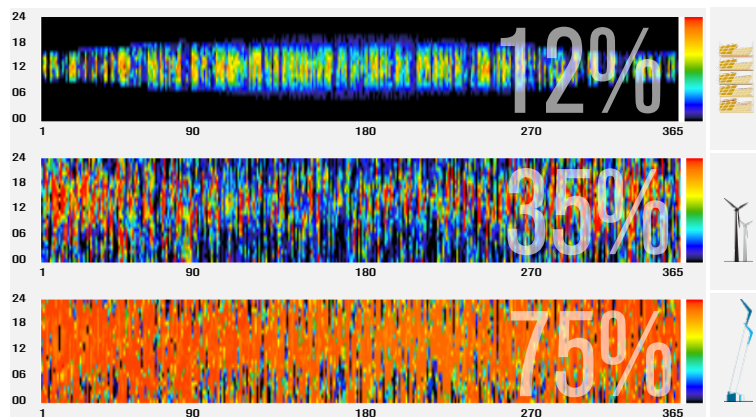
21.05.18 EnerKite - Plant model, Capex with integrated 100 kWh storage, AEP at rated wind 6.5 m/s @ 100 m

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# CAPACITY FACTOR MATTERS

10

## Reliable supply – matching the demand



PV ideally powers demand  
during hours of sun shine

Wind today enables higher  
capacity factors than PV.

Ultra high capacity factors  
of EnerKites are in favor of  
low cost of electricity.

Image: Hourly power generation and annual profiles for PV 12% and Wind turbines 35%. EnerKite aims for 75% capacity factor (CF).

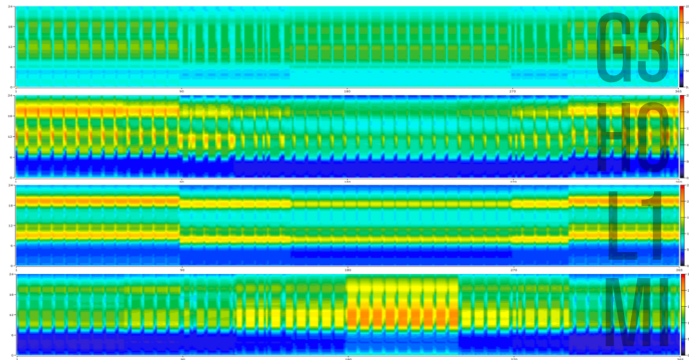
Source: Homer Pro, EnerKite.

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# LOAD PROFILES

11

## Hourly annual demand profiles



Industry  
Households  
Agriculture  
Island (DE)

Image: Hourly power demand profiles according to BDEW. Mixed demand profile from an touristic island in Germany.

Source: BDEW, EnerKite.

**EnerKite**

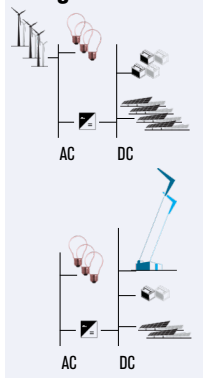
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# SIMULATION of MICROGRIDS

12

## Ideal - typical grids and ressources

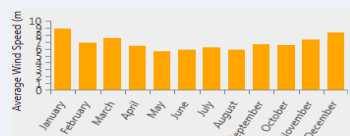
### Designs



### Ressources



Annual solar GHI 3, 5, 7 kWh/m²/d



Annual wind (200 m) 5 ... 12 m/s

### Simplifications

Raleigh distribution,  $k = 2$   
Logarithmic wind profile,  $z_0 = 0.1$   
Normalized annual variation  
of wind speed, solar GHI applies  
for specific annual mean values.

### Assumptions Capex // Opex

EK200.7 3500 €/kW // 20.000 €/a  
HAWT 2320 €/kW // 6.600 €/a  
PV 1000 €/kW // 24 €/kWh/a  
Storage 300 €/MWh // 7 €/MWh/a  
Inverter 200 €/kW  
GenSet 500 €/kW

Typical grid arrangements and reference annual solar GHI and annual wind profiles.

Source: Homer Pro, EnerKite.

