

Airborne Wind Energy:

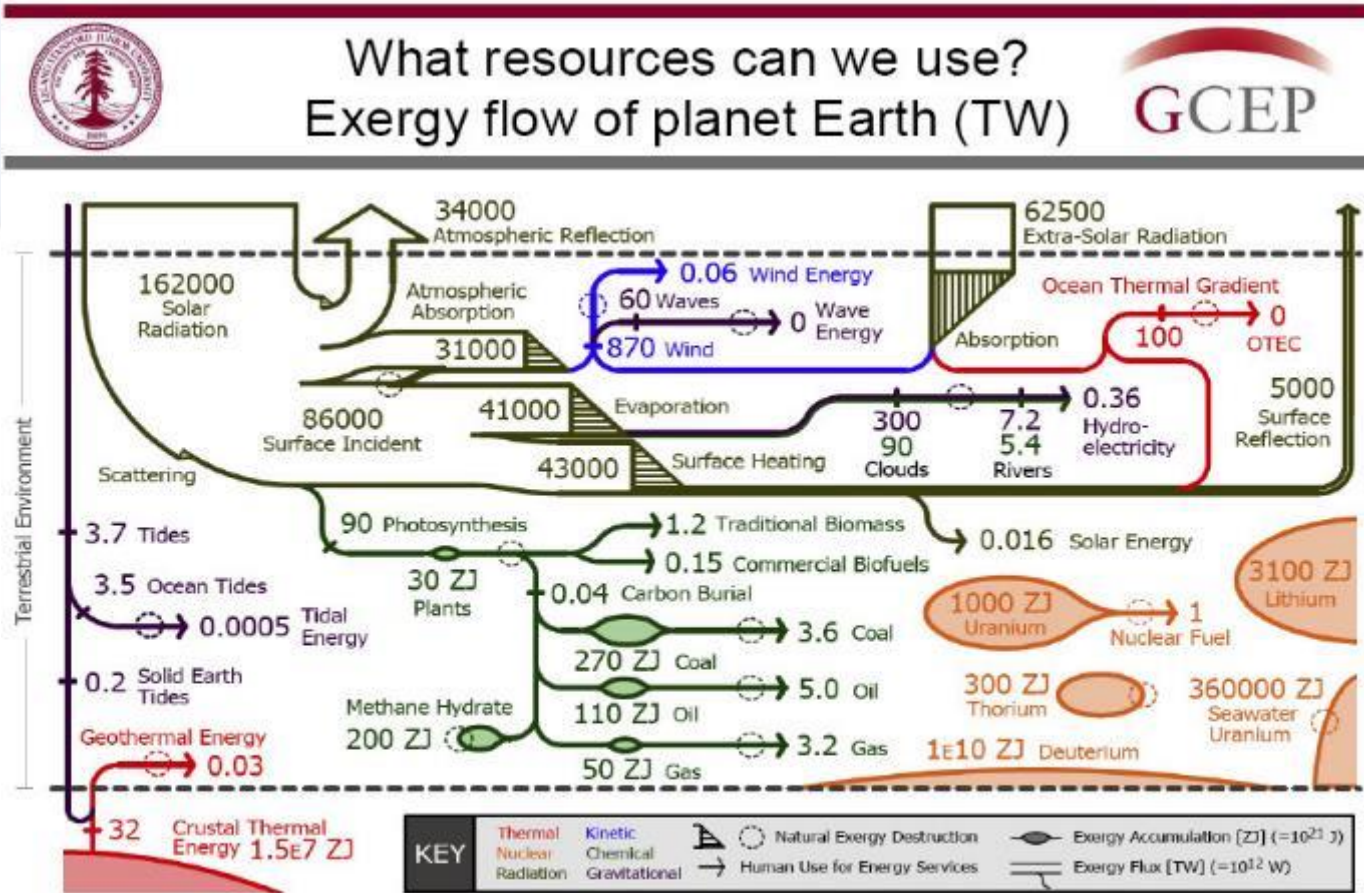


Opportunity or Pie in the Sky?

