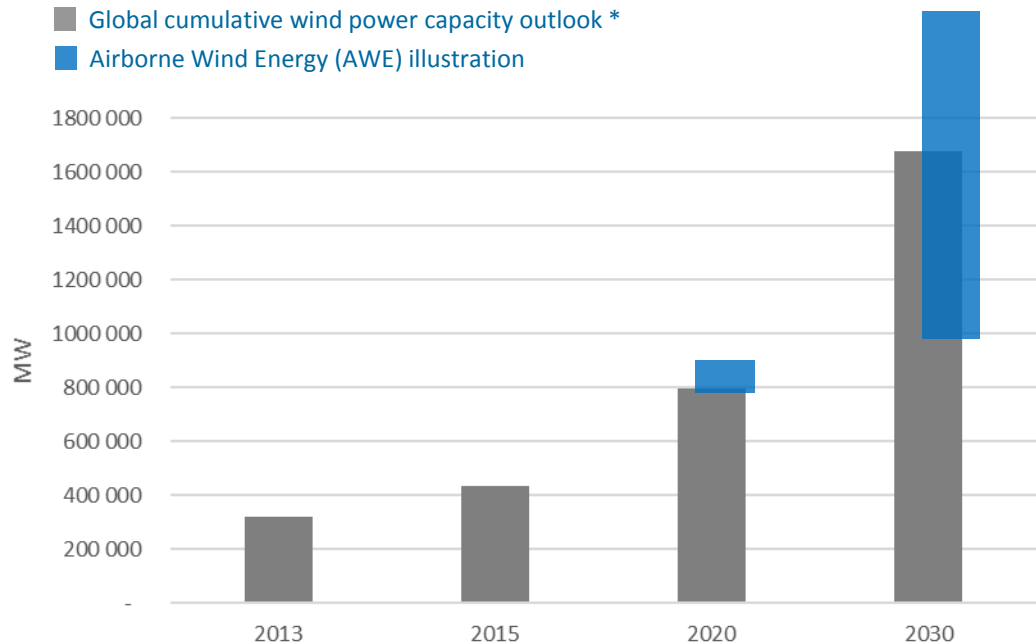




KICEMILL

TECHNOLOGY INTRODUCTION
ENERGISEMINARET 2017

POTENTIAL TO CHANGE THE OUTLOOKS



Kitemill: "Airborne wind is expected to capture part of the market and to even expand growth further"

Drivers:

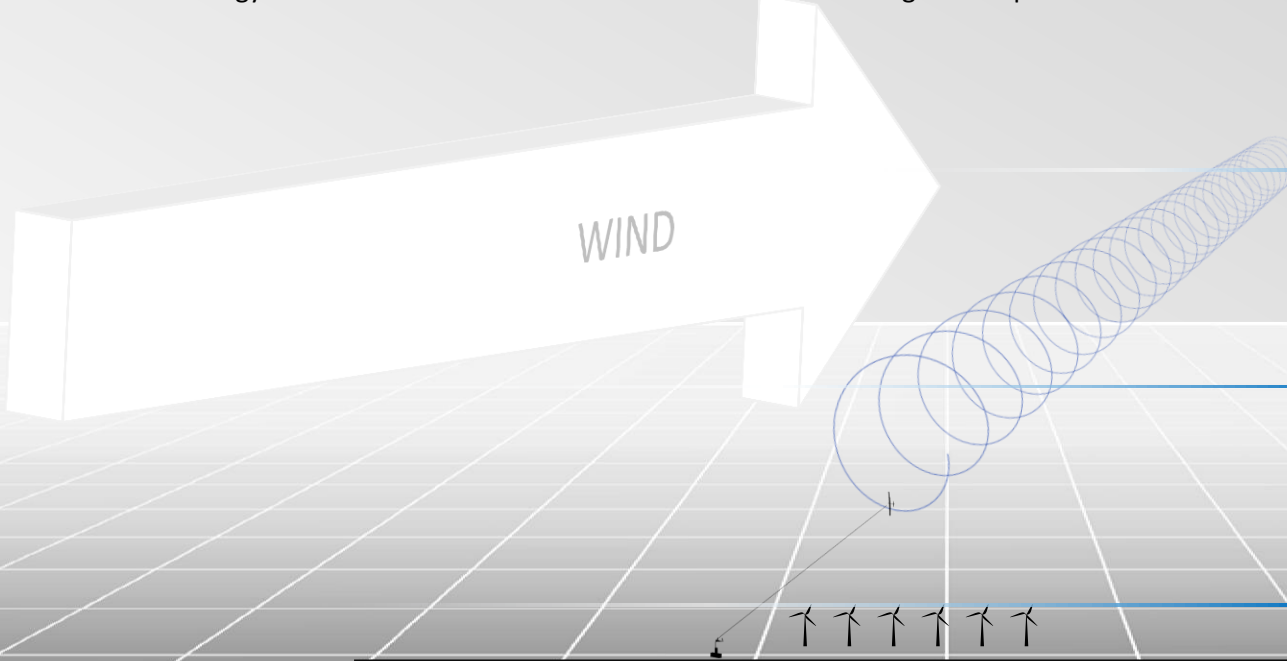
- Climate change
- Change to renewable energy
- A general more efficient society

