

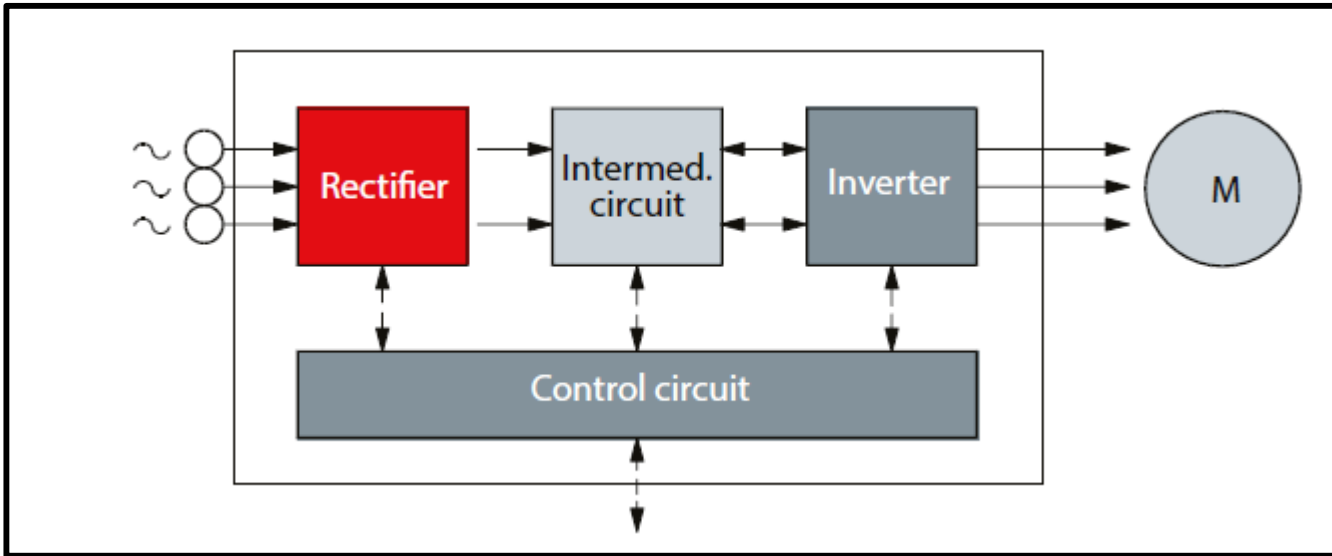
Why Use Variable Frequency Drives (VFDs)?