The Problem



Available Exergy Sources



Humans use an average of 15 TW of energy or 450 EJ/year

Existing Renewable Energy Technology



Biomass



Solar-Thermal



Solar-PV



Geo-Thermal



Hydro



Wind

Wind Energy as Function of Altitude: 100m

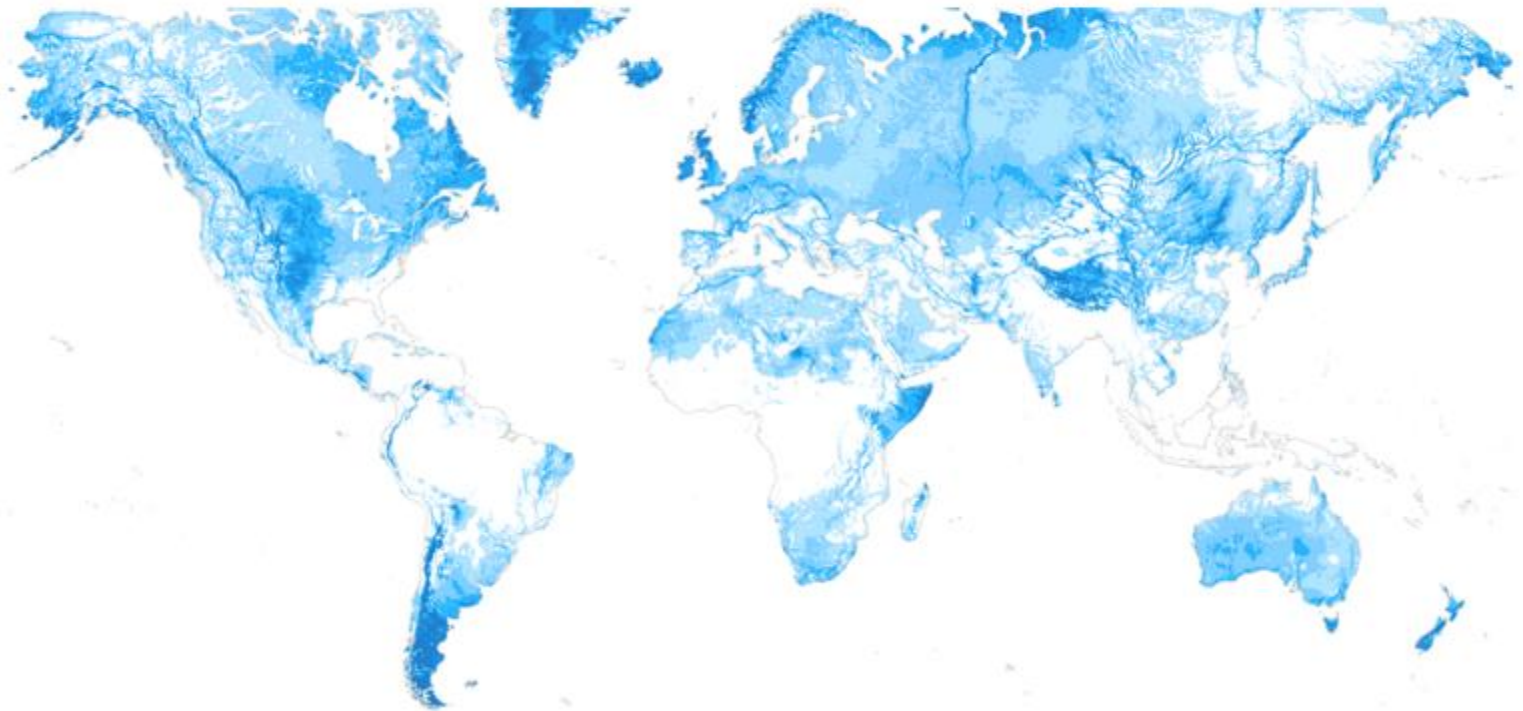
Wind speeds (m/s)