Methods

- Politically enabled

WIND AT NEW HEIGHTS

THE WIND GRADIENT is an expression of the increase in speed and stability with higher altitude.
 The energy content of the wind varies with the **cube** of the average wind speed

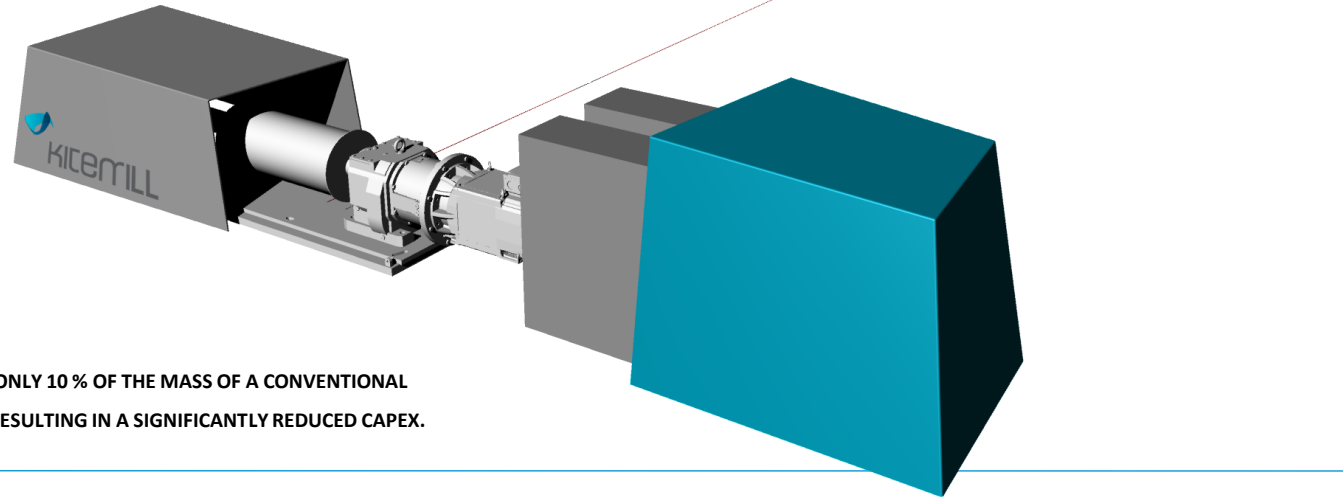


HEIGHT	AVERAGE WIND SPEED	AVAILABLE POWER
1 000 m	11 m/s	580 W/m²
500 M	8 m/s	320 W/m ²
100 M	5 m/s	80 W/m ²

A KITE TURBINE

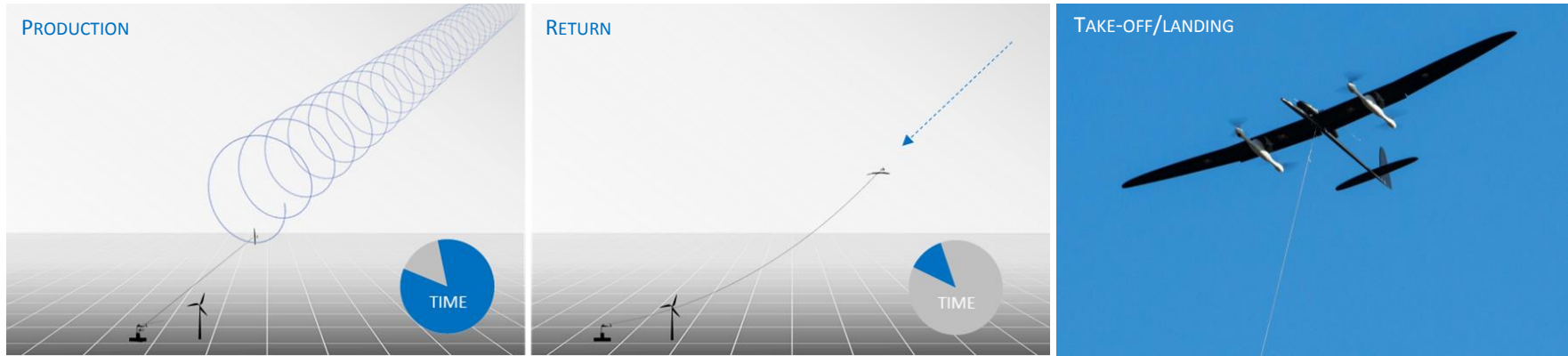
A kite turbine is made up of the following main parts:

- **A kite** - generates the tractive forces (lift)
- **Ground system** - converts the tractive force to electricity.
