

# RÜZGAR ENERJİSİ TEKNOLOJİSİNİN GEÇMİŞİ VE GELECEĞİ

Levent İshak  
Vestas Türkiye Kıdemli Servis Müdürü

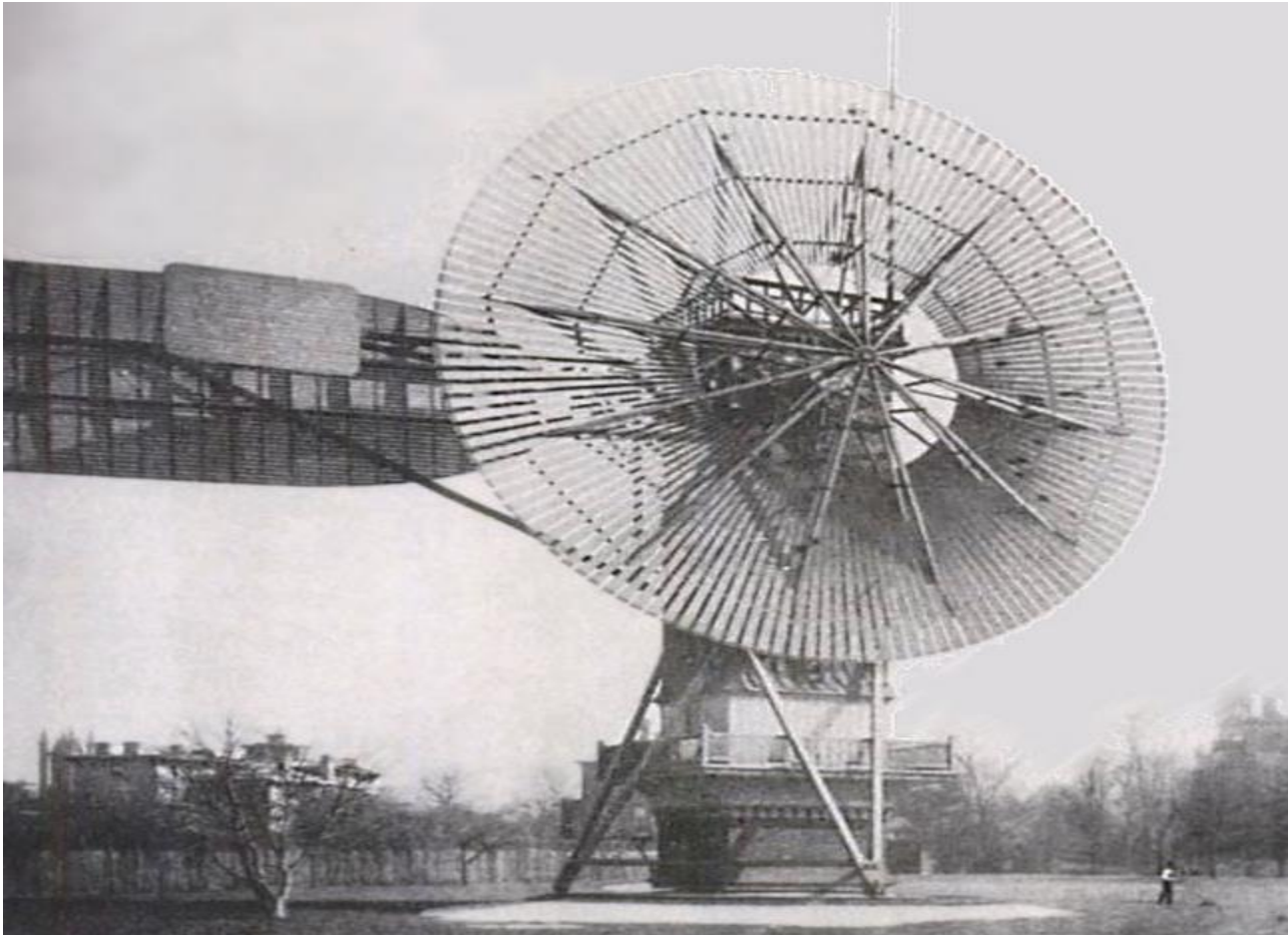
# Bir zamanlar....