6 7 8 9 10+

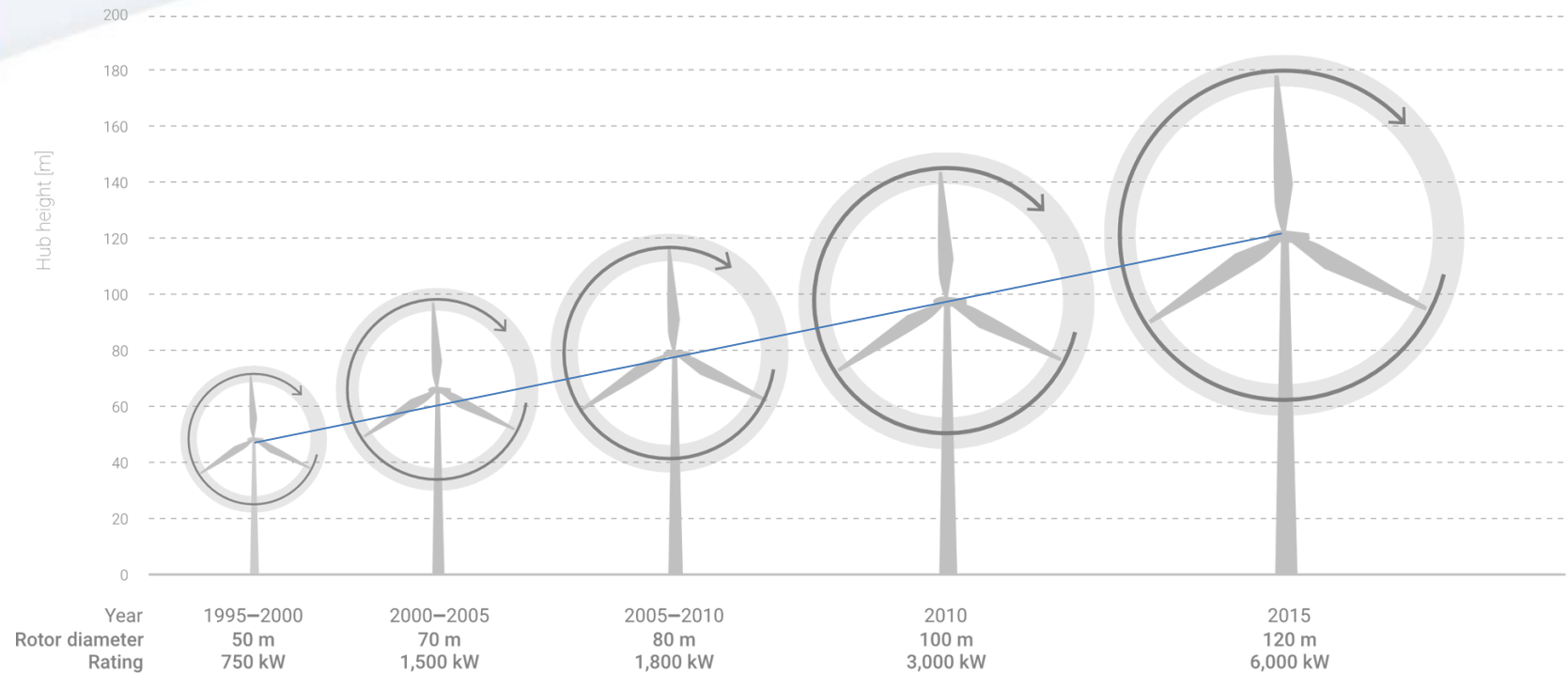


Wind Energy as Function of Altitude: 250m

Wind speeds (m/s)

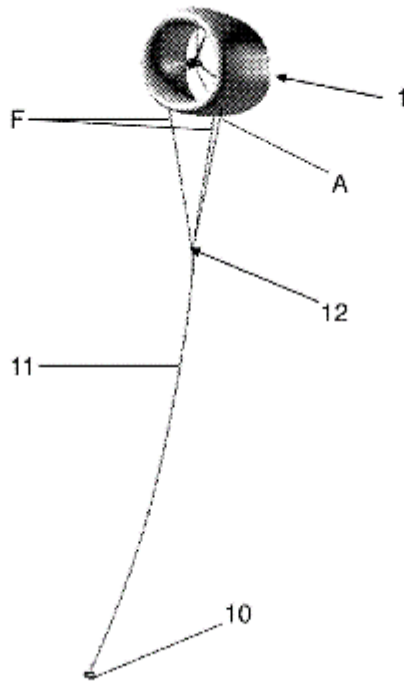


New Technologies are Needed to Tap Into Higher Altitude Wind!

