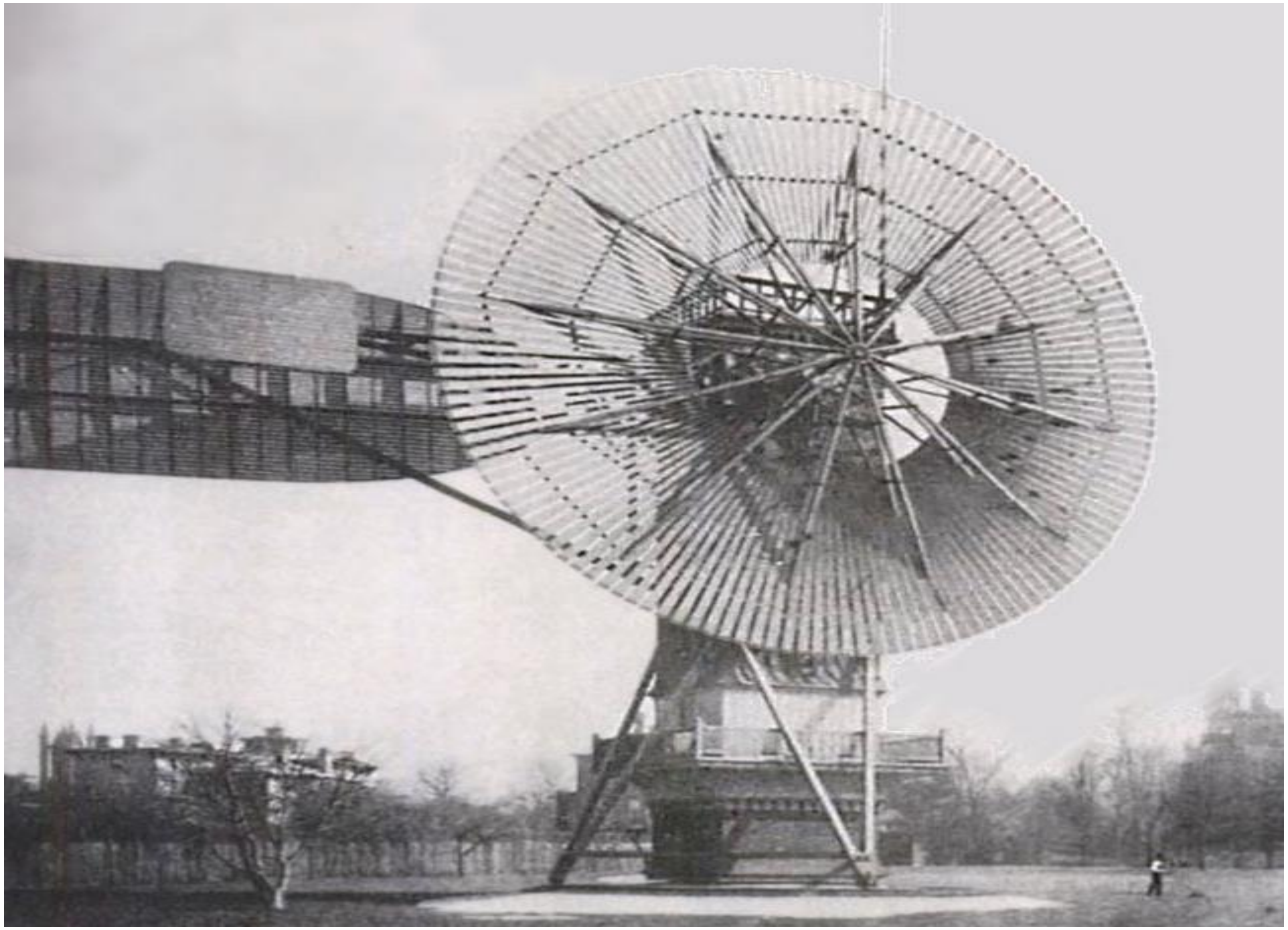
RÜZGAR ENERJİSİ TEKNOLOJİSİNİN GEÇMİŞİ VE GELECEĞİ

Levent İshak
Vestas Türkiye Kıdemli Servis Müdürü