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

**Su taşımak ve buğday  
öğütme amaçlı olarak  
kullanılıyordu**



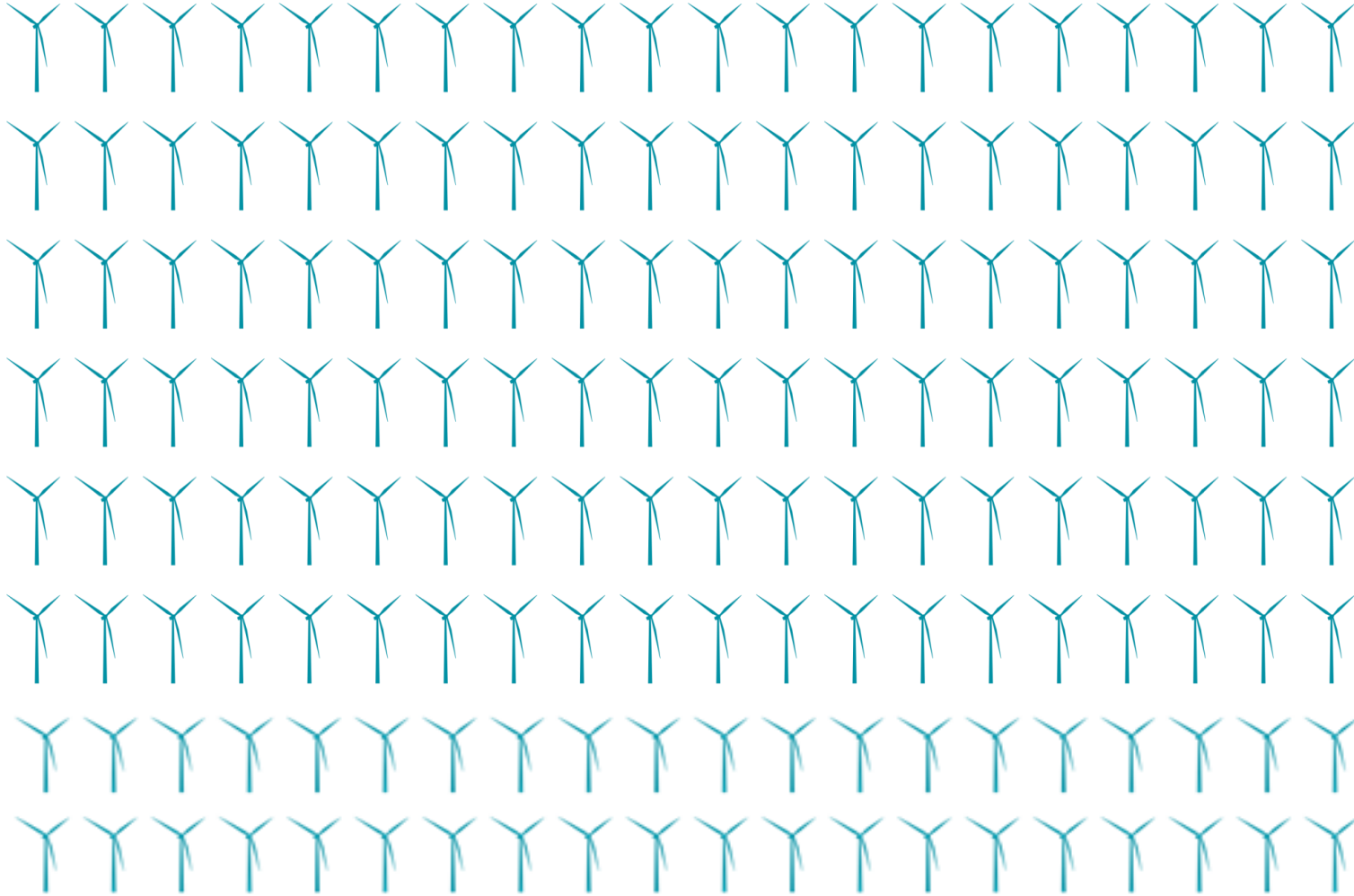


Charles Brush's windmill of 1888, used for generating electricity.