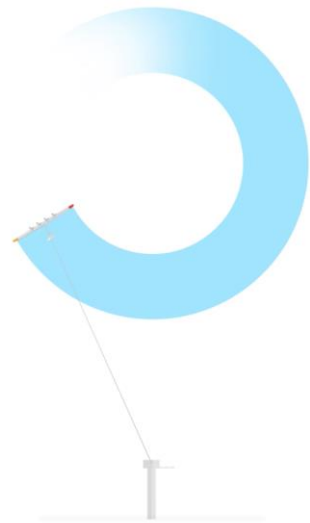
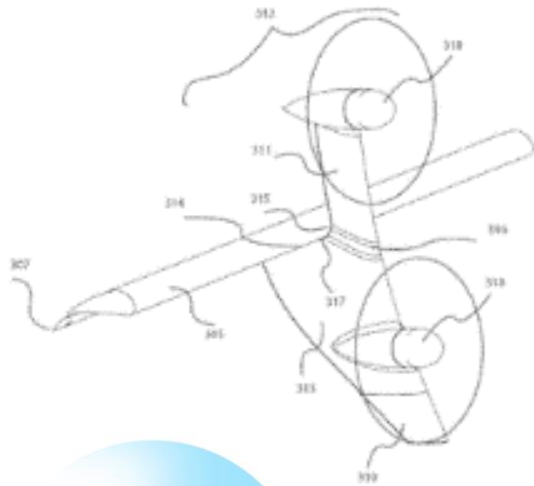


Source: National Renewable Energy Laboratory

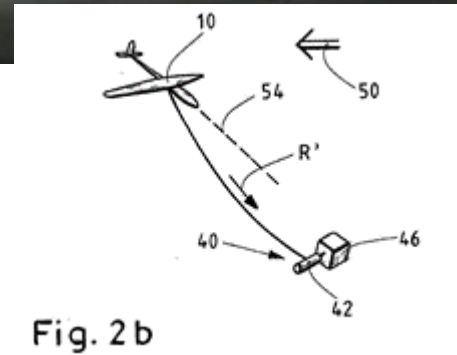
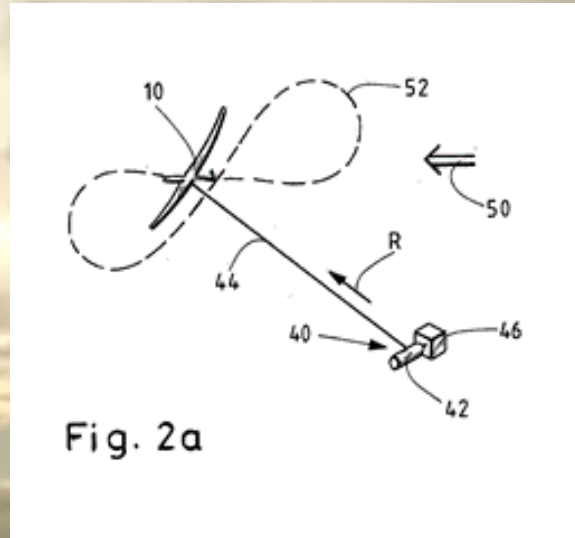
AWE Technology Explanation: Static Systems