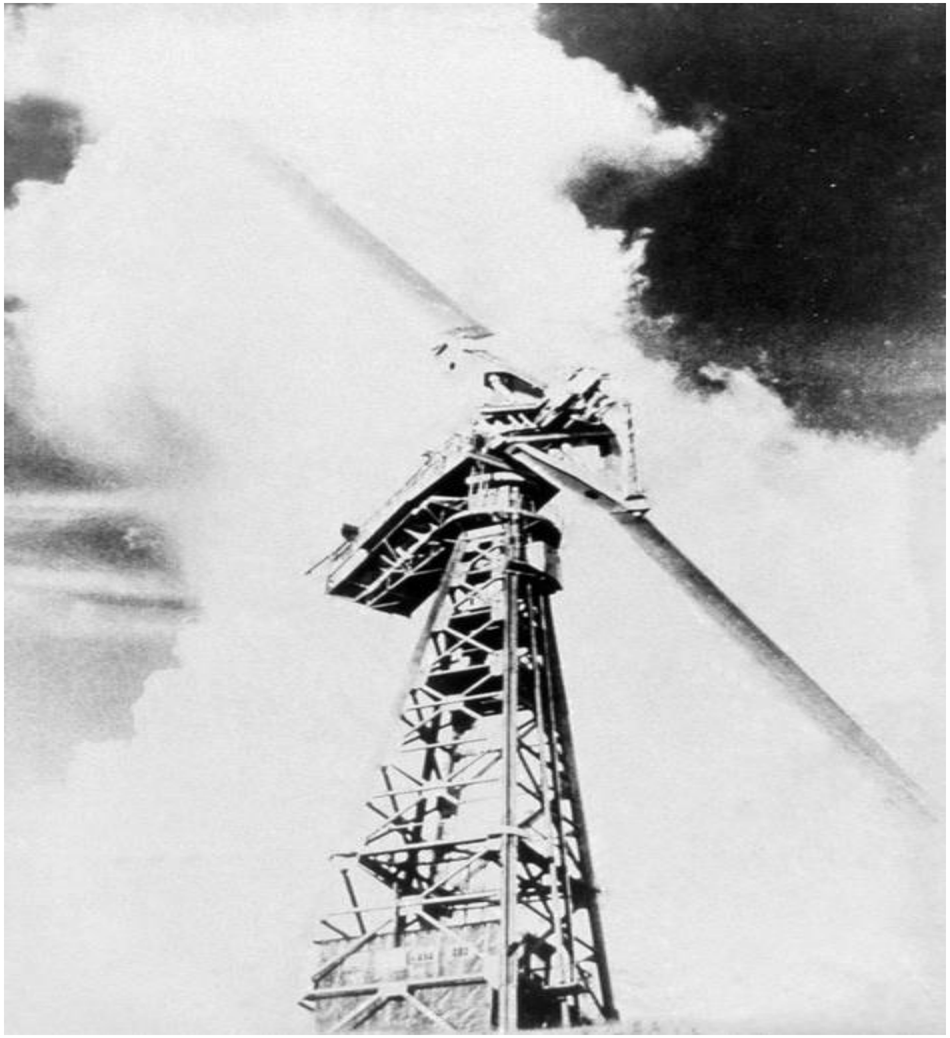
Bir zamanlar….

İlk bilinen Rüzgar türbinleri 1100'lü yıllarda tarihteki yerini aldı.