Dave Meglio

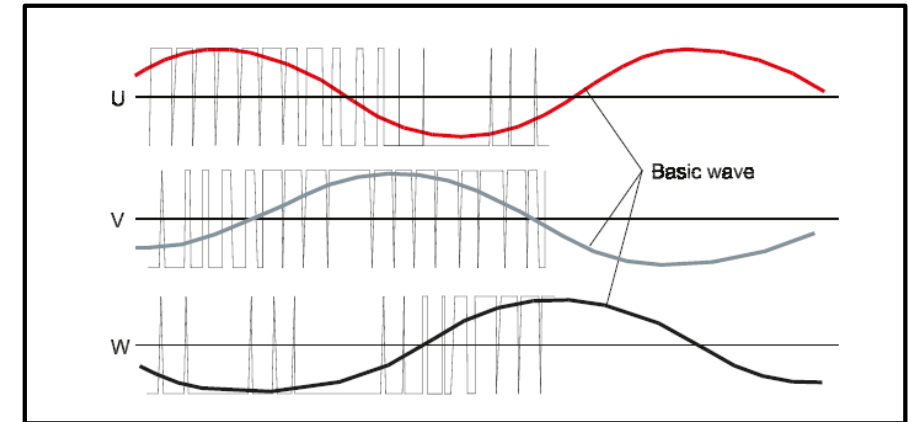
Meglio & Associates

Danfoss Representative

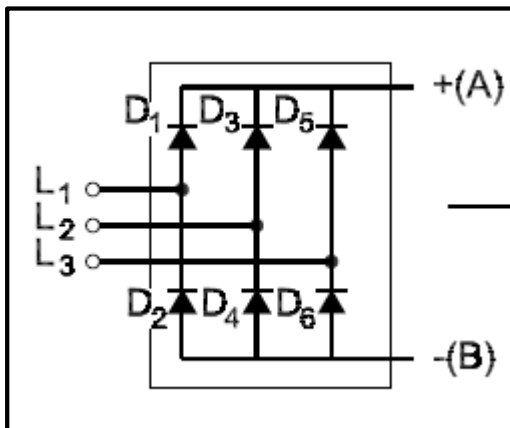
Simplified Drive Theory



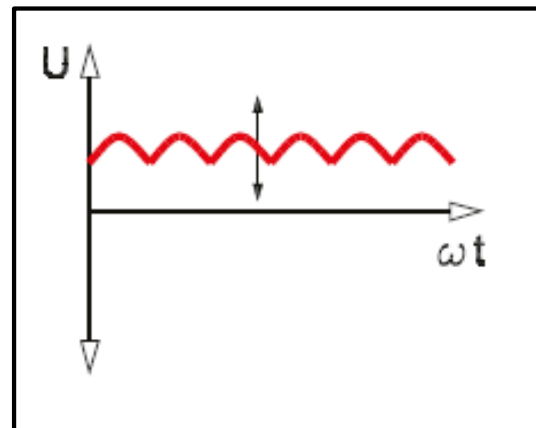
Speed Control of a Motor



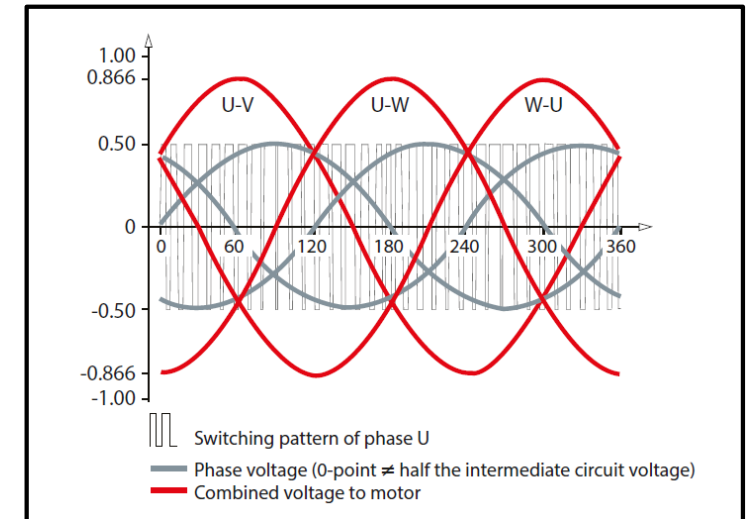
Rectifier Section



Intermediate Circuit - DC Bus



Inverter Section - PWM



How the VFD has Changed



Danfoss was the First Manufacturer to mass produce VFD's

VLT[®] 5 in **1968**

VLT[®] 200 in **1982**

VLT[®] 3000 in **1989**

VLT[®] 3500 in **1992**

VLT[®] 5000, 6000 and 8000 in **1997**

VLT[®] Automation Drive, HVAC, and AQUA in **2007**

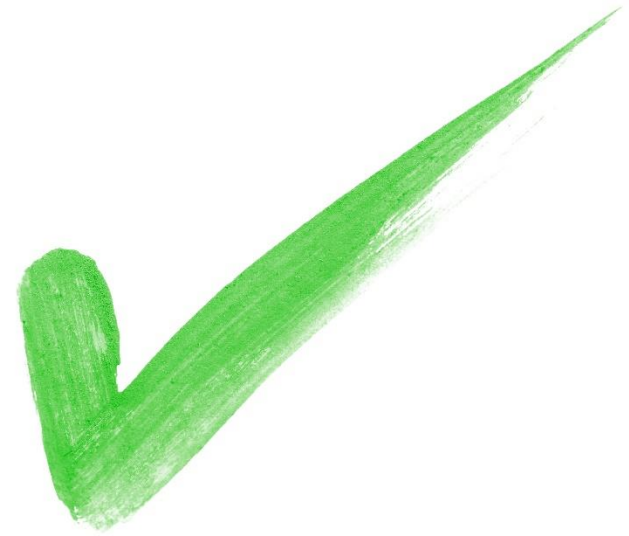
Variable Frequency Drives Can Help

1. Reduce Energy Costs
2. Better System Control
3. Reduced Maintenance
4. Bypass Capabilities
5. Protect the System

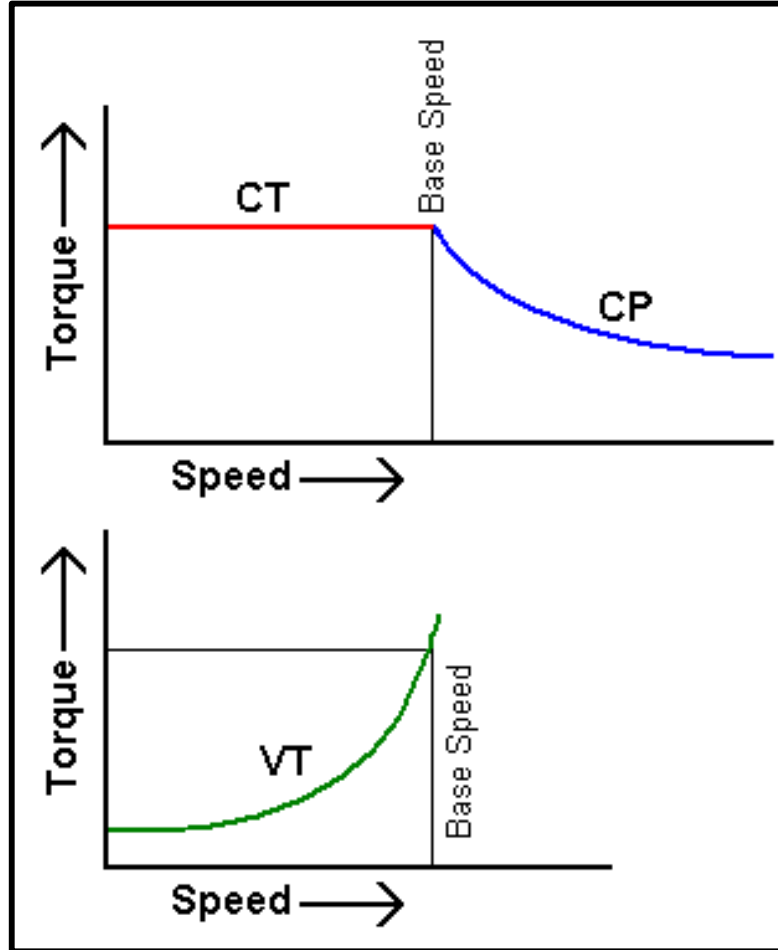
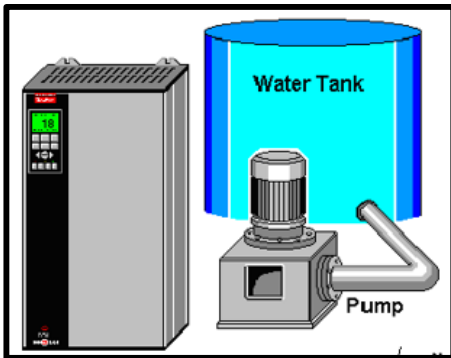
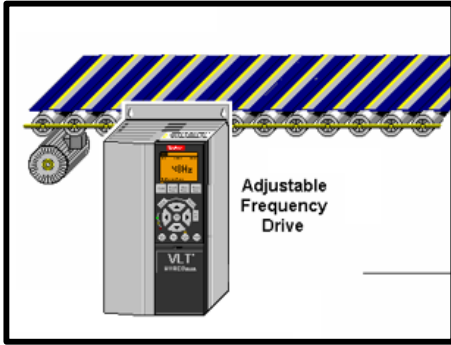


Different Names for VFD

- Variable Frequency Drive (VFD)
- Adjustable Frequency Drive (AFD)
- Inverter
- Adjustable Speed Drive (ASD)
- Variable Speed Drive (VSD)
- Frequency Converter
- AC Drive
- ...or just plain "Drive"



Application Torque Curves



Torque Requirements of Both Styles:

- Variable Torque: 110%
- Constant Torque: 150%

CT = Constant Torque

- **Conveyors**
- **Machinery**
- **Any High Inertia Load**

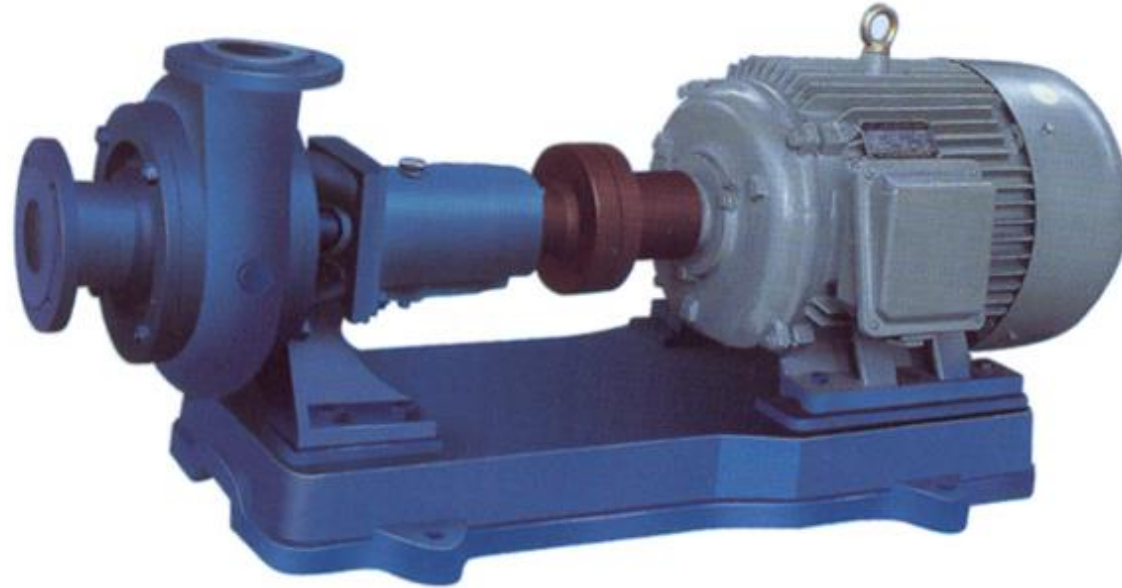
VT = Variable Torque

- **Pumps**
- **Fans**

1. VFDs Reduce Energy Costs

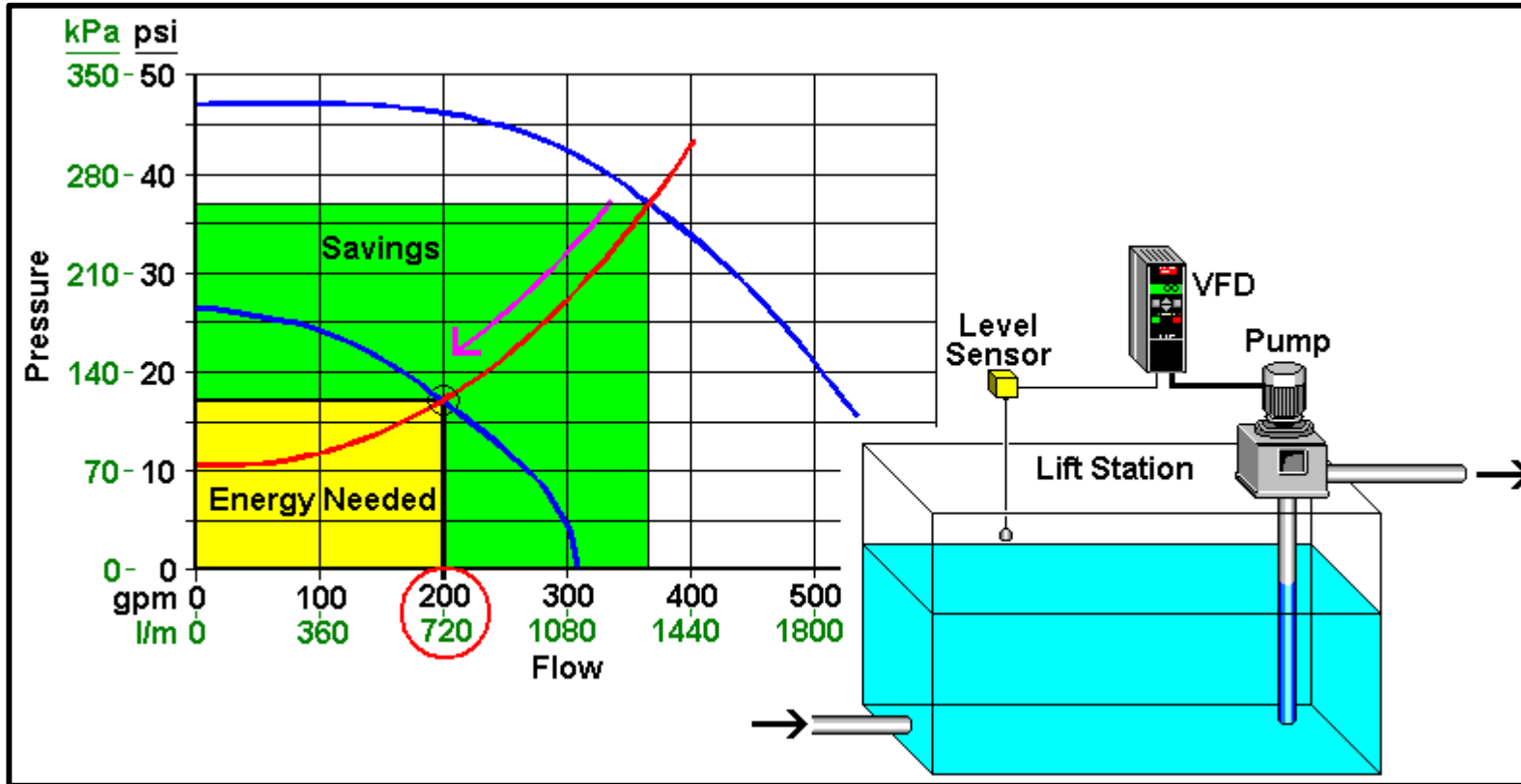
**A 20% Reduction in Speed Yields
a 50% reduction energy costs
(Affinity Laws or Cube Root Law)**

