Windswept

Kite Turbines

Investment Pitch, April 2022

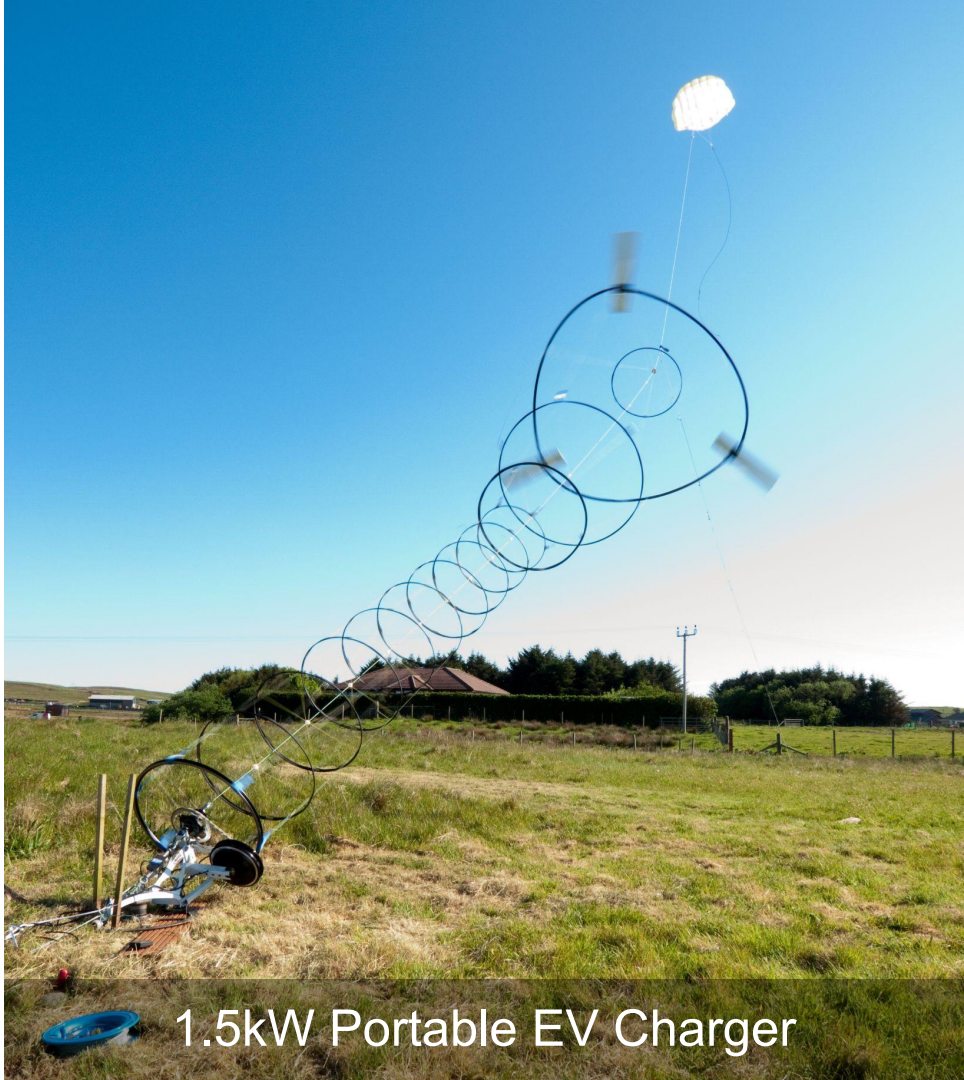
Windswept

Kite Turbines

for **Cleanest**

& **Cheapest Energy**

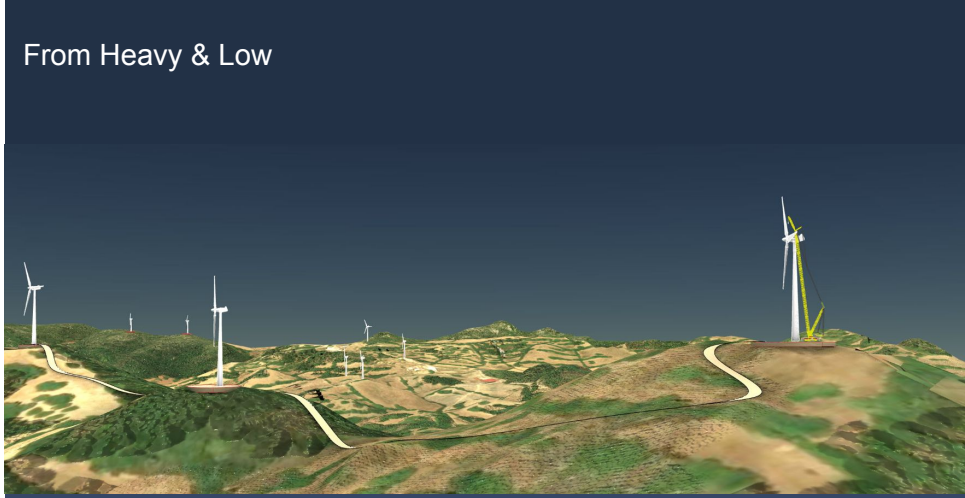
0.17gCO2e/kWh @<5p/kWh

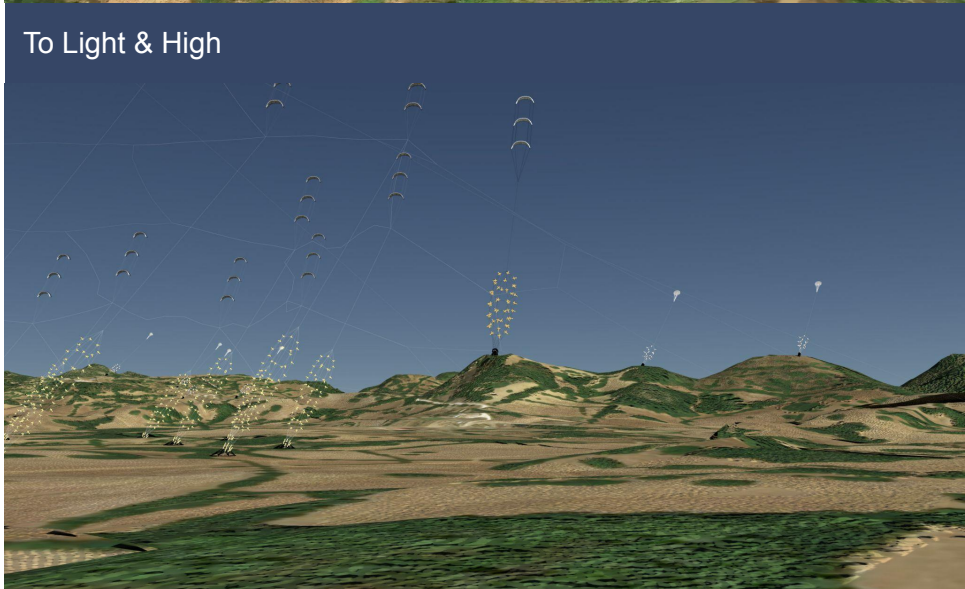


Vision

Automate Kite Turbines
for **scaling safely**