Su taşımak ve buğday öğütme amaçlı olarak kullanılıyordu

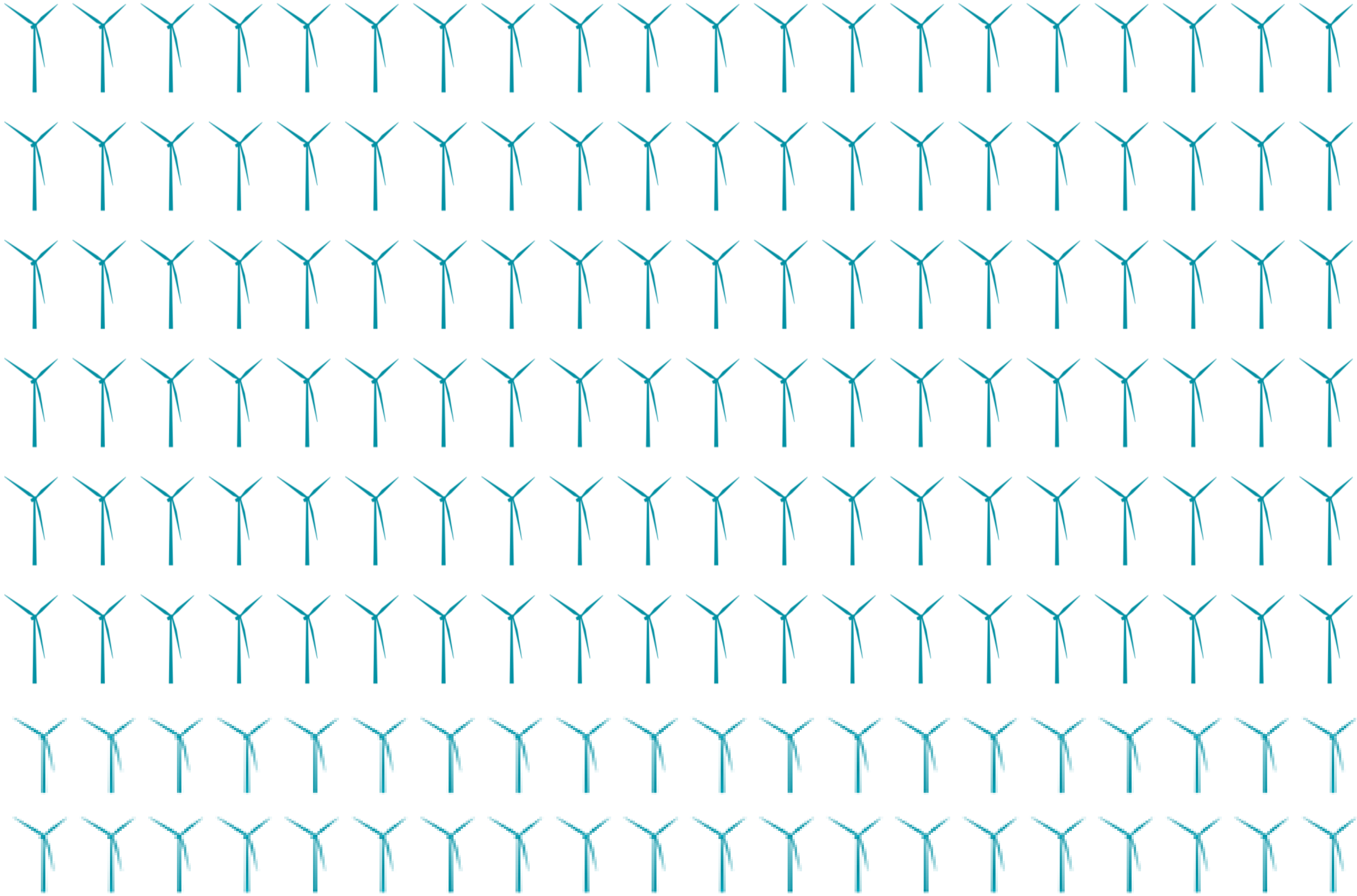


Charles Brush's windmill of 1888, used for generating electricity.

