

UTILIZATION OF WIND ENERGY AT OIL WELLS

- GREEN OIL WELLS -



General Concept

Traditional horse-head oil pumping unit is replaced with Yelkapan.

Yelkapan has it's own pumping unit powered both wind and grid. Yelkapan can convert excess wind energy into grid electricity through net metering system. When the wind blows slowly, grid electricity and the wind actuates oil pump together.

Special consideration for oil-well windpump

Special operational strategy is necessary for oil-well pumping. The key point is “continuous and stable pumping ability of windpump”. The pumping system should allow continuous and stable oil production. Oil production should not change by wind speed. It is possible with grid connected Yelkapan design. Average power of windpump should be equal to power requirement of oil-well pumping unit. Excess wind energy is converted to electricity and given to the grid and grid electricity supports the oil-well when the wind blows slowly. By the way, net metering system allows stable oil production.

Continuous operation

It is important that the windpump runs through 12 months per year. So the windpump investment can be economical. Oil well application is very suitable for continuous operation.

TOTAL BENEFIT OF YELKAPAN

Average wind speed is between 5,5 and 6,5 m/s at Texas
 P81 Yelkapan saves 46 000 kWh electricity when average wind speed is 5,5 m/s
 P81 Yelkapan saves 63 000 kWh electricity when average wind speed is 6,5 m/s
 1 kWh electricity price in US is 0,07 USD
 Yelkapan saves min 3220 USD – max 4410 USD annual electricity bill
 Yelkapan has 20 years effective operation life
 Yelkapan saves min **64 400** – max **88 200 USD** electricity bill during its lifetime.

TARGET PRICE

Our target price is maximum
 2 575 USD per kW for **33 kW** grid-connected Yelkapan (Total **85 000 USD**)

SAVING COSTS

The costs below will be saved by replacing existing solution with grid-connected Yelkapan solution.

Average wind speed	5,5 m/s	6,5 m/s
20 years operating cost	64 400 \$	88 200 \$
<u>C-80 pumping unit cost</u>	45 000 \$	45 000 \$
Total Saving Costs	109 400 \$	133 200 \$

Technical Compatibility

API Pumping Unit Designations

Related document is “**API Specification 11E – Specification for Pumping Units**”. American Petroleum Institute designation coding for pumping units explained as below

C- XXX – YYY – ZZZ

XXX : Reducer model indicates “Peak Torque Rating” [1000 inch . lbs]

YYY : Sucker rod load capacity [100 lbs]

ZZZ : Stroke length [inch]

Peak torque ratings, sucker rod loads and stroke lengths in API designations:

Torque	Sucker rod loads		Stroke lengths	
in.lbs x 1000	lbs x 100	kN	in	cm
1824	365	162	192	488
1280	305	136	168	427
912	256	114	144	366
640	246	109	120	305
456	213	95	100	254
320	200	89	86	218
228	173	77	74	188
160	143	64	64	163
114	133	59	54	137
80	119	53	48	122
57	109	48	42	107
40	95	42	36	91
25	89	40	30	76
	76	34		
	67	30		
	56	25		
	53	24		

Unit size usually defined as torque ratings. Example, *C-57 size unit*.

See the API document or manufacturer catalogs for all combinations of API designations.

Lufkin is the oldest manufacturer. It is located at Texas.

Sucker Rod Load Requirements or Power Compatibility

Matching of windpump units and API designations are below:

API Designation	Windpump unit	API Designation	Windpump unit
C-57-95-48	15 kW	C-114-133-54	30 kW
C-57-89-42		C-80-133-54	
C-57-76-54		C-80-133-48	
C-57-76-42		C-80-119-64	
C-40-89-42		C-80-119-54	
C-40-89-36		C-80-109-48	
C-40-76-48		C-57-109-48	
C-40-76-42			

Stroke Lengths:

Existing stroke length of Yelkapan is 60 cm. It is not sufficient for oil wells. It must be enlarged up to 137 cm (54 in). Design update required.