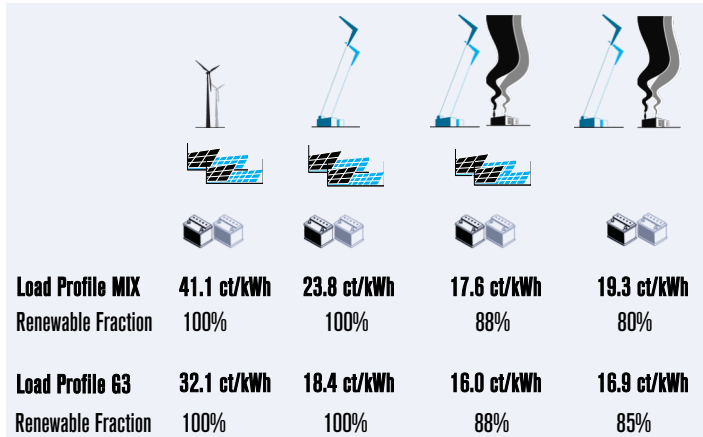
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# SYSTEMS COST OF ELECTRICITY

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## Optimized hybrid systems



16 ct/kWh and 88% diesel savings with an cost optimal system.

100% Renewables with EnerKite result in about 15 - 20% higher cost of electricity only.

Hybrids with EnerKites, PV, storage, diesel generator are less sensitive against varying load profiles.

Optimize your own system at

[www.enerkite.de/calculator](http://www.enerkite.de/calculator)

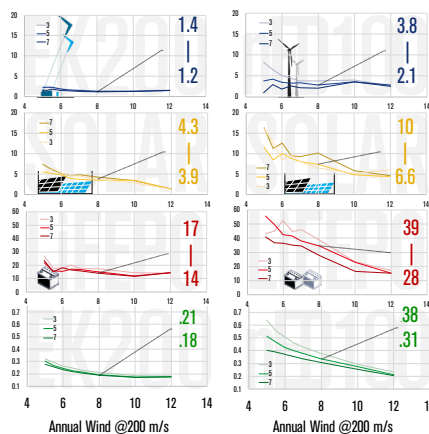
Source: Simulation EnerKite. Demand Profiles: Industry G3, Island Mix, Results for GHI 3 kWh/m2/d , v 200 m = 8 m/s, [www.enerkite.de/calculator](http://www.enerkite.de/calculator)  
24.05.18

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# SYSTEMS COST OF ELECTRICITY

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## Comparison of 100% renewable systems



**Wind**  
Power Rate  
kW / kW<sub>mean</sub>

Conventional Wind Power: 2.1 – 3.8 times mean  
EnerKite Power: 1.2 – 1.4 times mean power

**PV**  
Power Rate  
kW<sub>p</sub> / kW<sub>mean</sub>

EnerKite in optimized hybrid systems reduces the  
Peak Power rate of PV from 6.6 – 10 down to 3.9 – 4.3

**Battery**  
Autonomy  
hours

EnerKite in optimized hybrid systems reduces the  
Battery autonomy needed about 50%

**COE**  
€/kWh

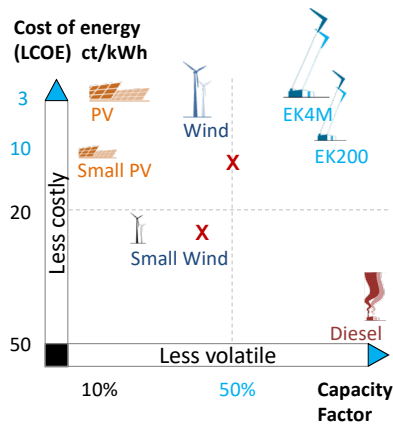
EnerKite in optimized hybrid systems reduces the  
Cost of Electricity about 50%

Source: Simulation EnerKite. Demand Profile: Industry, Reference Values indicated for GHI 3 – 7 kWh/m2/d , v 200 m = 8 m/s  
24.05.18

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# COMPETITIVE POSITIONING

## Empowering energy transformation



Source: Lazard LCOE Study 9.0 2015, Homer Pro calculations for reference conditions. EnerKite.

EnerKites are **mobile** as diesel generators

Serve electrical demands at **half the cost**

**Save up to 90%** diesel fuel

Save **50% of the storage storage** capacity needed with volatile renewables

**X** – direct competitors

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## THANK YOU

In the name of the EnerKite Team:

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13355 Berlin



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# SPARE SLIDES

Source:.