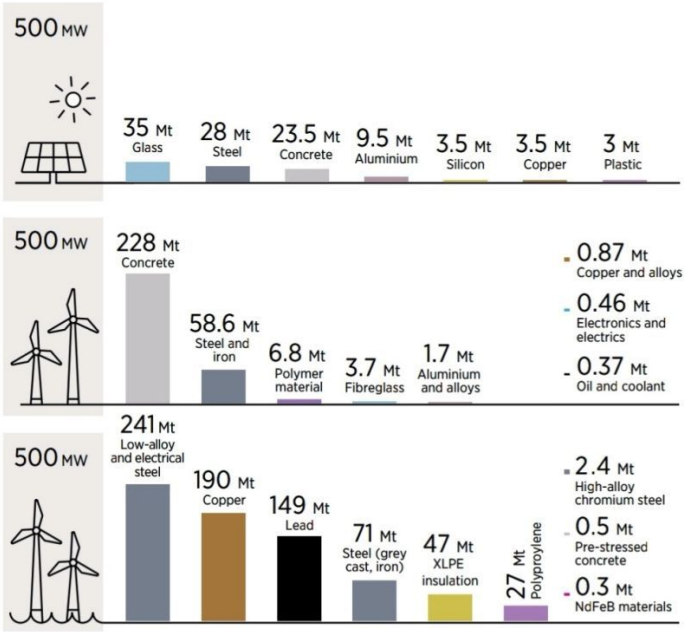
Starting with a 50kW product

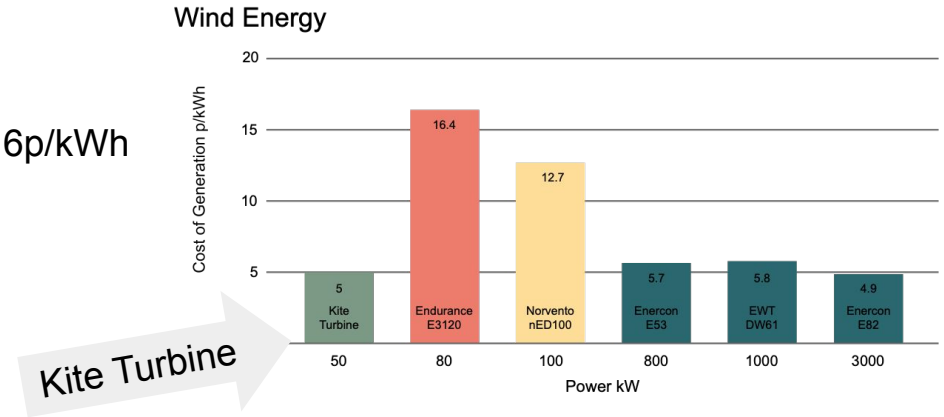




Problems

Small Wind is Too costly c.16p/kWh





Large Wind is Too Carbon intensive

Opportunity

Small Scale Solar Economics

- 50kWp solar energy costs **7p/kWh**
- An average UK 50kWp solar PV generates ~44MWh per year