VFDs are Used to Control Flow Of Air or Fluids



- Water & Air Systems are designed for the “Worst Case” situations
 - Most of the time they have excess capacity

Controlling Flow Saves Energy



- Use a VFD to control the System flow
- Pump or Fan rides down the system curve
- Saving Energy



Reduced Peak Demand Charges

- VFDs reduce starting currents from 6 to 10 times
- VFDs ramp up loads gradually



BUSINESS ENERGY EFFICIENCY PROGRAMS

Incentive Reference Guide

PROGRAM YEAR 21: JANUARY 1 – DECEMBER 31, 2021



**ENERGY EFFICIENCY
PROGRAMS**

Variable Frequency Drives (VFD)		
Code	Measure Description	Incentive*
BPM1	Variable Frequency Drive (Pumps and Fans up to 500hp)	\$135/hp controlled (up to 80% of project cost)



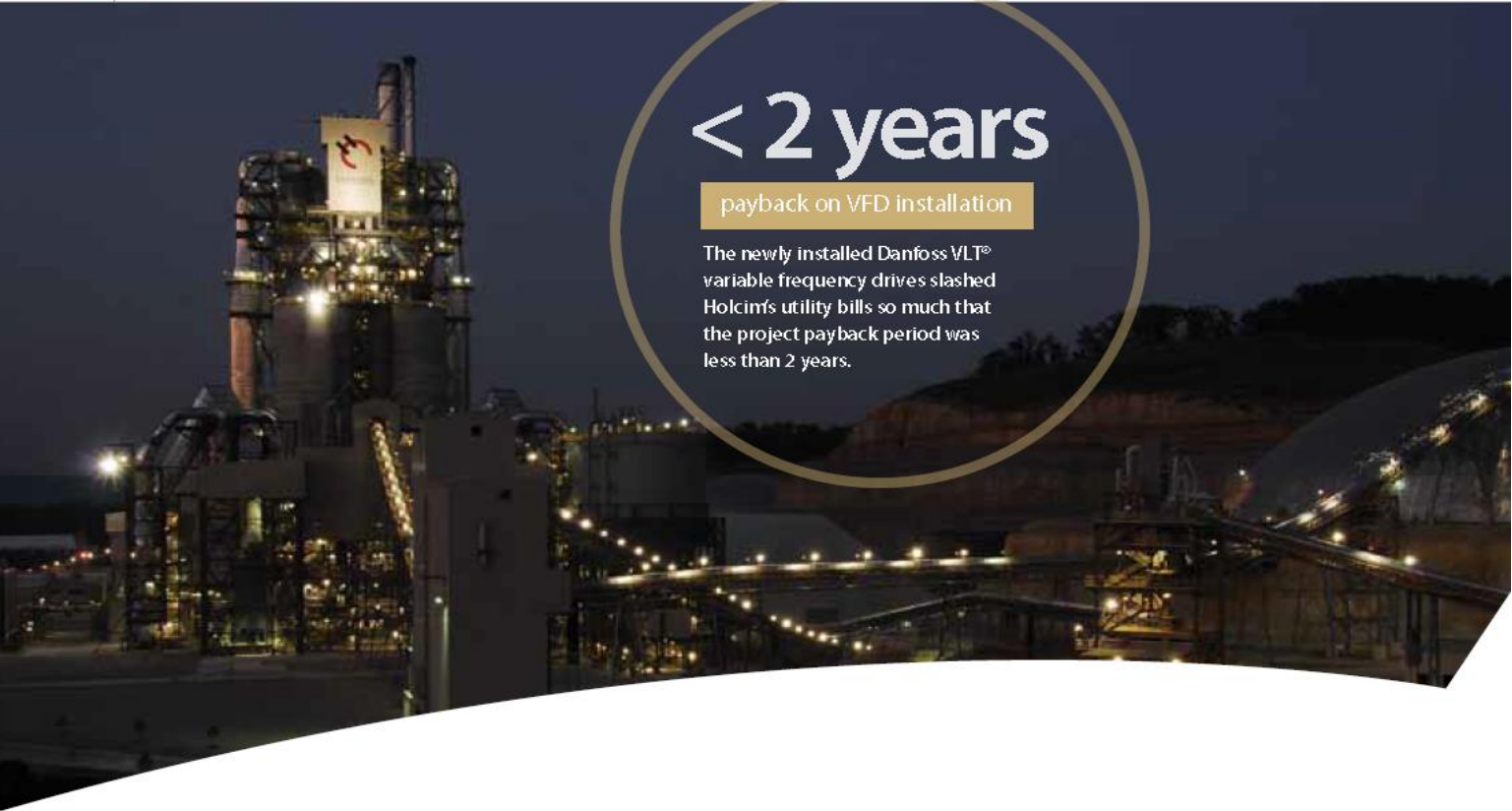
**OLIN BRASS
200hp
PUMP
PROJECT**



HOLCIM CEMENT (Bloomsdale, MO)



● CASE STUDY THREE



< 2 years

payback on VFD installation

The newly installed Danfoss VLT® variable frequency drives slashed Holcim's utility bills so much that the project payback period was less than 2 years.