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## UNIQUE SELLING PROPOSITION

### **Non-volatile, portable, flexible, deployable**

Demand side generation as easy as with a diesel genset

### **Patented technology**

Backing robust kites and key features for and long term profitability

### **Short time to market**

Starting sales in 2020

### **Scalable solutions**

Easy to scale and catering to all energy needs

### **Awarded**

EU and federal grants, EU Seal of excellence, Industriepreis 2016, Best Pitch BEE, Best StartUp 1/40



Investitionsbank  
für  
Innovationsprojekte  
**ILB**

 Bundesministerium  
für Wirtschaft  
und Technologie

**ZIM**  
Zentrales  
Innovationsprogramm  
Mittelstand

 **INDUSTRIE  
PREIS 2016**  
BEST OF

**BEE**  
Bundesverband  
Energieeffizienz  
GmbH

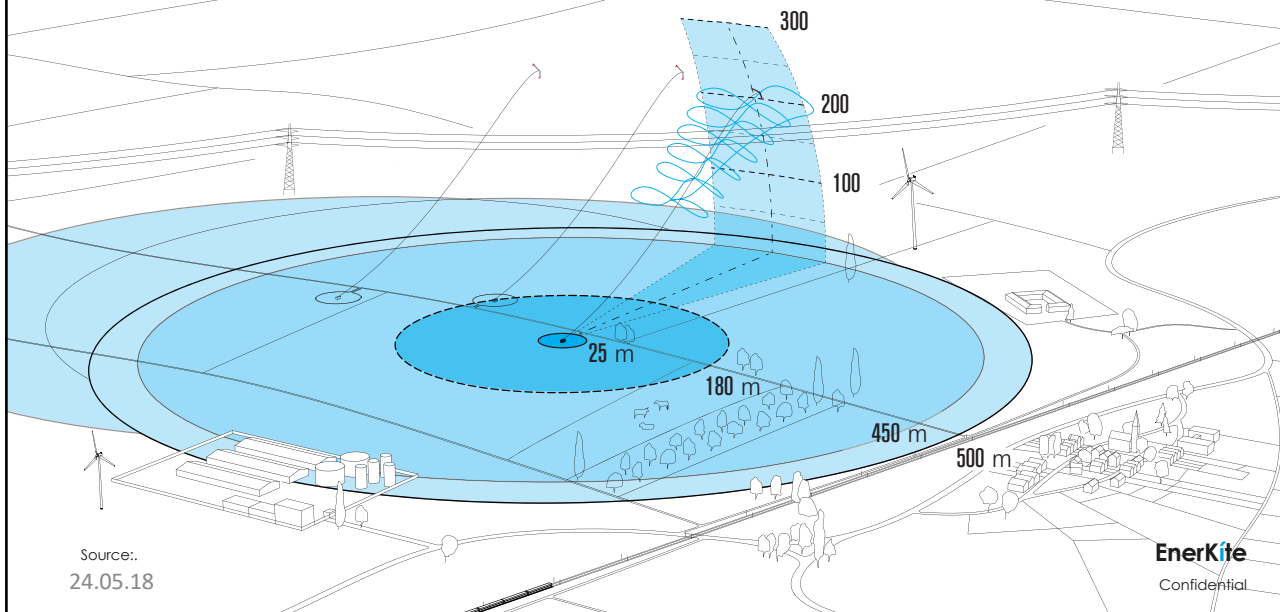
**1/40  
BEST**  
STARTUP  
AWARD

 **EU SEAL OF  
EXCELLENCE**

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## CONCEPT OF OPERATION

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## POTENTIAL STUDY

20

### Full load eq. hours and GIS based onshore potential

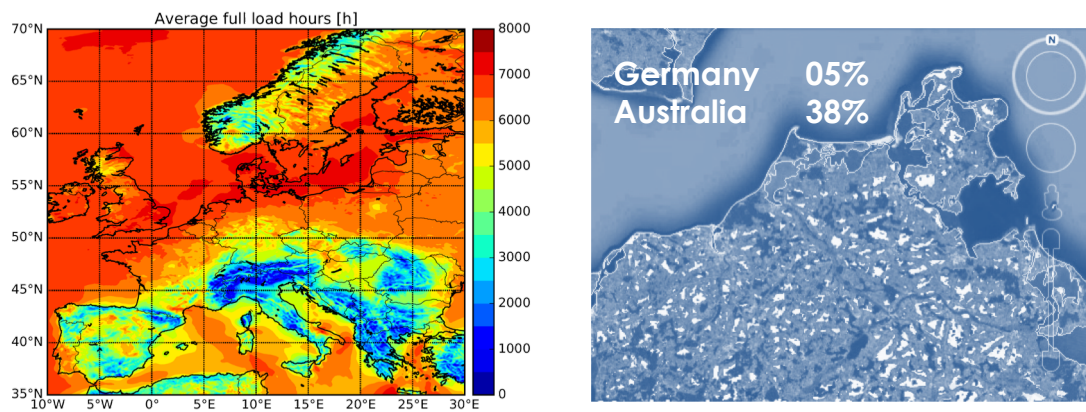


Table: Potential onshore capacity

Source: Irena Global Atlas 3.0, CIA The World Factbook, Global competitive index (GCI) 2017 - 2018 from <https://www.weforum.org>.

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