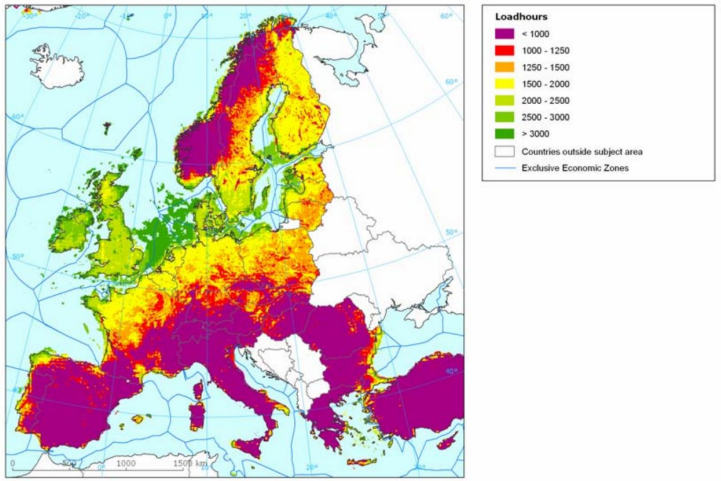
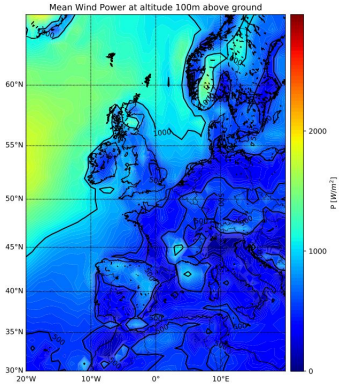
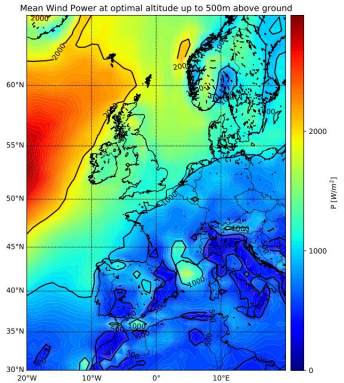


Figure 3-10: Distribution of full load hours (80m hub height onshore, 120m hub height offshore) over Europe

Kite Turbines cost less with higher output

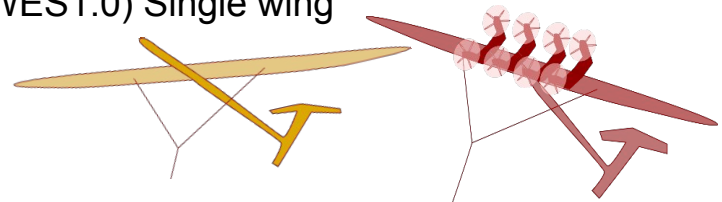
- A 50kW kite turbine energy costs **5p/kWh**
- A UK site with a capacity factor of c.30% will generate over 130MWh per year





Competitors

(AWES1.0) Single wing



Energy Price: >7p/kWh

R&D Investment to date:

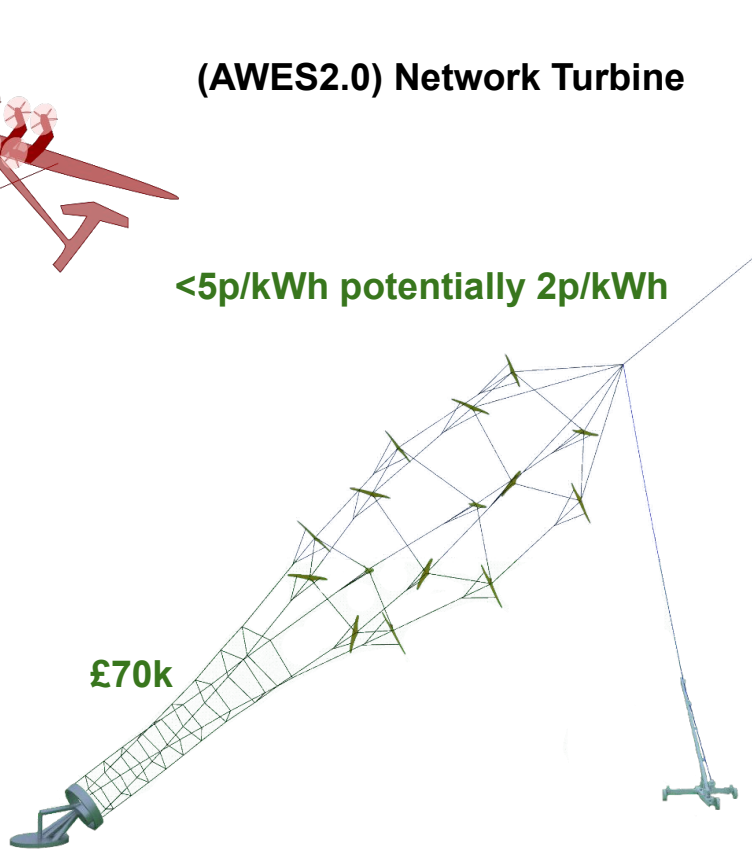
>£400M >£500M

Our Solution

(AWES2.0) Network Turbine

<5p/kWh potentially 2p/kWh

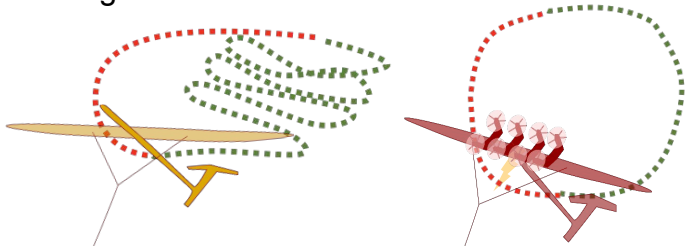
£70k



- Less airborne mass
- Safer
- More efficient
- Scalable parameters
- Easier control
- Continuous output
- No line wear
- Faster & deeper in the power zone
- Backline launch & recovery option
- Less ground area used
- Modular build and maintenance