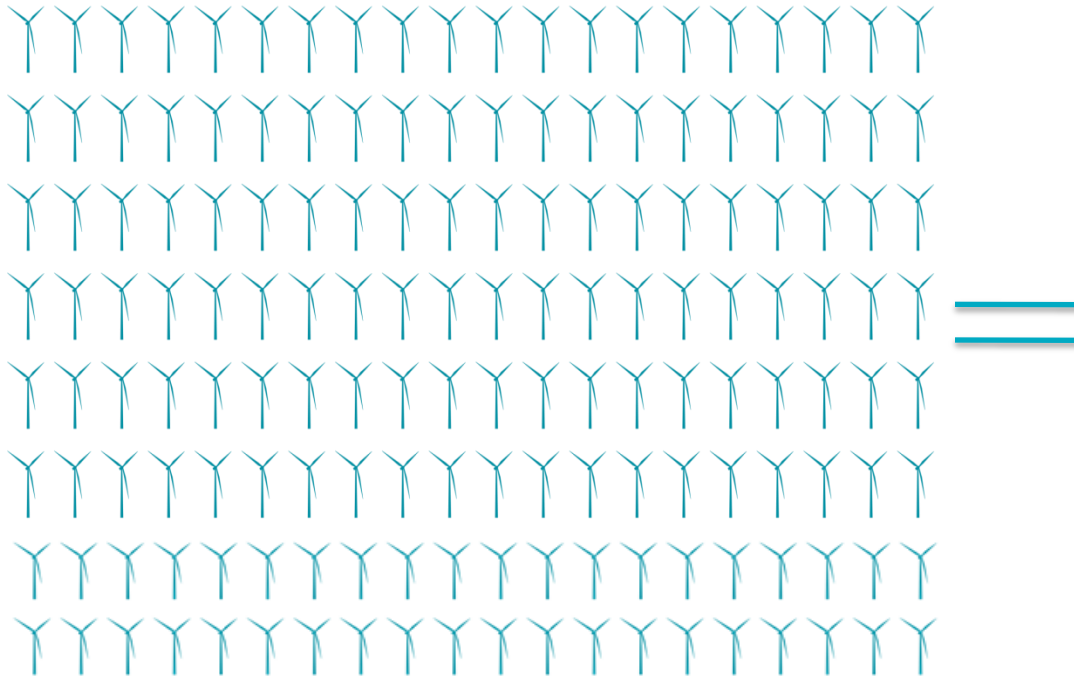


The world's first megawatt-sized wind turbine near Grandpa's Knob Summit,, [Castleton, Vermont](#)