- **Control system** - controls winch and the kite



THE COMPLETE KITEMILL CAN BE BUILT WITH ONLY 10% OF THE MASS OF A CONVENTIONAL WINDMILL WITH THE SAME CAPACITY, THUS RESULTING IN A SIGNIFICANTLY REDUCED CAPEX.

HOW IT WORKS



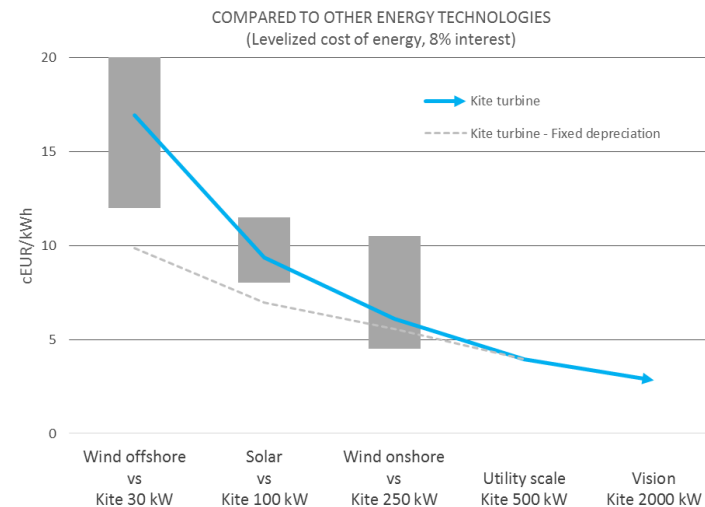
ATTRACTIVE WITH A POTENTIAL TO BECOME PRICE COMPETITIVE

1. Potential to become price competitive:

Cost calculation - unit cost:		Kite (Vision)	Windmill (year 2014)
Power	kW	2 000	2 000
Full load hours per year	hrs	4 200	2 453 ⁽¹⁾
Annual production	GWh	8,4	4,9
CAPEX	M€	1,5	2,5
Average energy cost LCoE:	c€/kWh	2,8^(2,3)	6,8