Better

Phased power - poor performance from high-risk and high-mass single blade



Yo-Yo

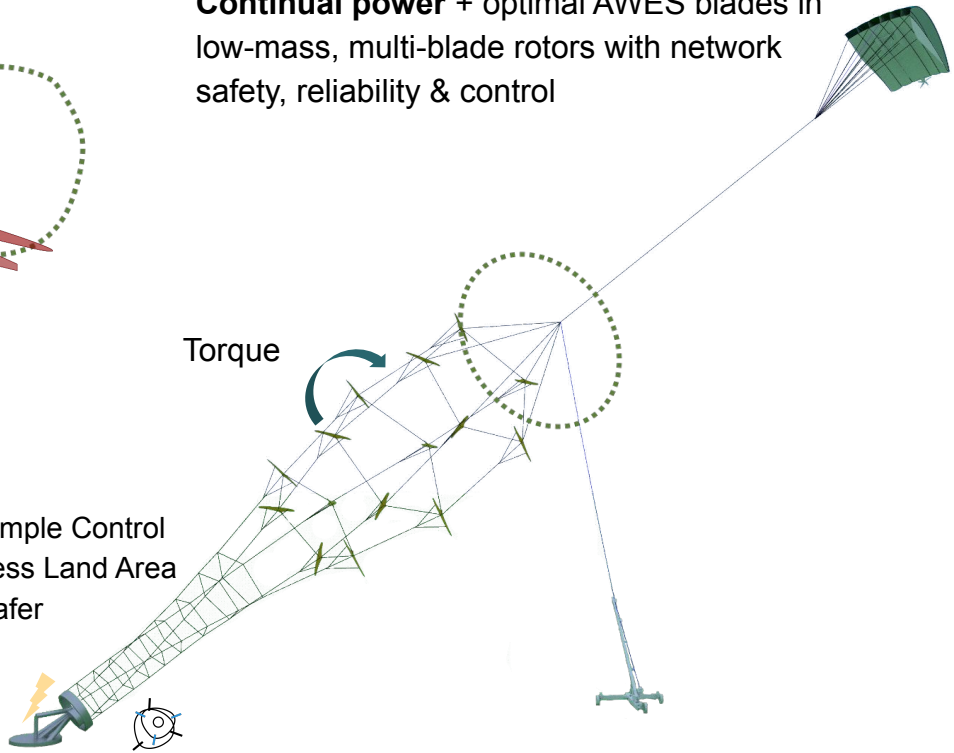
Fly-gen

Complex Controls
Excessive Land Area

SkySails
kitemill
ampyx power

MAKANI
KITE//KRAFT

Continual power + optimal AWES blades in low-mass, multi-blade rotors with network safety, reliability & control



Torque

Simple Control
Less Land Area
Safer

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Progress ...

2013

Company founded by Rod Read

Open Designs & Research

2016 - 2020

60 Kite turbine prototypes

Research with Univ. of Strathclyde

2019

Build and test of first major prototype

Dynamic Principle Defined

2020

Patent Granted

AWES Power/Weight Record

2021

Shell Gamechanger grant win.

Funding from HIE & Shetland Islands Council

2022

Shell Phase 2 - test and production set-up

2022

Shell Phase 1 - scoping for 10kW prototype development

2023

Shell Phase 3 - production ramp-up of 50kW + Offshore turbine scoping

Market strategy

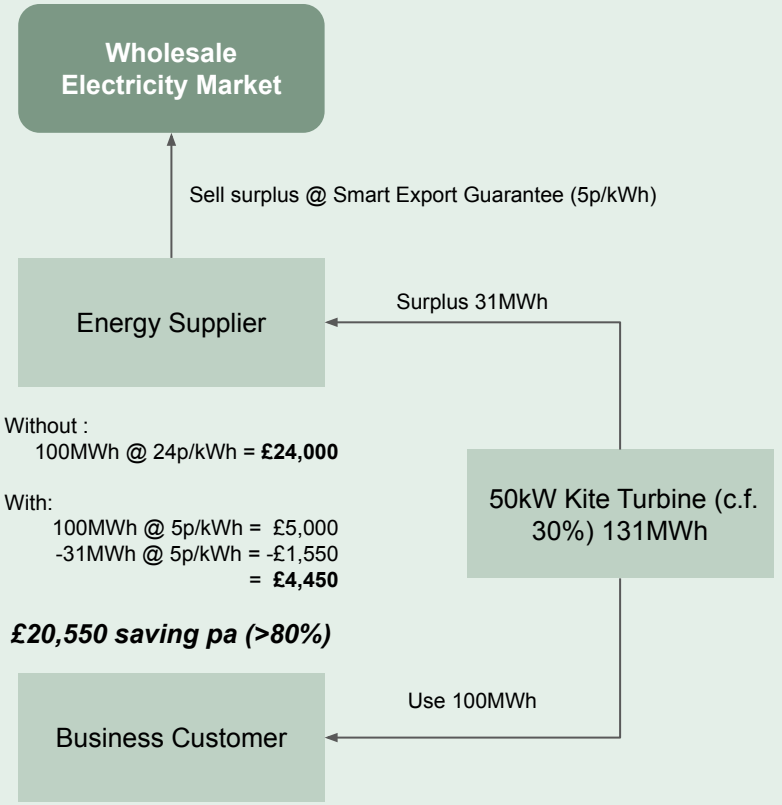
Businesses with annual demand >100MWh

In 2019 **43,270 UK businesses** consumed over 100MWh of electricity per year[2]