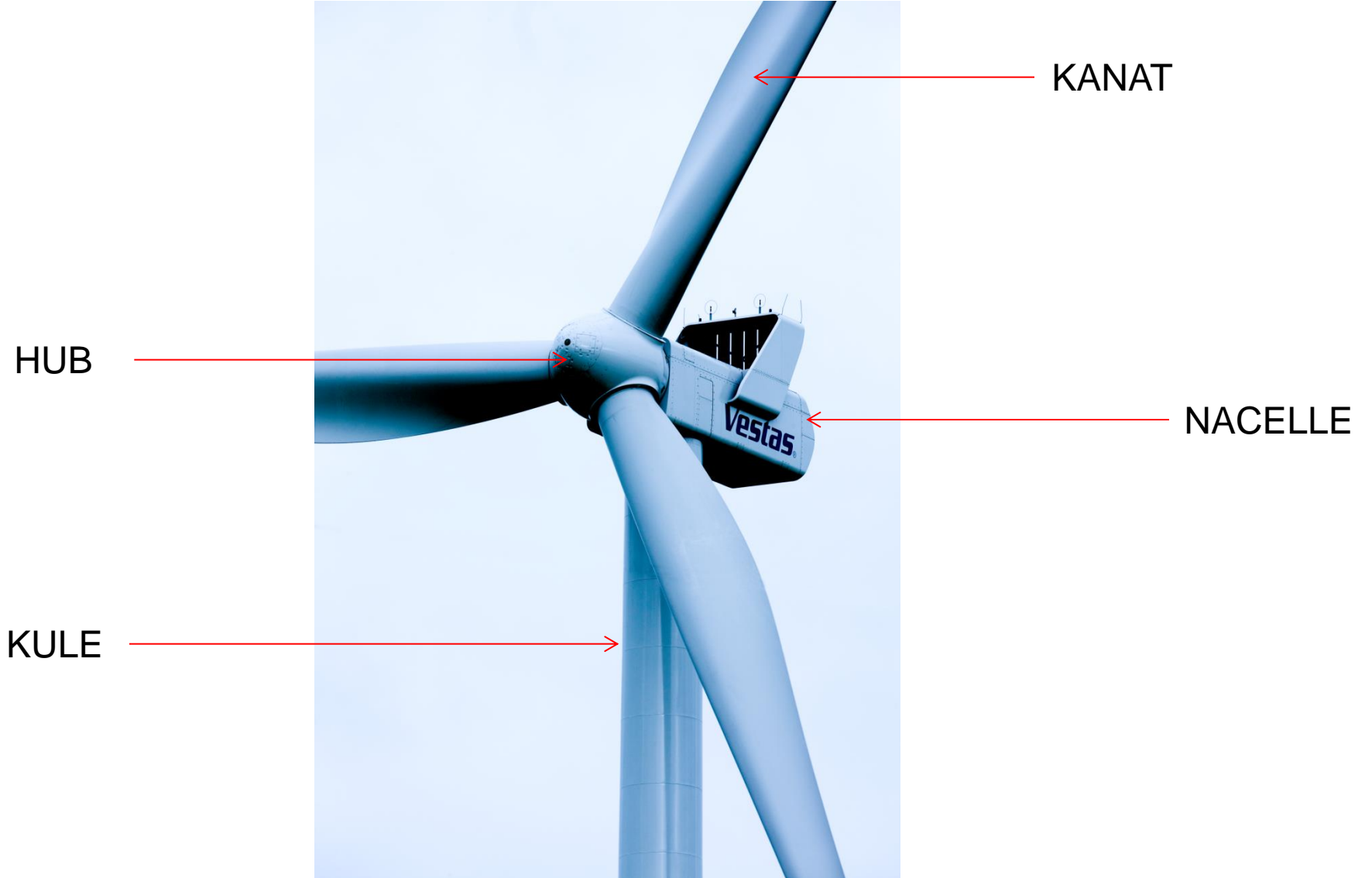
30 yıl önce 8000 kW için...



**Bugün artık tek bir türbin 8000 kW elektrik üretebilmekte**



# GÜNÜMÜZDEKİ TÜRBİNLER

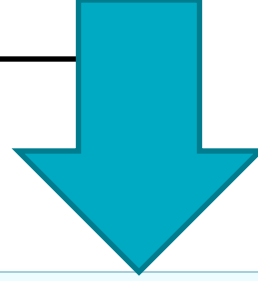


KANAT

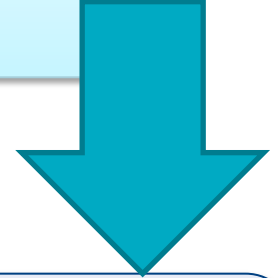




ESKİ  
NACA KANAT PROFİLİ  
TEK KANAT AÇI MEKANİZMASI



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

Vestas



ESKİ  
2.5 MW'TAN AZ  
3 KADEMELİ DİŐLİ KUTUSU  
YARI GÜÇ DÖNÜŐTÜRÜCÜ

MODERN  
2.5 MW ÜSTÜ  
ÇOK KADEMELİ, YÜK DAĞITICILI DİŐLİ KUTUSU  
DOĐRUDAN TAHRİK  
MANYETİK ALTERNATÖRLER  
TAM GÜÇ DÖNÜŐÖMÜ  
KOMPAKT DİZAYN