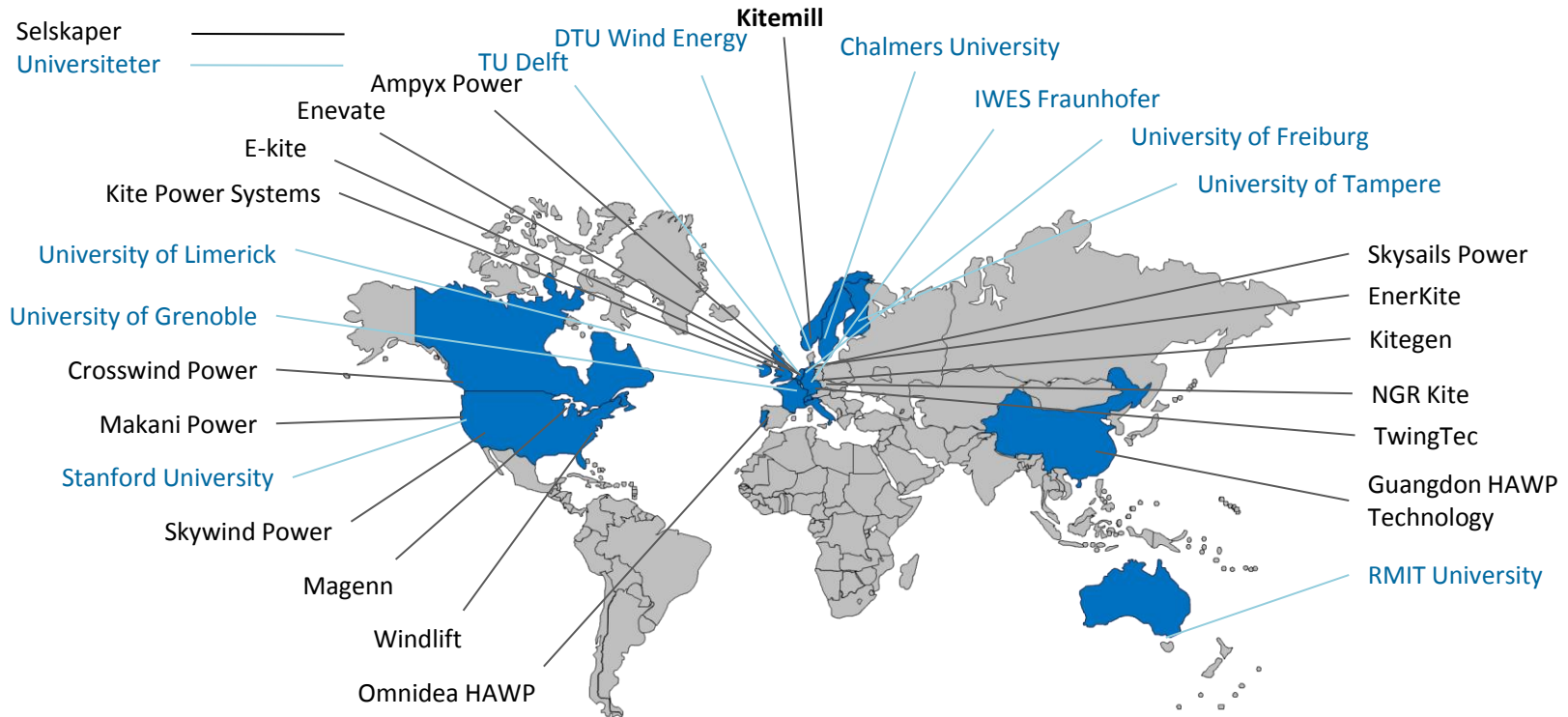
2. The geographical market is very large due to the availability of wind at high altitudes

High altitude winds are more often available than near surface winds.



⁽¹⁾ Average world GWEC 2015, ⁽²⁾ Annuity 8 % x year ⁽³⁾ Real (excl. inflation)

ON THE VERGE OF A BREAKTHROUGH




Source: Delft University www.kitepower.eu, modified by Kitemill.

Commercial sub-suppliers are not included even if their involvement includes investments and thereby «risk taking».





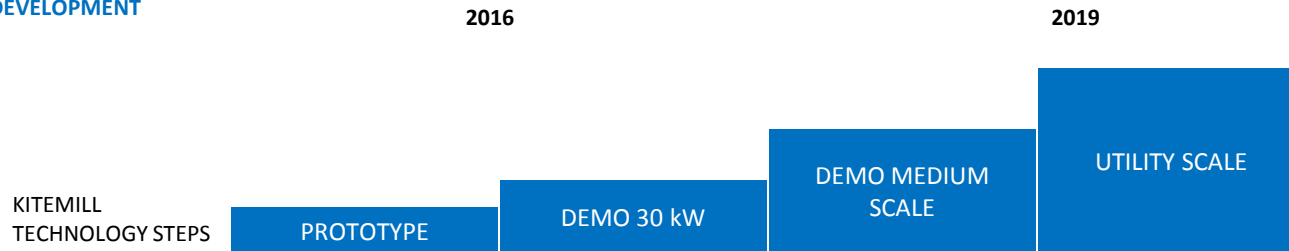
- 
- The image shows a Kitemill autonomous aircraft, a fixed-wing plane with a white fuselage and black wings, mounted on a white launch pad. The launch pad is placed on a grassy field. The aircraft has 'KITEMILL' written on the wings. The background features a large, dark, flat area, possibly a dry lake bed or a field, under a clear blue sky.
- 2008 Kitemill founded
 - 2010 Statement of Feasibility by DNV
 - 2012 Rigid wing design, carbon fiber
 - 2015 Autonomous production of energy
 - 2016 Autonomous in all configurations + 30 kW prototype
 - 2017 Making control system robust for 24/7 operation.