Electricity supply tariff is c. 24p/kWh and rising. The consumer will save 19p on every kWh of generation consumed

The consumer will be offered the option to **finance the turbine**

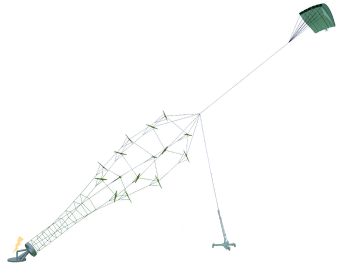
We will implement condition monitoring for predictive maintenance with modular replacement parts.



The Plan

Offer *a* **fully autonomous 50kW turbine** for sale under £62k **by the end of 2023**.

Our project delivery plan, as contracted with Shell GameChanger funding is:



Phase 1	Phase 2	Phase 3
2022	2022-2023	2024+
£190k 100% retro-funded	£710K 50% retro-funded	>£1M 15% funded
Ask £0	Ask £350k SEIS @ 10% + EEF or IUK	Ask ~£850k
On-going scoping, design and specification for validation.	Prototype build, test and data analysis. Techno-economic report and market research. Initial beta product sales.	Production build and sales of 50kW turbines. Scoping for assessment of offshore and scaling potential.

Board

Rod Read

CEO CTO

- Founder, inventor
- E&E Engineering, Comms, Offshore, Aquaculture

Oliver Tulloch

Engineering

- PhD in Kite Turbine
- Greenland Kite Turbine adventurer
- PT modelling dynamics

Anthony Waite

Commercial Lead

- 15+ years European Power Wholesale Markets
- MEng Electrical Engineering

Peter Jamieson

Non Exec Chief Scientist

- U-o-Strathclyde Formerly Garrad Hassan & Partners
- Author of Innovation in Wind Turbine Design
- Global expert in wind power scaling

Dr Hong Yue

Non Exec Control Systems

- Host AWEC 2019
- Control and optimisation of complex systems WECC Strathclyde

Team

We are seeking funding to build our team of engineers, management and technical staff

Financials

	Commencing Sept 22	Year 2 Beta	Year 3
Units sold	0	18 in UK	124
Sales 50kW Units @ £62k	0	1,116,000	7,688,000
COGS	0	(450,000)	(3,100,000)
Gross Profit	0	666,000	4,588,000
Total expenditure	(509,130)	(972,640)	(1,386,660)
Cost of sales	(50,000)	(100,000)	(100,000)
Net profit	(559,130)	(406,640)	3,101,340
Net cash flow	(509,130)	(815,770)	2,385,570
Head count	16	20	27

Investment Summary

Our project requires match funds.

Shell GameChanger project partner and customer
With **Highlands & Islands Enterprise** and
Shetland Islands Council.

Raising £120k SEIS on valuation of £1.3M
then **~£850k EIS** for production phase

The funds enable us to

- Employ
- Deliver
- Market in 2023

Wind Energy Partnerships Welcome

Long Term

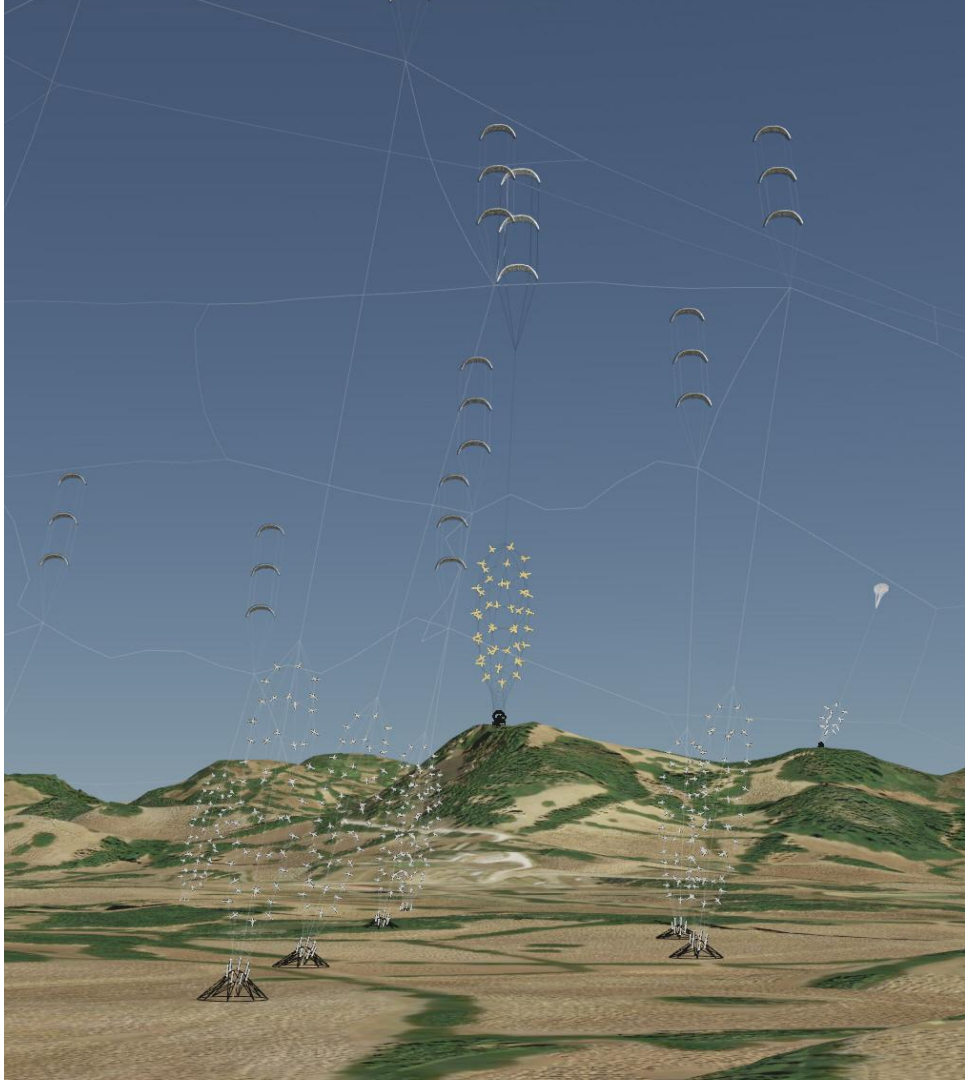
Kite Turbine Networks avoid cubic mass scaling