CEMENT PLANT ACHIEVES

Solid Energy Savings with VLT® Drives

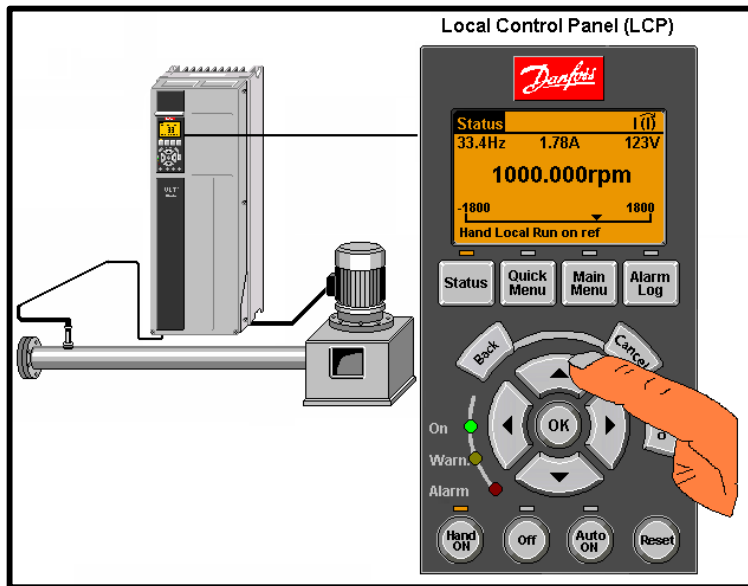


HOLCIM SITE – BLOOMSDALE MO

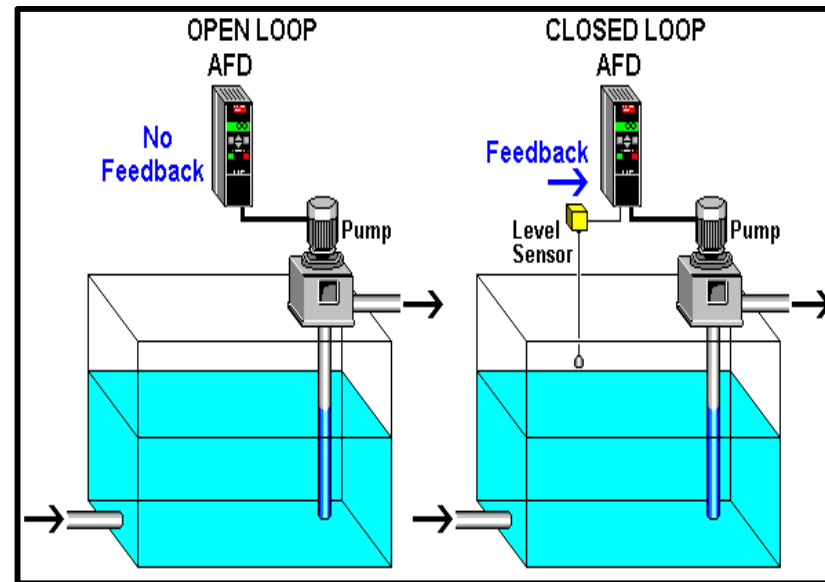


2. Better System Control

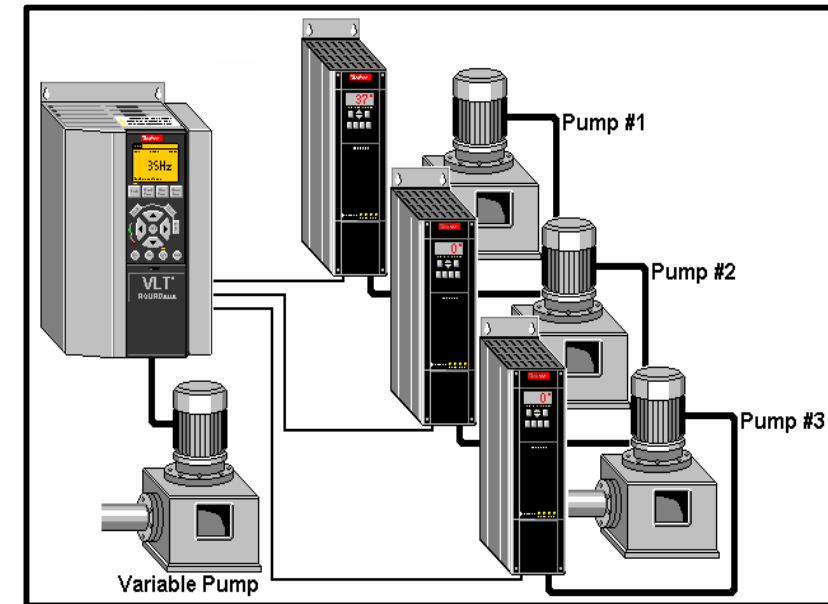
Local Control Panel



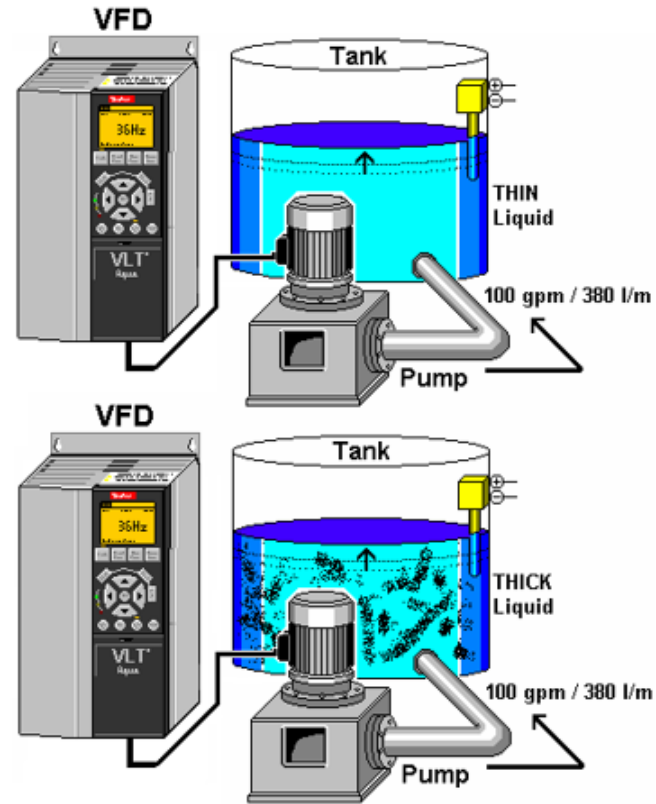
Open or Closed Loop



Motor Alternation

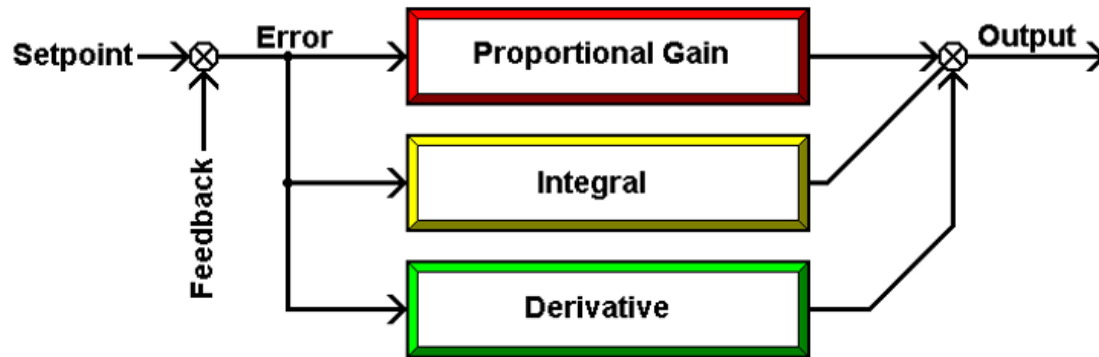


Drives Maintain Constant Speed



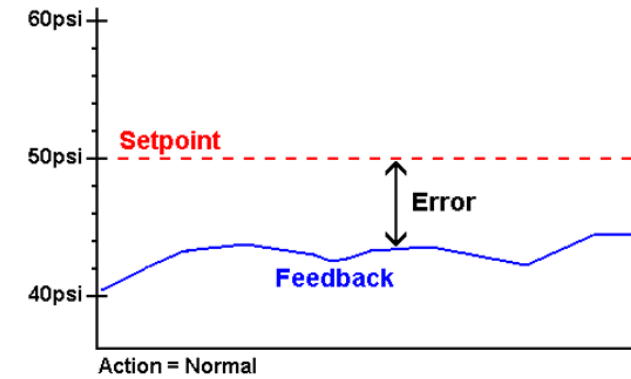
Light load or heavy, the drive should maintain the same speed.

PID ALGORITHMS

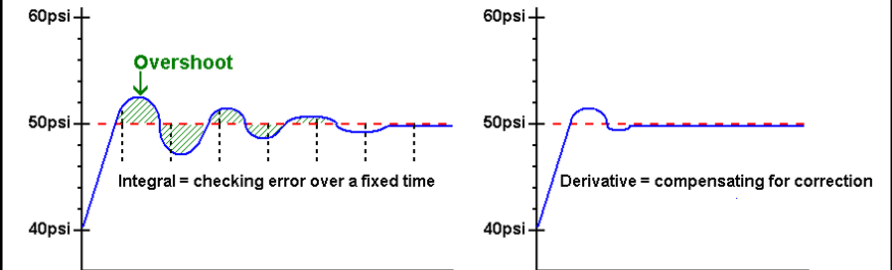