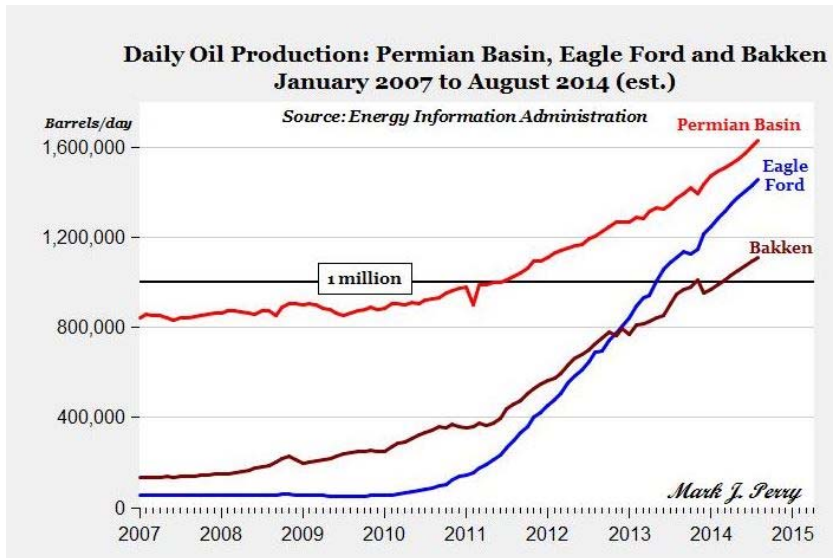
Cost Estimations for API Sucker Rod Pumping Units

Welded steel construction costs is minimum 2 USD/kg in Turkey. The unit weight costs is minimum two times if it is more than welded steel construction like a working machine. So average cost of unit weight assumes **5 USD/kg** for pumping units.

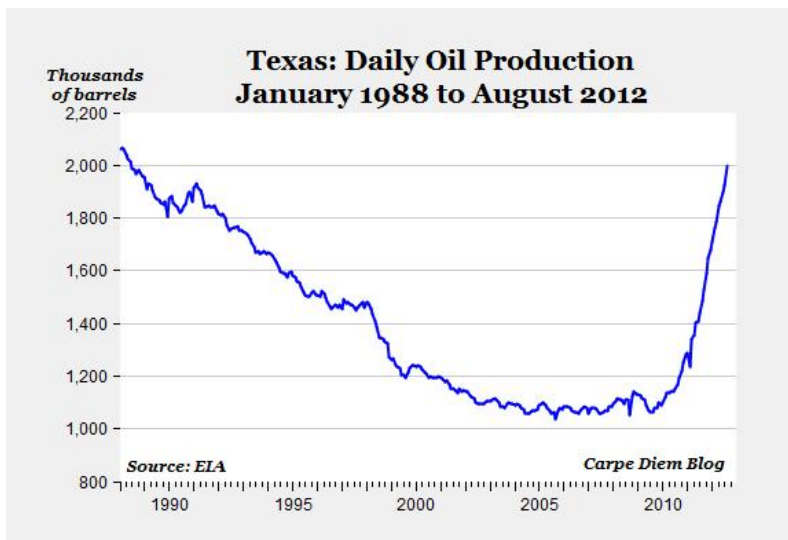
API Size	Weight [tons]	Estimated Cost [USD]
40	5,5 – 6	27 500 – 30 000
57	6 – 7	30 000 – 35 000
80	7,5 – 9	37 500 – 45 000