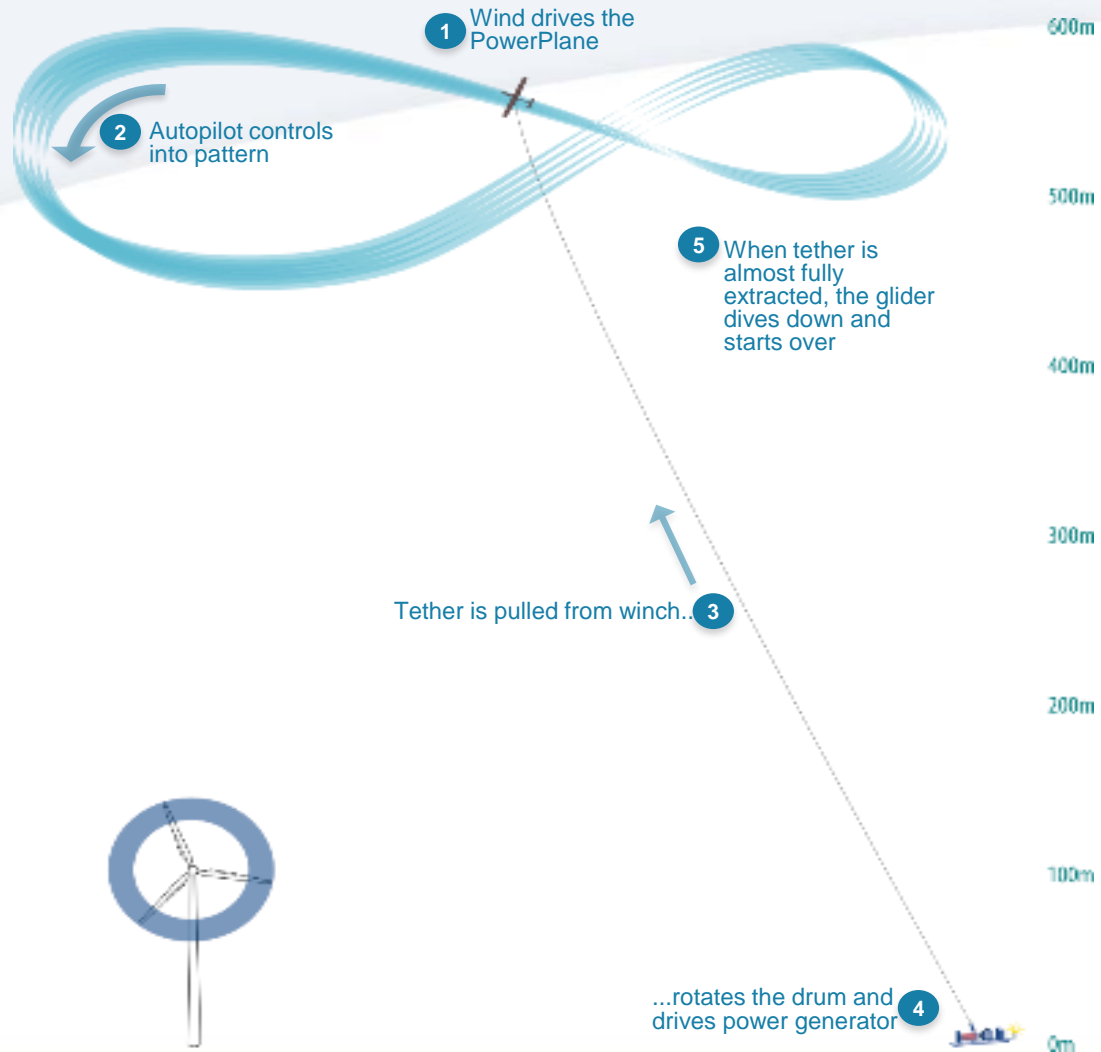
AWE Technology Explanation: Cross Wind – Drag Mode



Technology Explanation: Cross Wind - Lift Mode



Technology explanation: Swept Area



What are the Benefits of AWES?