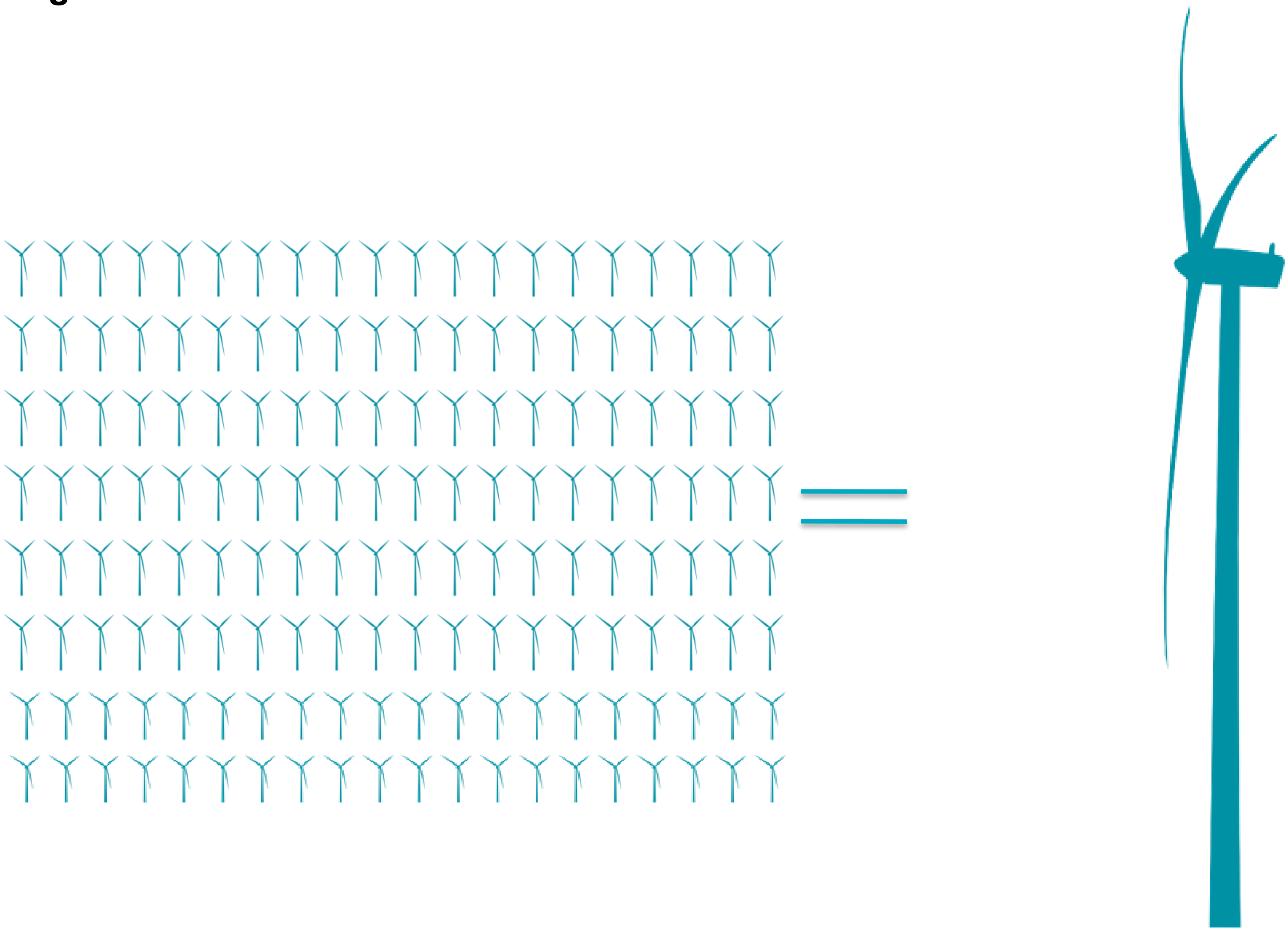


The world's first megawatt-sized wind turbine near Grandpa's Knob Summit,, Castleton, Vermont