Summary: There are many different PID algorithms. All contain these 3 features, **Proportional Gain**, **Integral**, and **Derivative**. The ways these terms are combined may be different.

Proportional Gain



Integral & Derivative



Additional Benefits of Improved Control

VFDs can go from **0 – 200% of base motor speed**

VFDs have an **infinitely adjustable speed range**



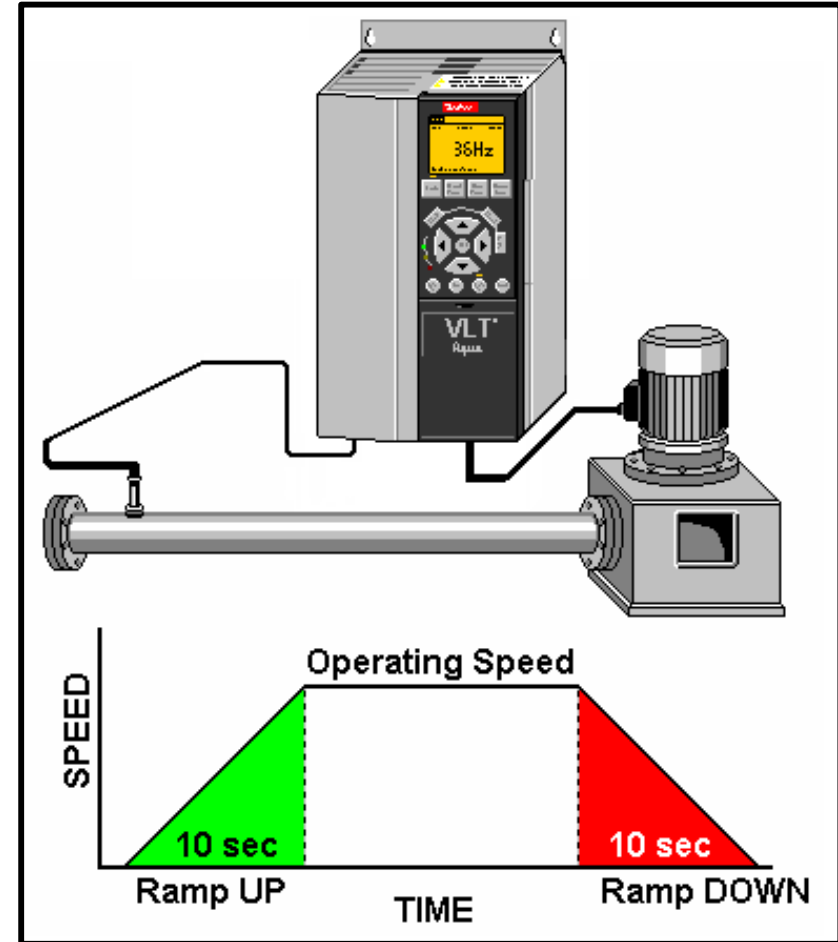
3. Drives Reduce Maintenance Costs

Controlled Ramps Help:

- Belts Last Longer
- Reduced Line Stresses:
 - Water Hammer
 - Breaking Pipes

Motor Life is Increased by:

- Balancing Voltage when Line
- Voltage is not Balanced.