GELECEK  
6 MW ÜZERİ  
DEĐİŐKEN ORANLI DİŐLİ KUTULARI  
SUPERİLETKEN ALTERNATÖRLER

A white wind turbine stands prominently in a field of tall, golden-brown grass. The turbine's three blades are spread out against a vibrant blue sky filled with wispy white clouds. The word "KULELER" is written in large, white, sans-serif capital letters across the middle of the image, partially overlapping the turbine's tower and the sky.

KULELER



Kablolu Kule



Üç Bacaklı Kule



Betonarme Yapılı  
Kule

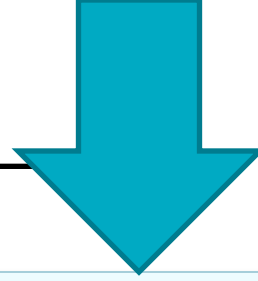


Kafes Kule

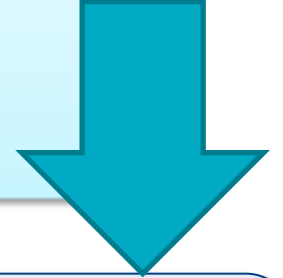


Silindirik Kule

ESKİ  
SİLİNDİRİK ÇELİK KULELER, 110M  
TAŞIYICI SİSTEM  
BETONARME



MODERN  
KONİK, 140M  
HİBRİD  
KAFES, LDST



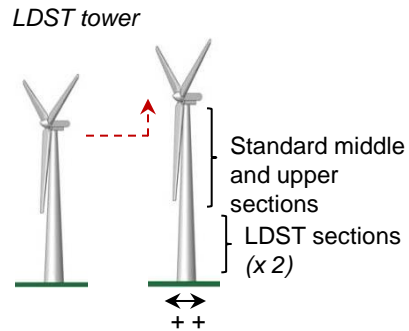
GELECEK  
UZAY KAFES  
KOMPOZİT MALZEME

# 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

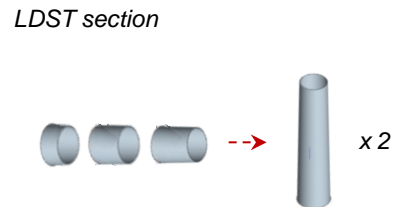
Hub height:  
By increasing the diameter using LDST the tower gets stiffer / stronger and can go to higher hub heights:



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

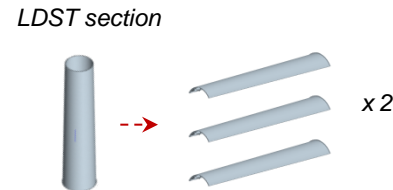
LDST sections:  
Each LDST section is composed of regular shells (i.e. tubes) with a larger diameter:



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

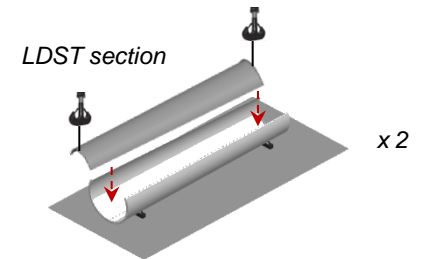
Slicing:  
Due to transport the LDST sections are sliced into three segments after production. Before slicing the sections vertical flanges are welded on and used to re-assemble on site:



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:



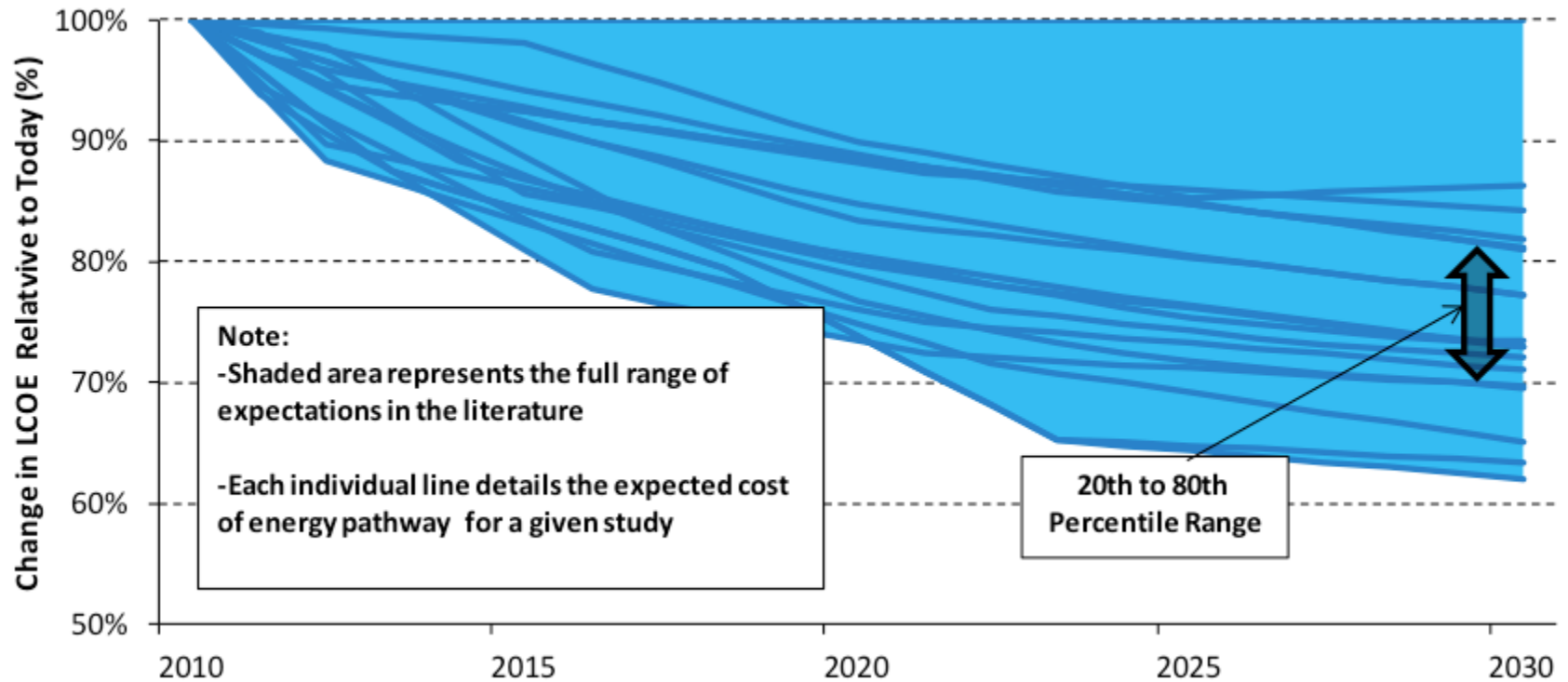
Internals, platform, cables,  
Once the LDST sections have been re-assembled, their internals are mounted. Due to the slicing of the LDST sections it is not possible to mount their internals ex works. The standard middle and upper sections have their internals installed ex works

# Economy





**NREL** ( National Renewable Energy Laboratory ) 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	





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**Wind.** It means the world to us.<sup>™</sup>

**TEŞEKKUR EDERİZ**

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