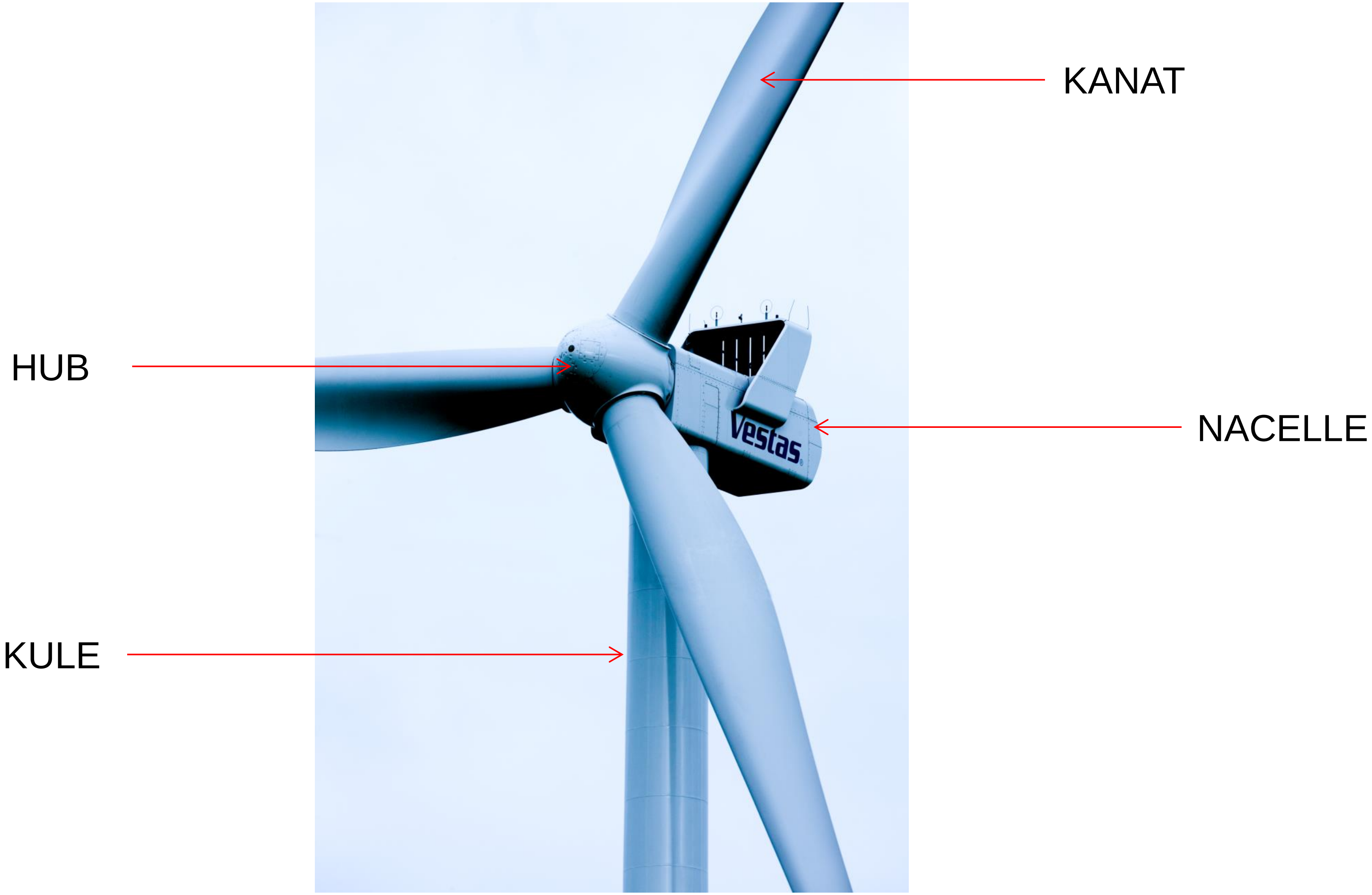
30 yıl önce 8000 kW için…



Bugün artık tek bir türbin 8000 kW elektrik üretebilmekte



GÜNÜMÜZDEKİ TÜRBİNLER



KANAT

ESKİ
NACA KANAT PROFİLİ
TEK KANAT AÇI MEKANİZMASI

MODERN
YENİ KANAT DİZAYNLARI
MÜSTAKİL KANAT AÇI MEKANİZMALARI
KARBON FİBER
KANATÇIKLAR VE YÖNLENDİRİCİLER

GELECEK
ELASTİK KANAT MALZEMELERİ
ÜRETİM OTOMASYONU
GELİŞMİŞ KOMPOZİT MALZEMELER
GELİŞMİŞ YÜK KONTROL MEKANİZMALARI

NACELLE

ESKİ

2.5 MW'TAN AZ
3 KADEMELİ DİŞLİ KUTUSU
YARI GÜÇ DÖNÜŞTÜRÜCÜ

MODERN

2.5 MW ÜSTÜ
ÇOK KADEMELİ, YÜK DAĞITICILI DİŞLİ KUTUSU
DOĞRUDAN TAHRİK
MANYETİK ALTERNATÖRLER
TAM GÜÇ DÖNÜŞÜMÜ
KOMPAKT DİZAYN