Drives Reduce Maintenance Costs

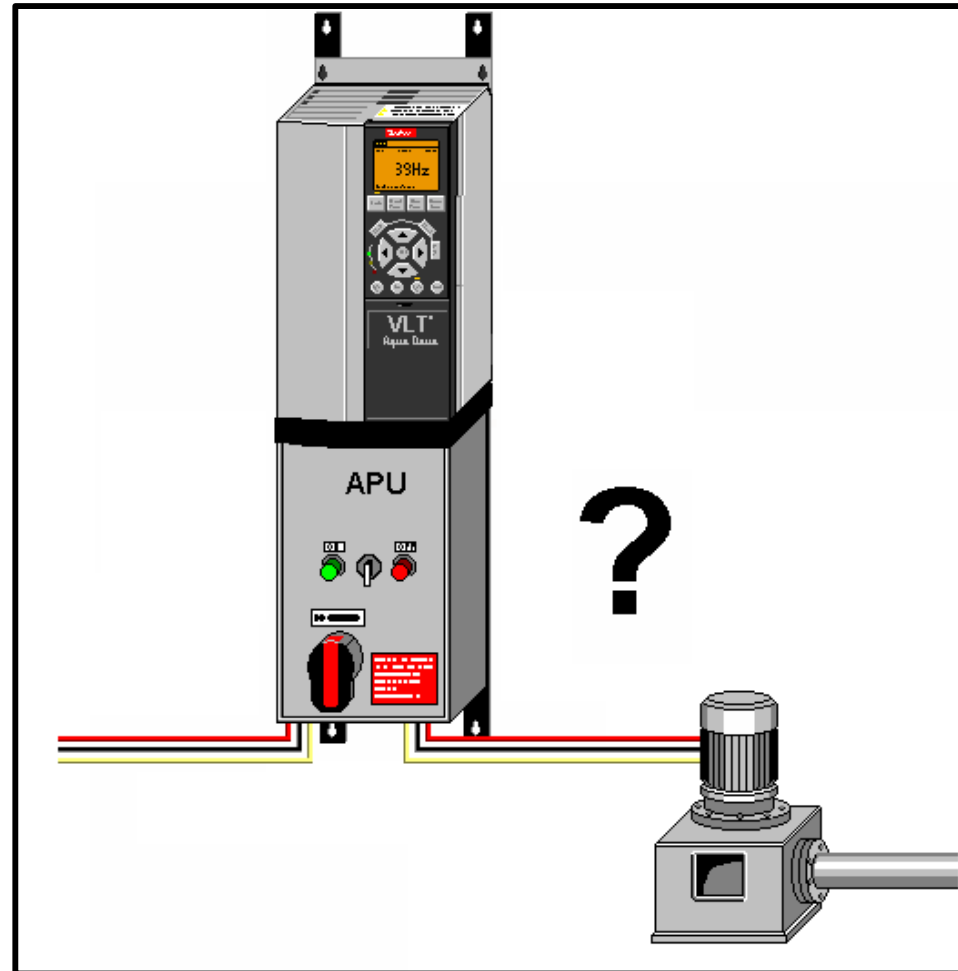
Mechanical devices such as:

- Dampers
- Modulating Valves
- Inlet Guide Vanes
- **All** require regular maintenance; replacing these devices with VFDs eliminates all the routine maintenance associated with them

Filters Maintenance:

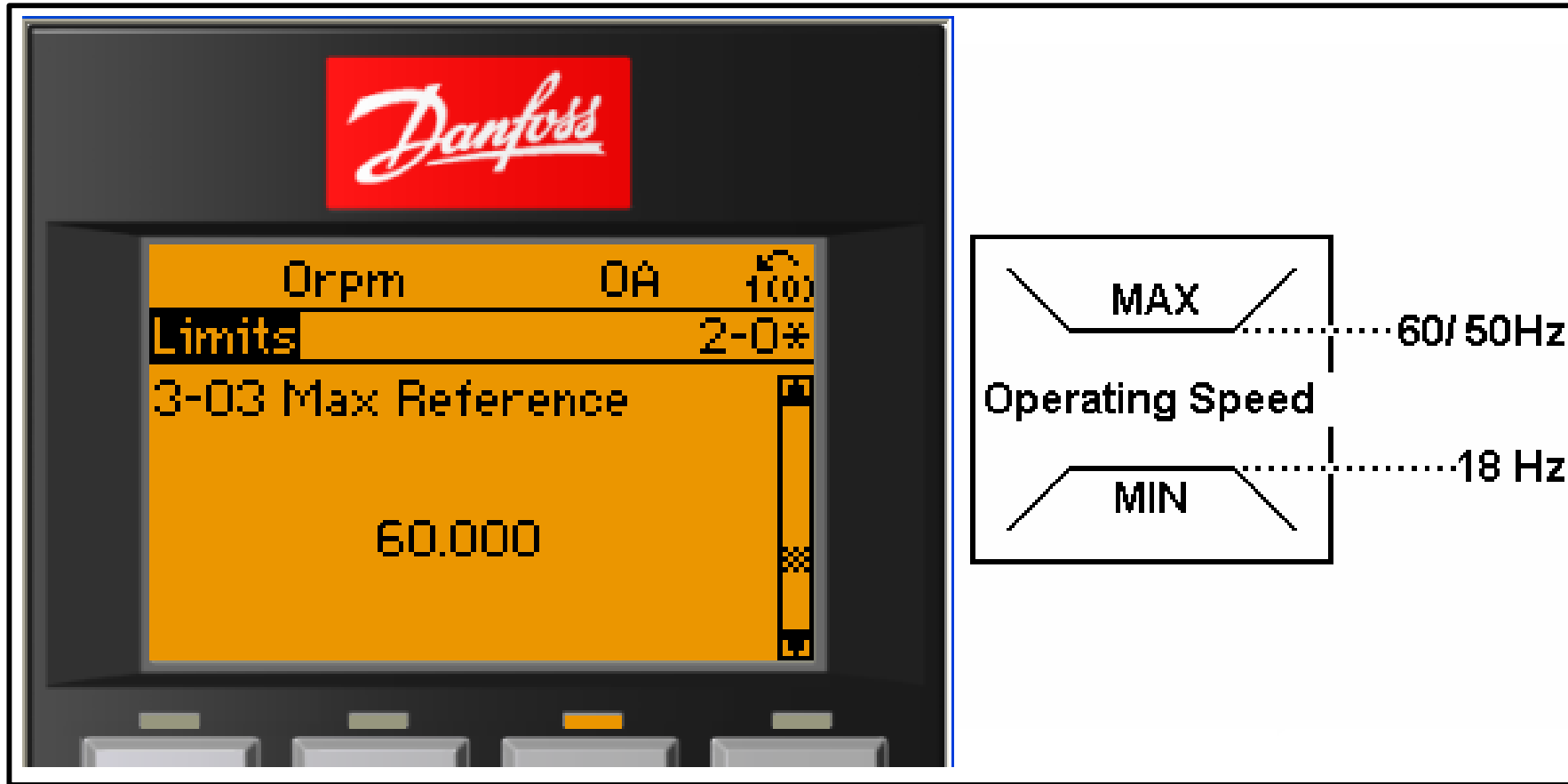
- Drives can tell you when it is time to change them