Key Informations about the Oil Pumping Market at US

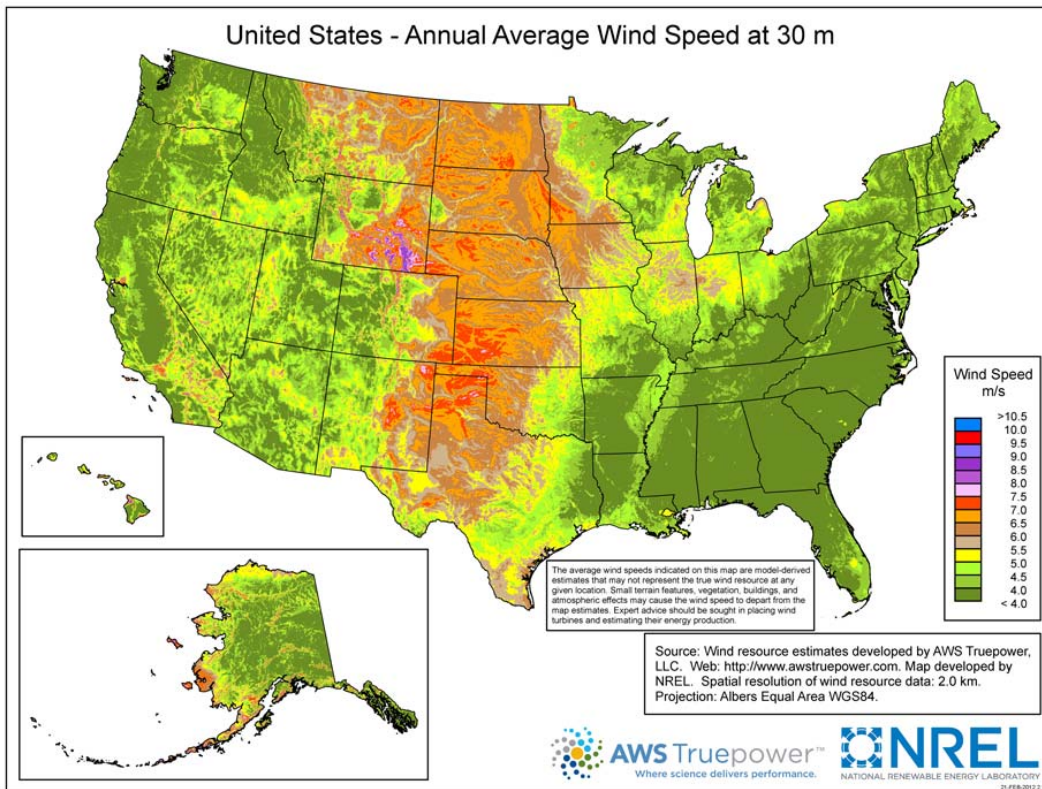
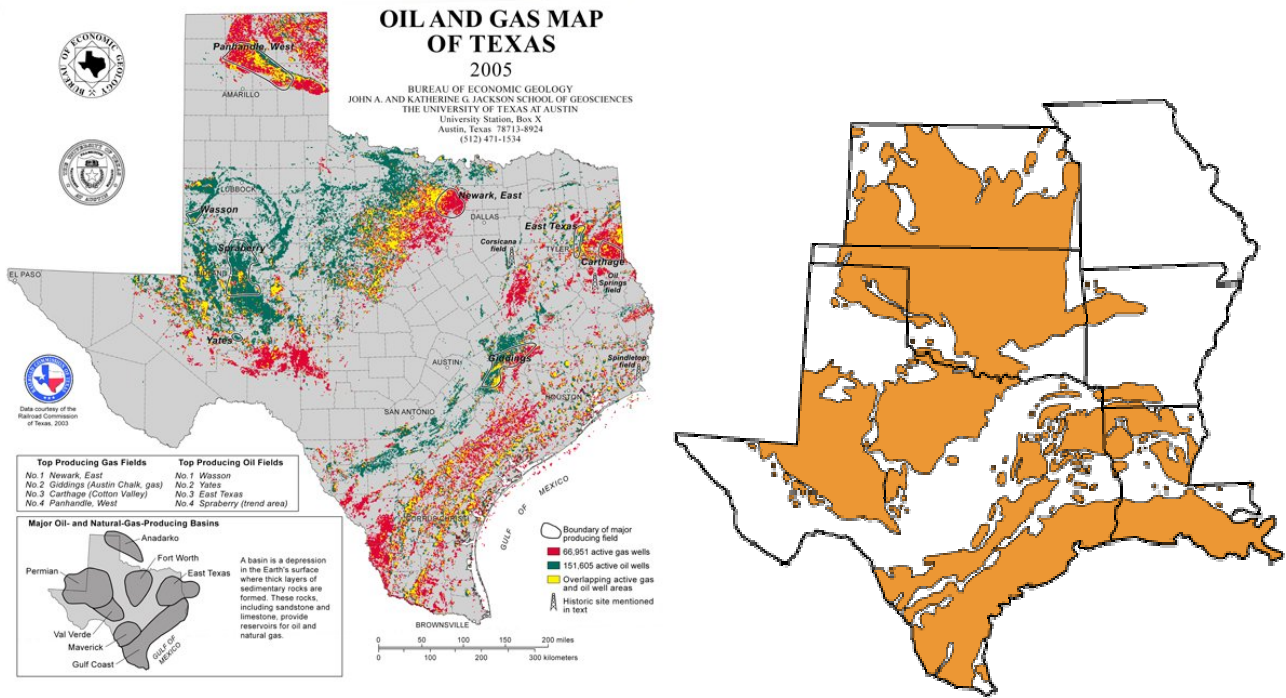
* Oil production of US has increased since 2010.



