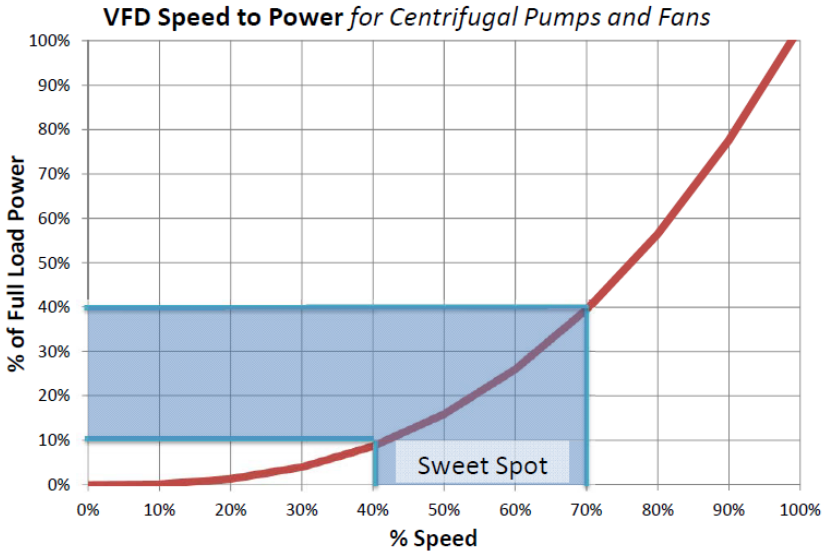
Centrifugal Fan and Pump VFD Power Relationship

% Loading	Cycling % Power	VFD % Power
110%	100%	133%
100%	100%	103%
90%	90%	78%
80%	80%	56%
70%	70%	39%
60%	60%	26%
50%	50%	16%
40%	40%	9%
30%	30%	4%
20%	20%	1%
10%	10%	0%
0%	0%	0%

VFD inverter efficiency ~ 97%

Affinity Laws	Flow ∝ Speed Flow ∝ Speed^2 Flow ∝ Speed^3
Real World	%Power = (%Speed)$^{2.7}$



** Avoid running VFDs fully loaded by setting maximum speed to ≤90%.*

Conversion Factors

$1\ l/s = 15.85\ GPM,\ 1\ l/s = 2.12\ CFM$

$1\ psi = 2.31\ ft\ w.g.,\ 1\ psi = 27.7\ in\ w.g.$

$1\ hp = 0.746\ kW$

Calculating kWh

$$Pump\ BHP = \frac{GPM\ \times\ Head\ (ft\ w.g.)}{3960 \times Efficiency}$$

$$Fan\ BHP = \frac{CFM\ \times\ SP\ (in.w.g)}{6356 \times Efficiency}$$

$$kW = \frac{Brake\ Horsepower \times 0.746}{Motor\ Efficiency}$$

$$kW = \frac{Amp \times Volt \times \sqrt{3} \times Power\ Factor}{1{,}000}$$

Motor Efficiency and Power Factor

Motor Name Plate (HP)	Standard Efficiency	Premium Efficiency	Approx. Power Factor
1	74	82	0.62
5	84	90	0.70
10	87	91	0.73
25	90	93	0.77
50	91	94	0.80
100	92.2	94.7	0.82
250	93.3	95.2	0.85
500	94.0	95.5	0.91
1000	94.5	95.7	0.92

Consideration Criteria for VFD

- **High Horse power** (>15 hp)
- **Long operating hours** (>2000 hrs)
- Loads that could benefit from **soft start/shut-off capability**
- Loads with **variable torque requirements**

Power Transmission

Coupling Type	Efficiency
Gear Drives	55%-98%
Standard V-Belt	~92%
Notched V-Belt	~95%
Synchronous Belt	~98%
Direct Shaft Coupling	100%

Notched V-Belt **Standard V-Belt**