Materials use



Foundation



Transportation



Installation

What are the Benefits of AWES

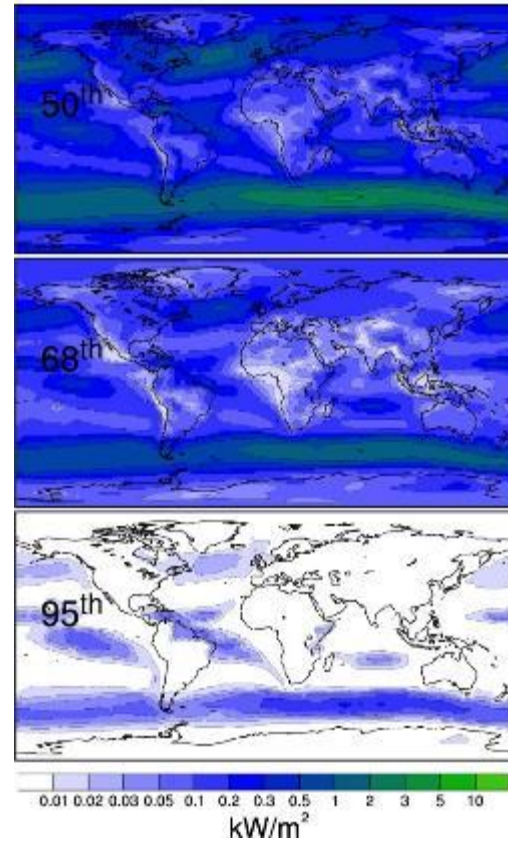


Visual Impact



Wake effects

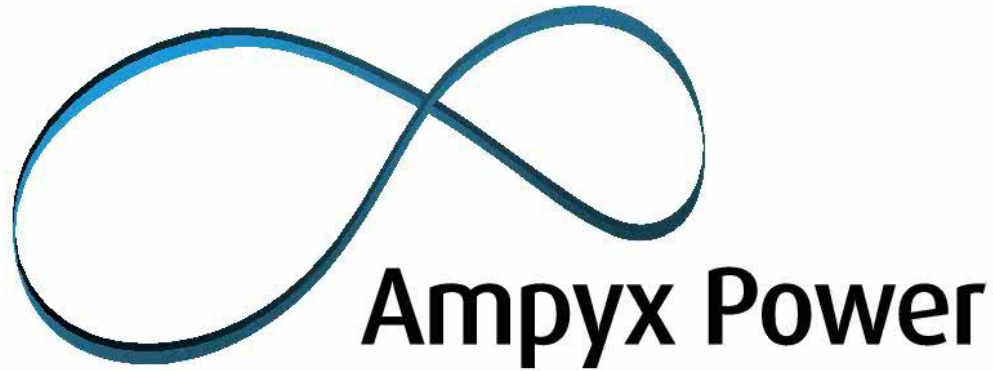
Level = 1000 m



Energy yield

What are the Benefits of AWES?

Visual Impact



**Autonomous pattern flying
View from the anchor point
November 2012**

Where is Airborne Wind Energy Technology Today?

Ampyx Power
airborne wind energy

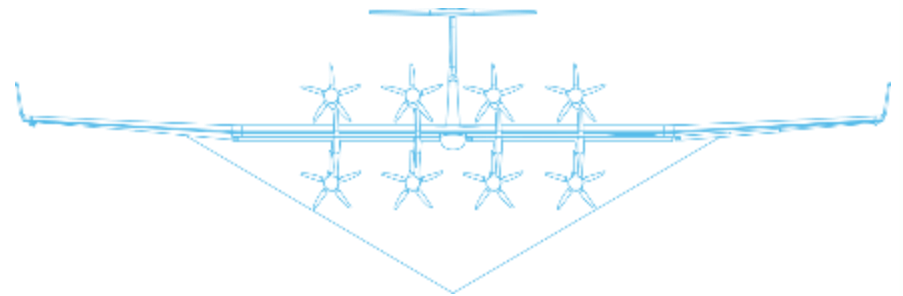


Altaeros: 20 kW commercial prototype system

Where is Airborne Wind Energy Technology Today?



Makani Power: 20 kW commercial prototype system fully tested



600 kW commercial prototype system initial tests

Where is Airborne Wind Energy Technology Today?