Permian (Texas and New Mexico)
 Eagle Ford (Texas)
 Bakken (North Dakota and Montana)



* South central oil basins of US have very good wind potential.



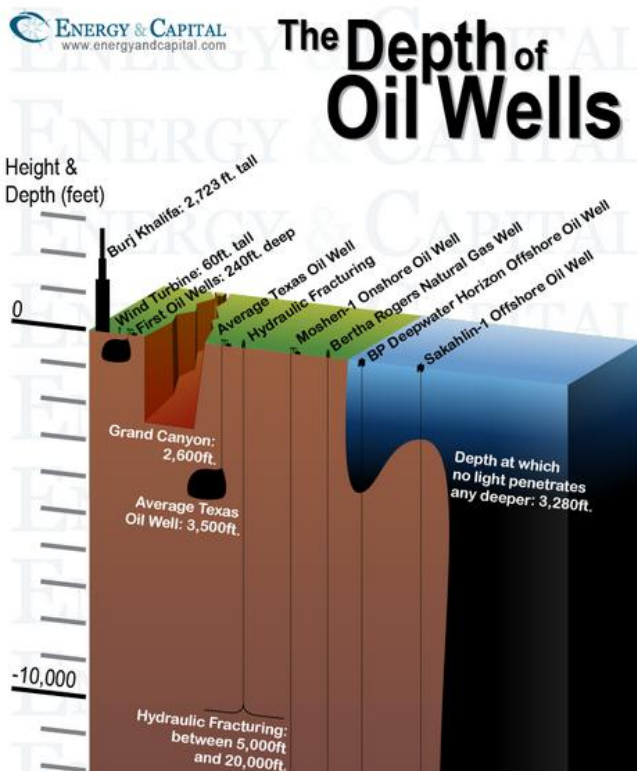
Average production of an oil well is between 11 -20 barrels per day at Texas.

(Average production calculation was done according to county statistics in Texas Almanac 2014 : Total production of a county divided to number of regular producing oil wells)

Small size API pumping units (C-40, C-57 or C-80) fits most of Texas oil wells according to the average production estimations.

Average Texas oil well depth is 3500 ft

(source <http://www.energyandcapital.com/resources/the-depth-of-oil-wells>)



Oil wells have usually grid connection :



TECHNICAL NOTE

Total number of oil wells in US is approximately 574 000.
Total number of sucker rod pumping units in US is approximately 400.000.
Total number of oil wells in Texas is approximately 153 000.
Total number of new oil wells drilled at Texas is approximately 10 000.



A view from Texas Oilfields



A view from Wasson Oilfield – Texas



A view from Yates Oilfield – Texas