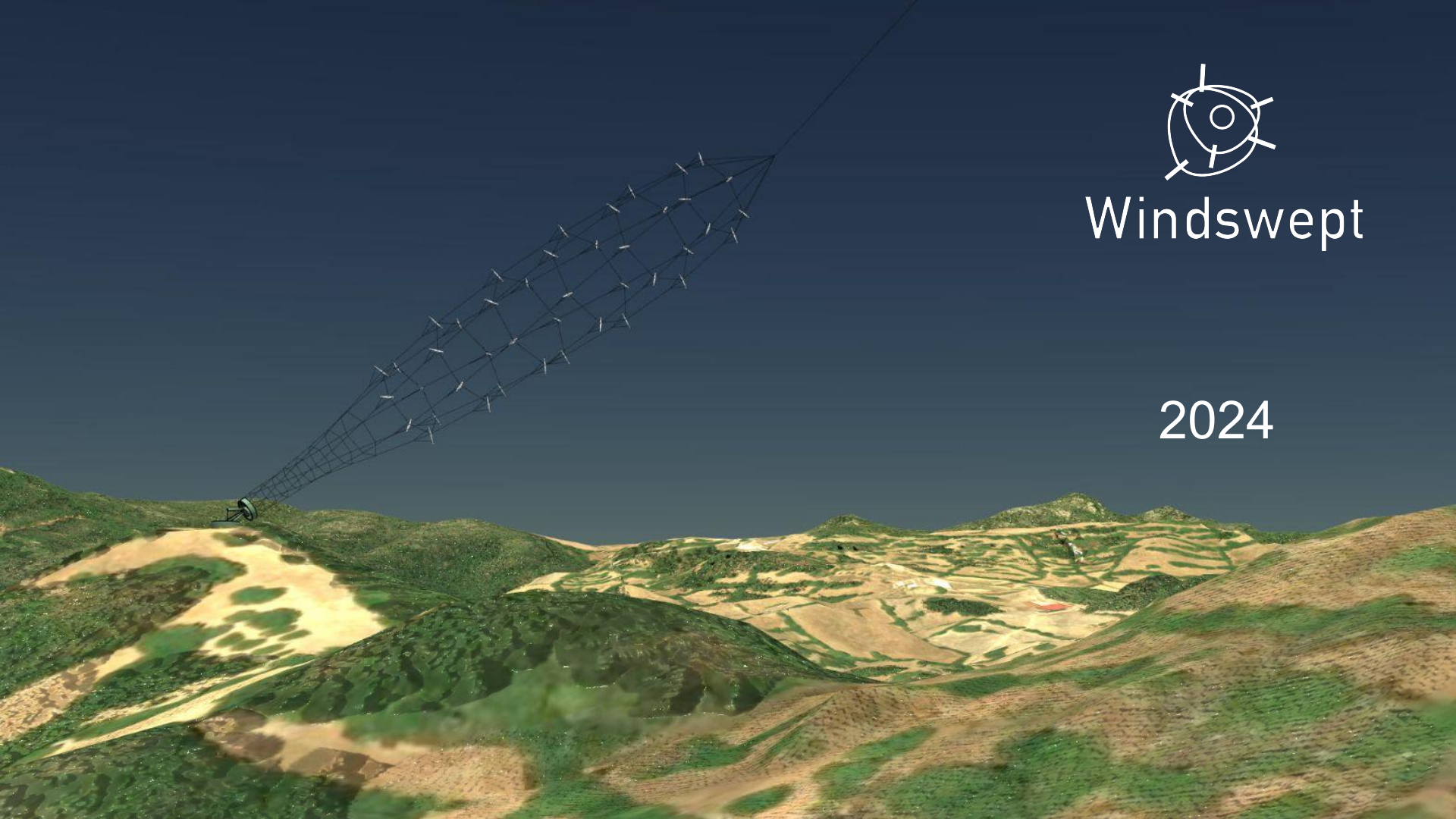
So they can be really big

Power-to-weight ratio ~2kW/kg.