4. Bypass Capability



Allows the Operator to Switch to Across the Line Control when Maintenance of the VFD is Performed

5. VFD's Protect the Motor and Itself



Limits on:
Current, Torque, Speed, Heat and Voltage
All help protect the VFD & the motor

Detected a Short Without Incident



Condition-Based Monitoring

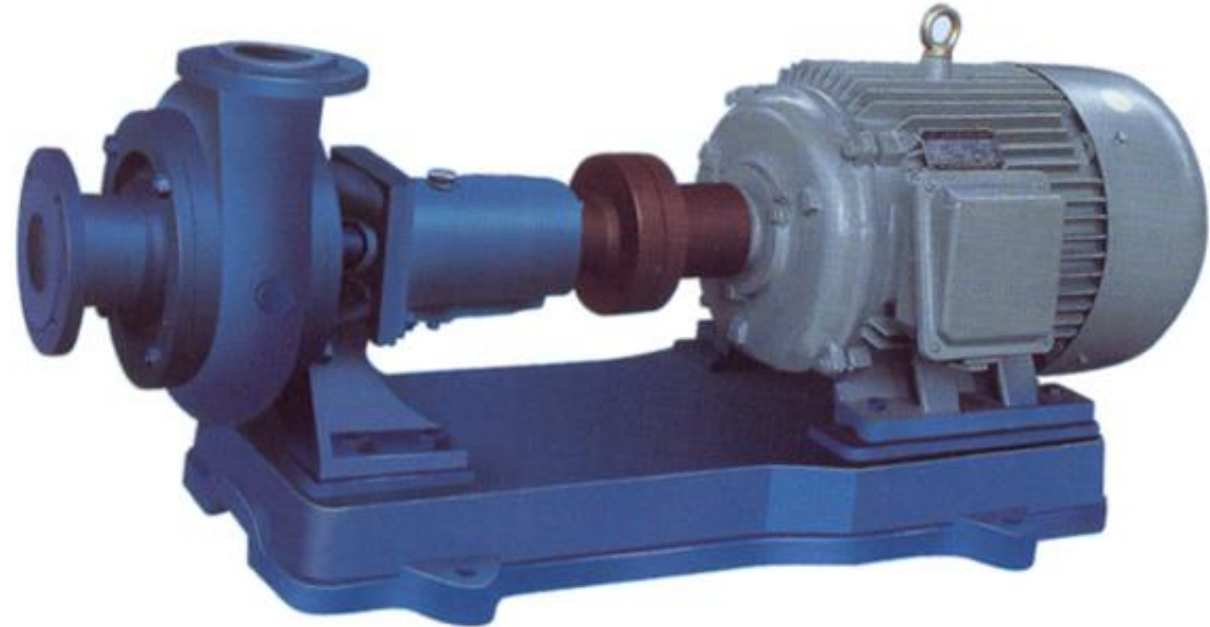


- Motor-Stator-Winding Monitoring
- Vibration Monitoring in Application
- Load Envelope

CBM Video: <https://www.youtube.com/watch?v=Y1x5AbqtPqE>

VFDs Help!

1. Reduce Energy Costs
2. Better System Control
3. Reduced Maintenance
4. Bypass Capabilities
5. Protect the System



QUESTIONS?



SAVE THE DATE

2021 Ameren Illinois

VIRTUAL
Business Symposium

WEDNESDAY, OCT. 20



Artwork by Morgan Mullen, member of the Peoria Guild of Black Artists

Program Allies

- Contractors who have registered and received training from Ameren Illinois
- Familiar with application forms and processes
- Help customers complete energy efficiency projects
- Look for a Program Ally by visiting *AmerenIllinoisSavings.com* and click on “Find A Contractor”
- Interested in becoming a Program Ally?
 - “For Contractors” tab of the website



PROGRAM RESOURCES

Energy Advisors

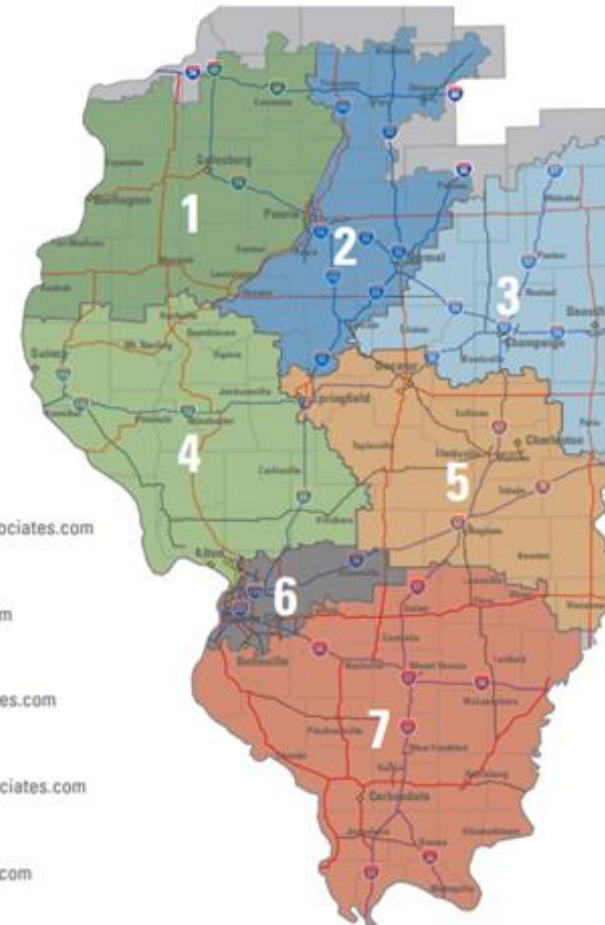
- Free site walk-throughs/consultations
- Consult on projects/application process

Joe Birschbach-Industrial Energy Manager

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ENERGY ADVISOR TERRITORY MAP



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Don't Forget – September 30th CLIP Deadline!



For My Business

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