GELECEK

6 MW ÜZERİ
DEĞİŞKEN ORANLI DİŞLİ KUTULARI
SUPERİLETKEN ALTERNATÖRLER


KULELER

Kablolu Kule

Üç Bacaklı Kule

Betonarme Yapılı Kule

Kafes Kule

Silindirik Kule

ESKİ

SİLİNDİRİK ÇELİK KULELER, 110M
TAŞIYICI SİSTEM
BETONARME

MODERN

KONİK, 140M
HİBRİD
KAFES, LDST

GELECEK

UZAY KAFES
KOMPOZİT MALZEME

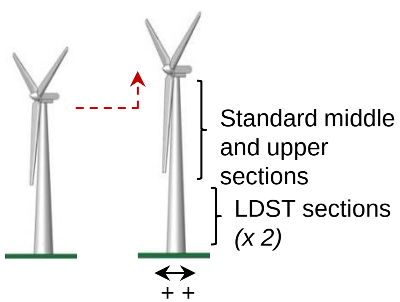
The LDST (Large Diameter Steel Tower) Concept

Due to a large diameter LDST can go to higher hub heights while reducing the usage of steel. Slicing each LDST section into 3 segments (re-assembled at site) is needed for transport issues

Large diameter

Hub height:
By increasing the diameter using LDST the tower gets stiffer / stronger and can go to higher hub heights:

LDST tower

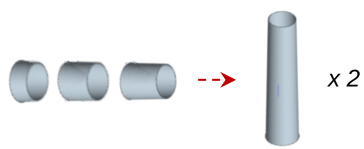


Cost:
By increasing the diameter the steel plate thickness can be reduced and still withstand the same loads. This decreases the amount of steel used and hence BoM compared to a standard steel tower

Production

LDST sections:
Each LDST section is composed of regular shells (i.e. tubes) with a larger diameter:

LDST section

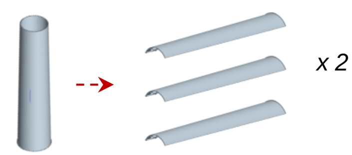


Standard middle and upper sections:
The standard middle and upper sections are similarly composed of smaller shells. However, these regular sections also benefit from a larger diameter and reduced steel plate thickness

Transportation

Slicing:
Due to transport the LDST sections are sliced into three segments after production. Before slicing the sections vertical flanges are welded on and used to re-assemble on site:

LDST section

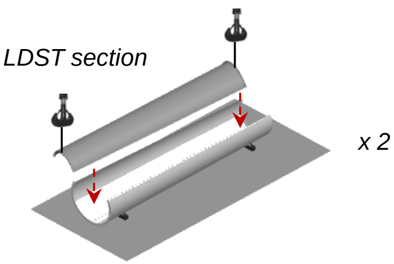


Truck:
The standard middle and upper sections are transported similar to a standard steel tower.
The LDST segments can be transported on relatively cheap flatbed trucks

At site

Re-assembly:
The segments of each of the LDST sections are bolted (bolzen) together with longitudinal flanges:

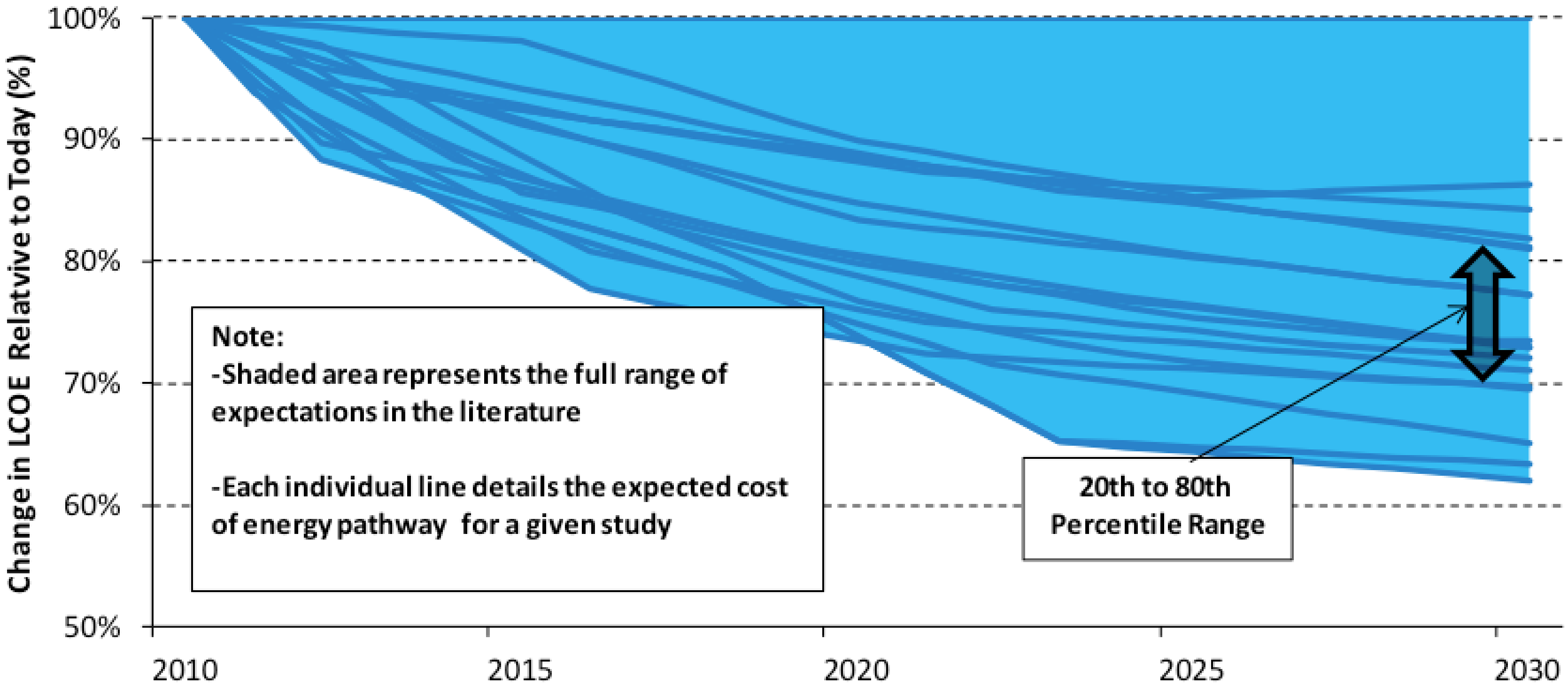
LDST section



Internals, platform, cables,
Once the LDST sections have been re-assembled , their internals are mounted. Due to the slicing of the LDST sections it is not possible to mount their internals ex works. The standard middle and upper sections have their internals installed ex works


Economy

NREL (National Renewable Energy Labaratory) projection: the LCOE of U.S. wind power will decline by 25% from 2012 to 2030



ENERJİ BİRİM MALİYETİ - Haziran 2015 (USD/MWh)

Plant Type (USD/MWh)	Max	Median	Min
Ocean&&	250	240	230
Solar PV	250	110	60
Solar CSP	220		100
Natural Gas Combustion Turbine	200		140
Wind, offshore	200		100
Coal, integrated gasification, combined cycle	170		100
Fuel Cell	160		100
Coal, pulverized, scrubbed	150		60
Nuclear	130		90
Enhanced Geothermal	130		80
Distributed Generation	130	70	10
Biopower	110		90
Geothermal Hydrothermal&&	100		50
Hydropower&&	100	70	30
Natural Gas Combined Cycle	80		50
Wind, onshore	80		40
Blind Geothermal&&		100	
Small Hydropower&&		140	
Coal, pulverized, unscrubbed^^		40	

FLOATING TURBINE

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TEŞEKKUR EDERIZ