Endurance E3120 50kW = power-to-weight ratio of only 0.02kW/kg

Traditional wind turbine mass grows faster than power as wind turbines scale

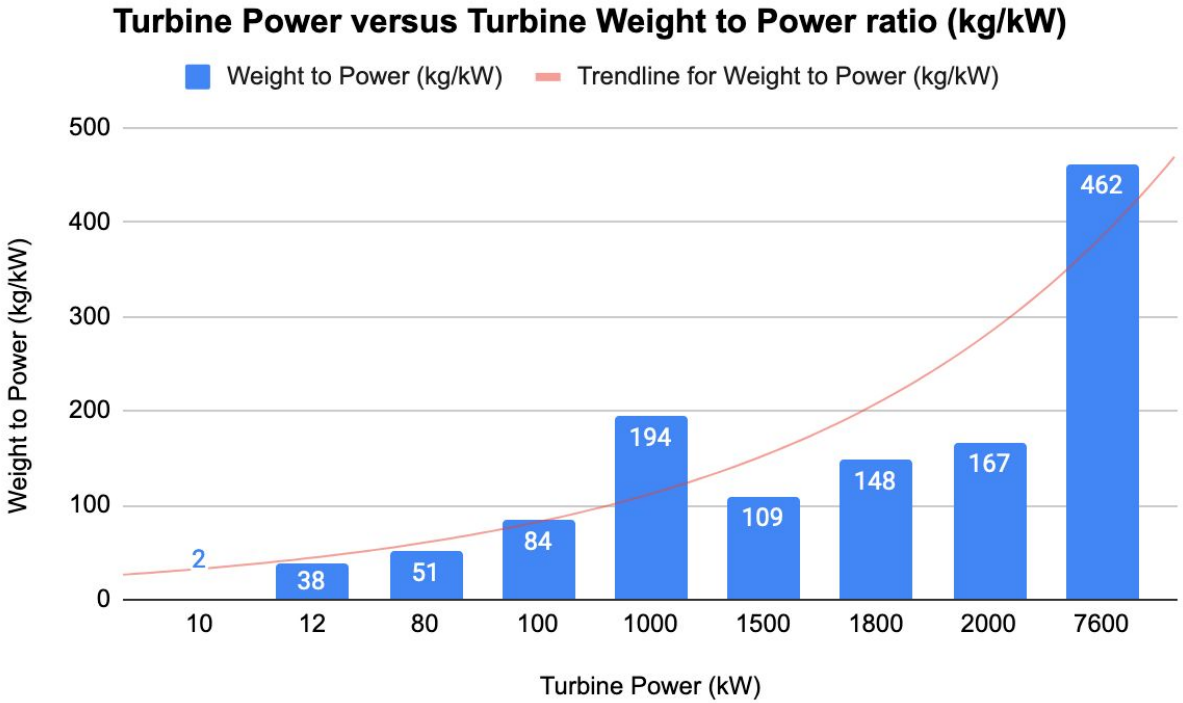



Windswept
2024

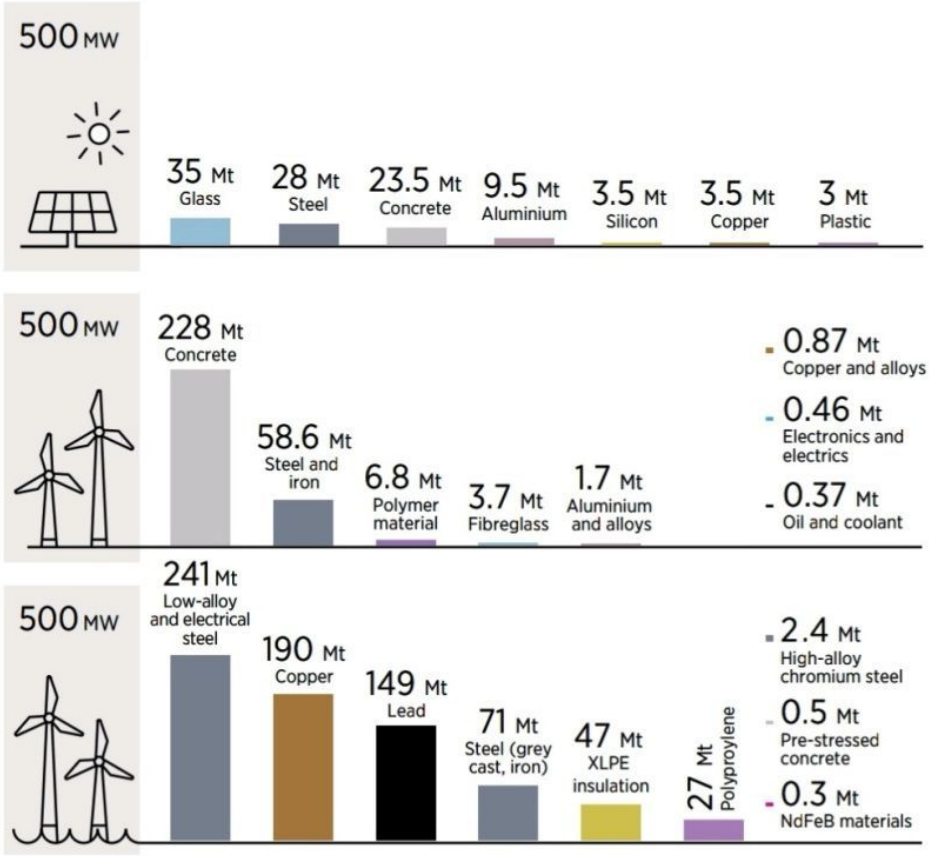
References

1. Levelized cost of energy (the LCOE)
2. Business population estimates for the UK and regions: 2019 statistical release
3. https://www.gov.uk/government/statistics/solar-photovoltaics-deployment
4. ELECTRICITY GENERATION COSTS 2020