Makani Flight Test

Ampyx Power
airborne wind energy



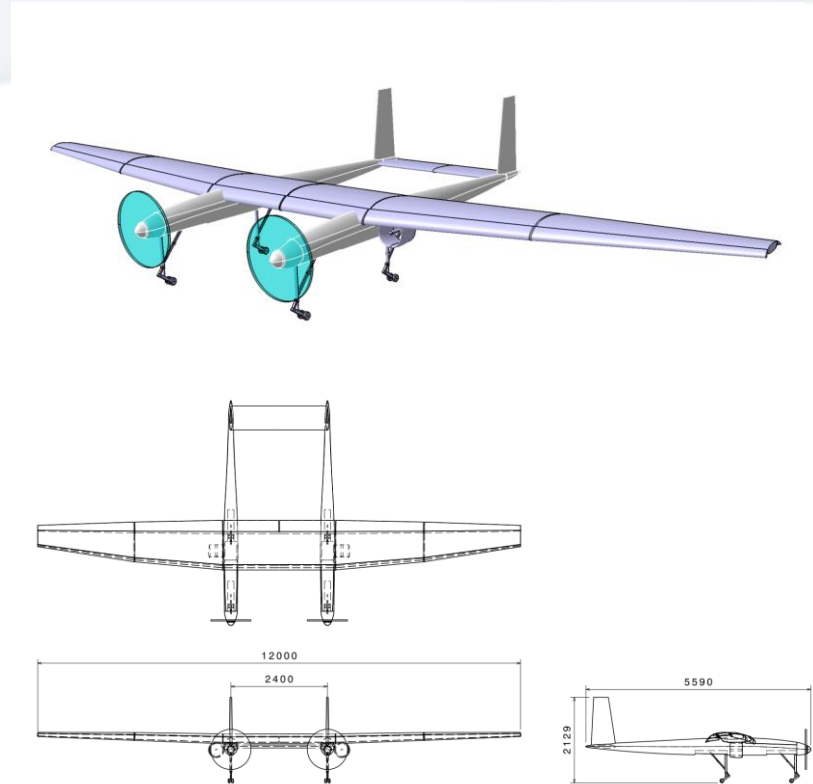
here is Airborne Wind Energy Technology Today? Makani Hoover Test 600kW system



Where is Airborne Wind Energy Technology Today?



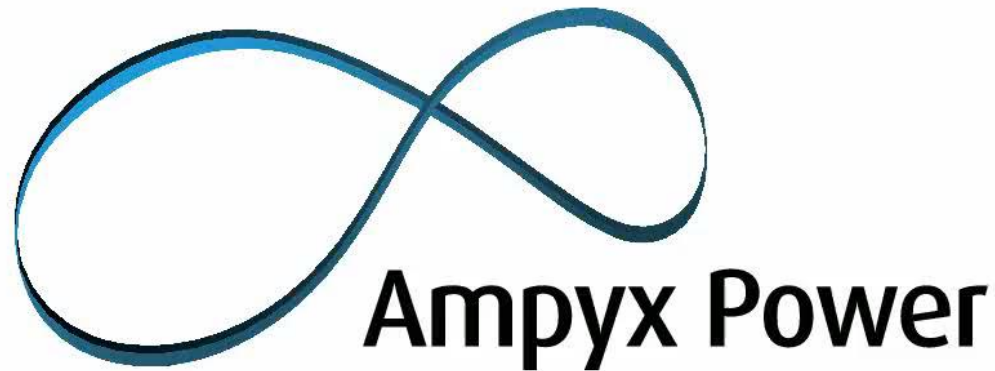
Ampyx Power: 20 kW commercial prototype system fully tested



250 kW pre-commercial prototype
2016 2.5 MW commercial type 2018

Where is Airborne Wind Energy Technology Today?

Ampyx Power flight test



50 minutes autonomous flight
Complete video from the on-board camera
November 2012

Airborne Wind Energy: Opportunity?



Source: Big Hero 6

Or pie in the sky?