THE SCALE UP RACE

There will be a race towards competitive energy cost and larger scale units.

PRODUCT DEVELOPMENT

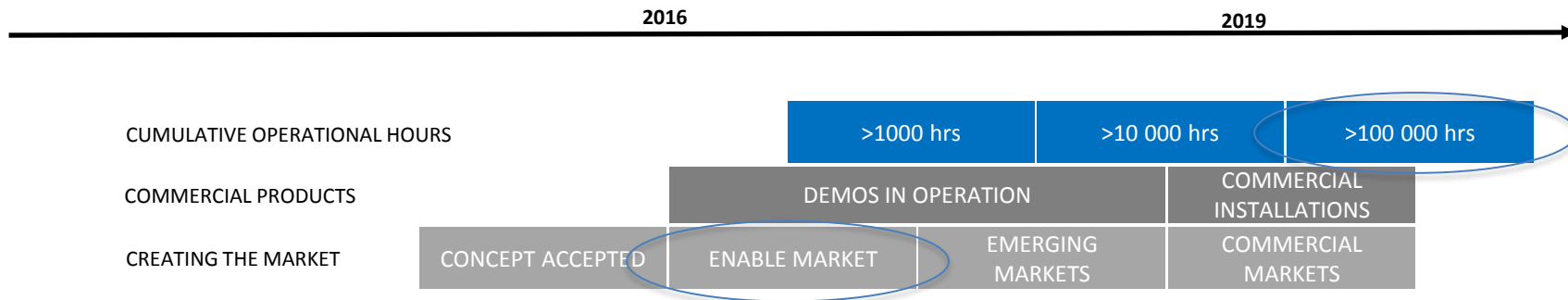


EFFICIENCY RATE WILL INCREASE BY SIZE

OPERATION & MAINTENANCE COST WILL REDUCE BY SIZE

Scaling up is possible as safety and reliability become proven by the former version, the changes cannot be too large as that would make the former operational experience less relevant. **The real scale up race** is about scaling up the customers ability to fund their projects.

RAPID COMMERCIALISATION

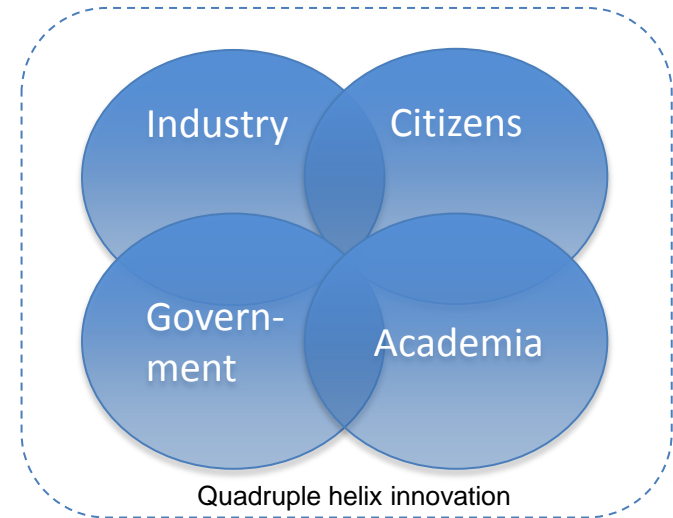


MAIN TARGET IS TO ALWAYS GENERATE MORE OPERATIONAL HOURS THAN ANY OTHER AWE SUPPLIER.

THE GREEN INNOVATION MODEL

How to make a successful technology introduction?

- The Danish model for wind has been profitable for Denmark.
- The German model for solar has been successful for the energy mix in Germany.



BUSINESSES + AUTHORITIES + SCIENTIFIC INSTITUTIONS + THE CIVIL SOCIETY

CREATING A MARKET PLACE FOR DEMO PLANTS





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