Appendix


Turbine Power versus Turbine Weight to Power ratio (kg/kW)
Weight to Power (kg/kW)
Trendline for Weight to Power (kg/kW)
Weight to Power (kg/kW)
500
400
300
200
100
0
2
38
51
84
194
109
148
167
462
10
12
80
100
1000
1500
1800
2000
7600
Turbine Power (kW)

Appendix Mass Reduction



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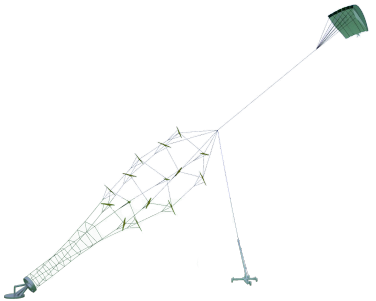
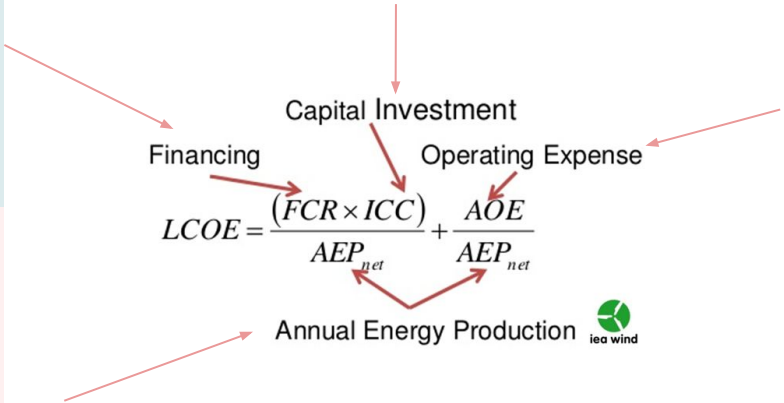


Appendix How Kite Turbines reduce the Cost of Energy

Recoverable Assets
Low Engineering Cost Barrier
Insurable Safe Design
Consenting lower AWES altitude
Environmental & NIMBY consent
Diverse Deployment Locations
Estimates from short deployments
ESG compliance

Low cut-in ~3.5m/s
Fast Servicing
Constant Autogyro Output
Redeploy to match resource
Runs in Perfect Kite Window

Rapid Modular Production from Minimal Facility
Tensile Turbine Array modular configuration options
Simple System Autonomy via ground control sets
Low footprint & Lightweight ground generation

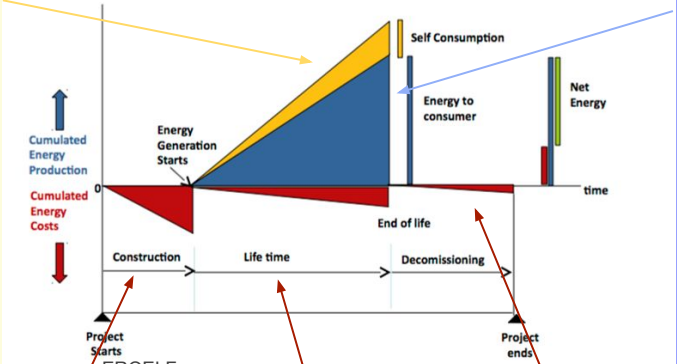


Back-drive mode to stay aloft
Line Fairing enhancements
Stacking efficiency –Low line drag/blade

Lightweight modular deployment
Deployment from ground level
Servicing at ground level
Modular servicing
“Disposable” blade costs
Low tech repairs
Simple deployment training
Transportable & Relocatable
Smooth Array network control
No running line wear
Tensile overspeed tolerance
Storm shelter recovery mode
Offshore-able

Appendix How Kite Turbines Improve Carbon Cost of Energy gCO2e/kWh

Lightweight modular deployment
Operations at ground level
Modular servicing small blades
Less material per kW than higher altitude AWES
Modular deployment matches shear profile
Banked upper blades in high Lift
Banked lower blades in low drag
Low mass blade deployments match wind energy capacity For AWES extraction
Efficient array smoothed network control
Low blockage hollow axis stacking



EROEI From www.euanmearns.com

Large wind range
Low cut-in ~3.5m/s
Back-drive mode to stay aloft
Rings matched to shear profile
Constant autogyro output
Redeploy to match resource
Runs in perfect kite window
Low line drag per blade area
Low control mass overhead improves production capacity
Tensile network scaling
High deployment density
Large swept area
Good wake recovery from low TSR

Rapid Modular Production from Minimal Facility
Tensile Turbine Array and minimal ground station
Modular configuration to ease deployment matching
Simple System Autonomy via ground control sets
Low footprint & Lightweight ground generation
Structure and capability from wind pressure

Servicing at ground level
Fast Low tech modular repairs
Azimuth alignment from form
Low ground use

Recoverable asset
Relocatable modules
Lightweight & recyclable material